erase the first. Most important, we must not confuse the
totally distinct characteristics of these two networks and
apply them to the wrong one.

Legislation Prevents or Encourages Reconstruction

There are presently in place neighborhood review boards,
homeowners’ associations, etc., that have some influence on
new building and the rebuilding of the urban fabric. These
ought to be started by using our prescibes for the
 regeneration of that suburb or region (abandoning their previ-
s guidelines, most of which lead away from a sustain-
able urban fabric). This concept should work no less in any
conventional suburb than in a downtown, where the process
of approval is now taken for granted. The idea is to imple-
ment all these proposed guidelines in practical form.

We certainly take the view that urbanists should not get
mired in endless legal wrangling, possibly getting “shot
down” by some hierarchical authority. But often it is impos-
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least suspending the present requirements. That may be a par-
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setbacks in wide roads, low densities, etc., have such a stran-
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this postwar planning model is still being embraced by other
countries who seek to achieve United States-style prosperity,
but here, too, we need an incremental strategy. Our
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Complex Adaptive Systems Characteristics (CASC 1–10)

1. Diversity among the components; heterogeneous parts or “agents”; sources of novelty in the system. Includes some sort of natural selection processes within agent groups that ensure ongoing evolution, regeneration, and adaptation.

2. Nonlinear interactions; widespread information flow and feedback loops.

3. Self-organization; results from attractors in the system, and from adaptation to changes in the larger environment and other agents.

4. Local information processing; local interactions among autonomous agents. Typically agents “see” only their part of the system and act locally; no global control.

5. Emergence; exhibits unpredictable global behavior or patterns; spontaneous order results from local system interactions.

6. Adaptation; open and responsive to changes to the larger environment or context and to other agents in the system; continuously processing, learning, and incorporating new information; making boundaries hard to define.

7. Organization across multiple scales; agents in the system organized into groups or hierarchies of some sort, which influence how the system evolves over time.

8. Sensitivity to changes in initial conditions; small changes can create big results at some point in the future.

9. Non-equilibrium; most interesting behavior/creativity found at the “edge of chaos”; healthy systems operate in a dynamic state somewhere between the extremes of order and disorder, making it easier for them to adapt to changing conditions.

10. Best understood by observing the behavior—activities, processes, adaptation—of the whole system over time; qualitative descriptions and understanding versus quantitative descriptions alone.

Complexity: Framework for a New Planning Paradigm

Thinking of cities as complex adaptive systems challenges us to review and revise our current planning, engineering, and design methodologies, which in most cases reflect a more linear, Newtonian worldview. In undertaking such a review we need to ask ourselves: first, which methods recognize the properties of complex adaptive systems? Second, what kind of knowledge about the system is provided by the methods?22

As an example, figure 1 reexamines futures research methodologies through the lens of complexity in an attempt to answer these two questions for those focused on the future and others concerned with developing better foresight methodologies, as opposed to traditional forecasting methods, which are based primarily on linear extrapolations. It attempts to describe a landscape where futures research methods are used.23 The underlying matrix is divided into four quadrants each representing a different system paradigm, including a view about how the future is created.

Differences in the basic assumptions between these four approaches can be described in the following way: the vertical dimension looks at the nature of our possible understanding of the system, and the horizontal at our means of controlling, directing, or managing the system. In the vertical dimension design is contrasted with emergence. Engineering approaches and systems thinking represent design, and mathematical and social complexity represent more emergent processes. Vertically, the matrix represents an ontological view about the nature of things defined in terms of causality, and horizontally in terms of epistemology, i.e., what kind of knowledge can be achieved by which methods.24

Most methods designed to understand systems (and the future development of those systems) originated and are clustered in the engineering quadrant. Figure 1 helps us understand why we have difficulty using those methods to understand more complex, ambiguous, and emergent systems. It illustrates the point that most of the approaches we use today are inappropriate and ineffective in a complex and rapidly changing world, and it provides a template for rethinking and revising current methodologies.

Summary: Food-for-Thought Observations for New Urbanists

These five complexity-based observations about cities and urban environments are offered as food-for-thought to those engaged in designing the communities of the future.

1. Local interactions create self-organizing global patterns of community. Emergence is one of the key insights from complex systems research. It refers to properties or a higher level of pattern created by the interactions of local agents in the system. What emerges does so naturally, and is not directed by a central commander or imposed by some outside source.25

The behavior of the whole cannot be predicted from one’s knowledge of the parts of the system. In other words, the whole is greater than the sum of the parts. Complex systems often surprise us, and emergence is the process through which a system displays its creative and novel
behavior. As an example, a computer program developed by Craig Reynolds in 1986 and known as “Boids” simulates the flocking behavior of birds by programming agents, or boids, to follow three simple rules: 1) maintain a minimum distance from other boids; 2) match the velocity of nearby boids; and 3) move toward the perceived center of nearby boids.

