

# Can Complexity Theory Enter the World of Planning?

**Seema D. Iyer**

**Fundamental questions in urban planning regarding** the growth and decline of cities are akin to inquiries about, for example, the organic growth of a plant. Similarity stems from the fact that a causal or etiological study of the phenomenon has a rather arbitrary starting point, as the logic of the situation is not strictly linear. Perhaps, in the Kuhnian sense (Kuhn 1996), the social sciences, and planning in particular, are currently experiencing a paradigm

shift away from explanations based on causation and toward ones based on the idea of “suitable conditions” (Eckstein 1998). This approach incorporates both the endogenous and exogenous elements of an entity and, hence, attempts to understand a phenomenon within its own context. For example, in the case of the plant, many things in the proximate as well as distant environment must fall into place for germination, photosynthesis, and succession to occur. Albeit latent and often intangible, suitable conditions or the milieu within which social, economic, and political processes occur determine the possibility of outcomes. Of course, suitable conditions are wrought with the messy issues of contingency and circumstance, so that while a phenomenon may be highly deterministic, given the particular initial conditions and subsequent paths available it remains unpredictable. Determinism without predictability is the trademark characteristic of *complexity theory*, which is widely becoming a new way of thinking about contingency and path-dependence. While planners may never themselves engage in the novel numerical simulations and agent-based models used to “build” complex systems (Axelrod 1997; Allen 1997; Axtell and Epstein 1994; Krugman 1996), the theoretical bases of this new framework may bring to the fore planners’ inherent assumptions or biases that affect policy decision-making.

If complexity theory had to be boiled down to one word, it would have to be ‘interactions.’ The contingencies inherent to social and economic processes are the product of interactions that occur from person-to-person or person-to-environment. Complexity

theory provides a framework for understanding interactions in the aggregate without having to separately follow the path of each individual. A complex system can be fundamentally defined as one that consists of a large number of parts that interact with each other in some characteristic way. Depending upon the properties of the parts and the nature of their interactions, the system as a whole may assume qualities that cannot be inferred from analysis of the parts alone. A simple system, in contrast, can be understood at either scale, with each part a succinct representation of the entire system. Change within a complex system (or network or structure) mainly occurs due to a change in the nature of interactions that link the parts together. Therefore, complexity theory suggests that by focusing on interactions themselves, change in a system can at least be anticipated if not absolutely determined.

Cities, and the urban structures by which they are connected, can be viewed as complex systems. An urban system may be located within a geographical region or in a non-spatial realm that consists of the economic, political, social, and informational linkages between cities. More so today than ever before, urban areas do not function in isolation. Individual cities simultaneously interact with other cities, and the resulting national or global economy cannot be simply extrapolated from the happenings in any single city. Certainly, the analysis of urban systems is nothing new within the field of planning, however, there has been little attention to internal interactions. Instead, the predominant existing theories of spatial interaction make implicit assumptions about the network

of linkages between and within cities. Many of these theories have a disciplinary bias or emphasis, so that different units of action/actors and types of interaction are used in analysis of urban systems. Each disciplinary perspective envisions a different relationship among cities based upon the nature of connectedness between cities, and therefore, attributes different relative positions, prominence, or centrality to cities within an urban system. Centrality within a system is often associated with power or importance, and as will be discussed in this paper, the unstated assumptions of these theories have concrete implications with respect to policy formation.

Although several academic disciplines are engaged in urban systems analysis, few have developed approaches that consider multi-nodal systems. For example, economic-base theory equates trade volume between cities with urban centrality, which means that only the dyadic relationship between a city and its trading partners determines relative position within an urban system (Irwin and Hughes 1992). The three perspectives considered in this paper have developed theories about *direct* and *indirect* relationships between cities that incorporate spatial and non-spatial linkages. Within the field of geography, central place theory emphasizes the unidirectional flow between cities of the consumer to the supplier so that greater economic independence implies greater centrality. From the urban ecology perspective, interaction between cities leads to functional specialization via cooperative adaptation so that greater *interdependence* implies greater centrality. Finally, theories from urban sociology stress the role of circulation and

distribution within spatial networks so that domination over the flow of resources within the system implies greater centrality.

These three perspectives can additionally be differentiated along the structural/agency spectrum as each assumes varying levels of causal influence between the urban network as a whole and the individual cities that comprise it. The conceptualization of the city as an agent/actor within the urban structure has received much criticism largely from two counterpoints. Firstly, at varying spatial scales, complex socio-economic relationships and organizations are simply condensed into “a spaceless node, the named city” (Gottdiener 1985). All of the richness of place is reduced to a featureless, acultural, and, most importantly, replicable part of the entire system. Secondly, in the context of developed urbanized industrial-capitalist societies, the city may not be a “significant economic, political, or social unit of analysis” since the distinctions between rural and urban lives have diminished (Saunders 1985). But according to classical writers such as Weber, Durkheim, and Marx, the city is of immense historical importance precisely during an economic transformation. Arguably, around the world today there are many regions experiencing economic restructuring which could imply that the city is *the* important actor within the urban and global network. The collapse of the former Soviet Union has led to the transition from a command to a market economy for most of Eastern Europe and Central Asia, and according to many authors like Manuel Castells and Neil Smith, the Industrial Revolution has given way to the dis-

tinctively unique Information Technology Revolution in post-industrial societies since the nineteen seventies (Castells 1996; Smith 1996). The major theoretical question within this secondary debate is whether the urban structure accounts for or somehow predicts the variability among cities or, conversely, whether the urban structure is simply the outcome of increasingly complex relationships between cities with unique local characteristics.

Together, the perspectives from the different disciplines provide an understanding of the relative relationships that arise within the urban system. Complexity theory does not replace these perspectives; instead, it offers a new way to visualize and compare them. By explicitly and empirically analyzing the interactions within an urban system, planners may be able to distinguish which perspective is most appropriate or most relevant for various planning agendas. The purpose of this paper is to explore the underlying assumptions of these perspectives, examine the urban system that emerges from those assumptions, and discuss the policy implications of each towards urban change.

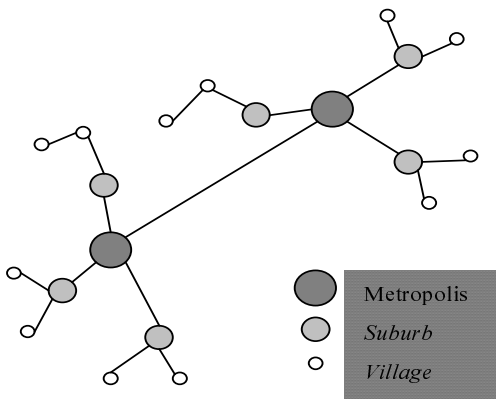
### **Central Place Theory**

Central place theory as posited by Walter Christaller (1966) is the outgrowth of a rich history of Germanic thought pertaining to location theory and economic geography. From the central-place framework, the distribution of towns in space emerges in a hierarchical urban landscape due to the nature of economic interactions between cities. The primary content of exchange between cities is the purchase

of goods or services by the consumer, which means that access to consumer markets by suppliers dictate the location of and relationship between cities. For a specific good, there is a maximum range a consumer is willing to travel and a minimum market size necessary to support producers. The interplay between the maximum and minimum range of a good determines where it is offered (Irwin and Hughes 1992). Goods that require a relatively large market for profitability are located in cities with maximal access across the urban network. Only such cities can support a wide breadth of economic goods as well as a large constituent population. Assuming a continuum of inner and outer ranges for goods, cities are functionally differentiated, which results in the flow of consumers from less central places to more central places for the provision of goods not available. Consumers move between place of residence to place of purchase, culminating the interaction with the transaction. Interaction between cities, therefore, is implicitly assumed to be unidirectional. Centrality, from this perspective, is a function of independence from other cities; there should be no outflow from the most central place since all goods of the regional economy are available to its own constituent population.