What appears to be very complex emergent behavior actually arises from a set of fairly simple underlying dynamics or rules. No central boid directs this process; the boids, acting only on local information gathered from their immediate neighbors and their environment, create the dynamic, elegant flocking patterns that are entirely unexpected; they cannot be predicted by just knowing the local rules defining each boid does.22

relatively stable geographic and man-made attractors serve as hubs of local activity, from which the emergent behavior or pattern of community arises.

The concepts of attractor and attraction are important to understand. Think about a tornado, for example. No external container or funnel gives a tornado its unique form. This dynamic, coherent, and focused system with a recognizable shape is formed by the interactions of the variables or attractors creating the tornado—moisture, heat, and wind rotation. A living city has many diverse and connected hubs or tornadoes of activity that give it its unique shape and personality.

What attractors can you identify in the old European cities we all love to visit? Most are characterized by multiple diverse centers of activity—cultural, commercial, educational, residential, and religious—connected by walkways, bridges, and most likely a central plaza where people spontaneously gather, celebrate, and protest.

Contrast these with the many lifeless urban renewal projects and downtown neighborhood developments where the concept of community includes Starbucks, Old Navy, a multiplex theater, a skateboard park, and restaurants surrounded by loft apartments and condos built in the midst of urban fabric and an uninviting cityscape. What’s missing, and how could you encourage real interaction, connection, and vitality?

3. Aesthetic cohesion is created by recognizing and incorporating the fractal qualities of people, place, and environment. The term fractal was coined in 1975 by mathematician Benoît Mandelbrot to describe a new concept in geometry. The word is derived from the Latin word fractus, meaning fragmented or irregular. Fractal geometry recognizes an order found within the irregular aspects of nature. It’s an order that in the past we had not seen, because in a sense we didn’t know how to see it—it doesn’t fit the classical linear definition of order. The fractal concept helps us appreciate the orderly yet constantly changing world we live in.23

There are two general characteristics that help us recognize this new type of order. First, fractal forms are self-similar.24 Like ferns in a forest, bark on a tree, or the lines on our faces, patterns and shapes are repeated. Something in each new impression is familiar, a reflection of previous patterns and shapes.21

Second, fractal forms are self-similar across scales.20 Patterns and shapes are repeated in finer and finer detail. The concept of self-similarity across scales has given us new ways to appreciate the special appeal of art and architecture. Patterns and shapes that are repeated in finer and finer detail add depth, texture, and a rich coherence to paintings and structures. The old European cathedrals are wonderful examples of self-similarity across scales, as are the paintings of Claude Monet and Vincent Van Gogh.25

There is an aesthetically pleasing quality to fractal forms in nature as they come together to create a beautiful whole. We respond positively to scenes where the buildings and landscape frame a focal quality. Frank Lloyd Wright had an intuitive feel for this concept, as do others who work to integrate their designs with nature. On the other hand, each of us could identify many buildings where the fractal quality is missing. These buildings jolt our senses and look like narcissistic, grotesque misfits in an otherwise richly textured city or landscape.24

4. A living city frames our interactions with subtle visual con-nections among people, place, and environment. Every interaction takes place within a landscape that is captured in our unconscious mind, if not consciously recognized. If you put a picture frame around a quick conversation with a friend as you wait for the light to change at a busy crosswalk, what’s in that picture frame around your interaction? Is it a park, a beautiful downtown cityscape, or buildings so high that you can’t see the sky? Again, think about the cities you enjoy vis-iting or living in. What’s in the picture? Living cities frame our interactions with views that invigorate our spirit and make us glad we’re alive, too.

5. A living city evolves within a larger context where emerging, new initial conditions will influence and shape its ongoing development. As complex adaptive systems, cities are influenced and shaped by the larger context in which they operate. They must adapt to changes in the larger environment be they new traffic patterns, new hubs of activity, or the ups and downs of economic conditions.

The key to developing foresight about the future is to see and understand the dynamics of the big-picture context in which your decisions and designs are being made. What new initiatives or “jumping” conditions are just over the horizon or under the radar that could dramatically influence the future of the cities you’re working with? What local, regional, or national, or international changes could go through your city like a bolt of lightning, rearranging its future overnight? How could you apply your thinking and planning resources now, so as to positively influence the future?23

Conclusion

Cities are unique complex adaptive systems. New Urbanists need to know as much as possible about complex adaptive systems theory and research, and look for ways to apply the insights and thinking to their everyday work—our future depends on it.

Note

The European Union report, “Business Knowledge Management: A Study on Market Prospects, Business Needs, and Technological Trends,” uses the same model to assess organizational knowledge management in Europe, and to present a new initiative—Knowledge Management Made in Europe (KMME)—where the emerging opportunities for the European Union are seen to be on the plans in the upper right quadrant—the field of social complexity.25