Central places do not necessarily refer to the central spatial location, but rather to the central functionality of a place. The observed network of consumer flows in a fully developed central-place hierarchy is a reflection of the underlying spatial division of labor. The structure of the urban network defines which goods are available in each city and presumably the make-up of the city's residents. The resulting spatial

pattern is envisioned to be a densely packed lattice of lesser central places radiating from the core. According to Gottdiener, the system of cities in the central-place framework combines predominantly economic activities in the analysis of both the horizontal and the hierarchical integration of space:



**Figure 1:** The physical layout of a metropolitan rail line network constructed with central-place assumptions regarding movement patterns.

The regional economy was viewed as a hierarchy of urban places which comprised a functional matrix of marketing, transport, and administrative networks supporting a nest of cities from small outlying ones to larger, centrally located agglomerations (Gottdiener 1985: 48-49).

The network arrangements of cities are highly dependent on transportation costs so that spatial competition at inter-urban and intra-urban scales becomes the most important factor in the economics of location (Isard 1956). Mathematical refinements to the framework regarding the shape and size of market area resulted in a fractal-like landscape of nested hexagons (Lösch 1954). The conceptualization of the urban system as self-similar at all scales became the notion of the optimal, not necessarily the actual, configuration of cities in space. Optimal outcomes, however, are rarely ever achieved in reality precisely because of the path-dependent nature of city formation.

The hypothesis regarding the primal role of the historical central city in organizing urban space has become one of the limitations of this perspective on urban form. In particular, central place theory fails to account for the polycentric forms of metropolitan areas that exist in the US today, and the mismatch between theory and reality is most starkly noted in many metropolitan rail networks. Transportation planning seems to be heavily influenced by this perspective, especially with respect to the directionality of movement between cities. The implicit assumption is that movement occurs between cities of differing centrality, and since centrality increases with proximity to the central city, traffic patterns facilitate movement from the periphery to the core. The physical layout of the fixed rail infrastructure within and between metropolitan areas is a manifestation of these assumptions (see Figure 1). Central place theory is unable to account for movement between areas of similar centrality. There is no inherent impe-

tus for such movement from this perspective, as such areas offer similar (if not the same) goods.

### **Urban Ecology**

The origins of urban ecology are based on the notion that spatial relations between cities have a certain degree of regularity, particularly with respect to the physical shape of cities. The theoretical roots of this perspective can be traced back to Émile Durkheim (1933) and then the prominent members of the Chicago School, beginning with Robert Park (1925) in the 1920s. The fundamental axiom in this collective work is that the urban landscape is a reflection of the society that maintains it, so that study of urban land patterns provides insight into collective societal action. Unlike the central place theorists' interest in the optimal distribution of cities and urban residents, the urban ecologists were mainly concerned with the growth and evolution of cities over time. One manifestation of this emphasis was Burgess's areal concentric zone model of metropolitan expansion, which depicted the areal morphology of socially distinctive urban areas (Friedmann and Weaver 1979). The emergence of cities and urban systems was theorized as the product of the symbiotic and 'biotic' competition for space among humans. The human struggle for space is mediated through the value-free property market, and the resulting geographical pattern of land allocation is presumed to "maximize efficiency for the community as a whole" (Logan and Molotch 1987). By the 1950s, Amos Hawley had become the dominant champion of the perspective, and the theory began to assume a much more ab-

stract formulation. The main proposition of the ecological approach became that a city's ability to adapt, grow, and evolve was a function of increasingly complex interconnections between cities (Hawley 1986). Hawley and other ecologists, however, have offered amorphous descriptions as to the nature of interactions between cities. The barometer for measuring increasing complexity within the system is the number and frequency of contacts between urban areas. Frequency of contact with other cities allows a city to adapt to the structural complexity of the overall urban system; the number of contacts contributes to the variety of resource and information inputs from the system as a whole, which forms a city's adaptive knowledge base.

The urban system develops until the maximum size and complexity is reached within and between cities. Growth is highly dependent on the given technology for transportation and communication that facilitates the formation of linkages within the system. Circulation of people and ideas throughout the urban system depends on the number of interrelationships and the frequency of contact within the system. Of course, as the technological capacity increases, the urban system can accommodate interaction in greater numbers and across longer distances. Technological innovation is viewed as an exogenous force that acts upon the entire urban system simultaneously and indiscriminately. The result of this external influence is a rearrangement or adaptation of the cities within the urban system. From the urban ecology perspective, cities are integrated according to mutual dependencies and function in support of the overall adap-

tive order within the urban network. Interaction between cities, therefore, is implicitly assumed to be uninhibited or multidirectional. Cities that are more accessible to the entire network, both physically and psychologically, are given greater importance as they facilitate network-wide interconnections (Gottdiener 1985). Cities with greater frequency of contact tend to develop complex economic structures that can lead to functional differentiation within the system (Irwin and Hughes 1992). Specialization of a city is a product of a limited amount of resources available from the surrounding network.

Urban ecologists clearly utilize many concepts from Darwin's theory of evolution to explain the functional role that interdependence among cities plays in increasing network complexity. An attempt within the central place framework to account for this increased complexity has simply proposed greater "nesting" of market areas that are still organized around the dominant central city. The ecological perspective's departure from central place theory lies in its introduction of adaptability and evolution within the system, which allow transformations of the dominant city itself. The emergence of a hierarchy is mainly attributable to the existing state of transportation and communication technologies, as these are the means by which adaptability is enhanced. However, relationships in the ecological network are viewed as cooperative rather than competitive, which implies that the unequal distribution of access to technology is simply a consequence of locational advantages within the system. One criticism of this view is that changes and outcomes of local areas are

dictated by the state of technology within the overall structure. Cities with similar accessibility throughout the system are assumed to be similarly adaptable to technological change. This approach cannot account for variation among similarly-categorized cities because local idiosyncrasies are not taken into consideration.

Much of urban ecology is, therefore, the study of convergence within the urban system to an eventual "equilibrium", as cities continually assume positions of relative centrality or importance. In essence, this perspective alleges the inevitability that cities will adapt to the overall urban structure along the path of least resistance, whereby technology is the leading indicator of change. Hawley's characterization of this equilibrational model, with exogenous shocks to the urban system through technological advances, has had direct and indirect influence on research policy, as the ecological perspective became more mainstream. The assumption that as technology shifts so too may the level of adaptability of a city has led to policy decisions that favor areas at the cutting edge of technology. Researchers adopting this perspective have tended to suggest that the duty of the government is to facilitate the expansion of burgeoning cities rather than ameliorate the social blight within collapsing cities. For example, based on a study of demographic and economic mismatch in New York during the 1970s, Kasarda and Friedrichs argue that if the government's position were to encourage local resistance to change:

...the outcome is ... increasing numbers of potentially productive minorities [who] find themselves socially, economically, and spatially isolated in segregated areas of social decline... (1986: 223).

Flanagan suggests that this point of view had not been lost on federal policy makers (Flanagan 1993). In 1980, the Commission for a National Agenda issued a report that acknowledged the proposition that shifts in national development often meant that local populations would be economically displaced, but the government's primary responsibility was to retrain and relocate workers left behind. According to Flanagan, the federal government's hands-off policy regarding the economic and industrial shift from the North to the South was largely based upon the urban ecological bias.

At the intra-city level, gentrification has revived interest in the fundamental and historical origins of the ecological perspective, particularly in light of the obvious parallelisms with the "invasion and succession" thesis of residential areas (Mckenzie 1933). Of course, until the 1970s, this notion of invasion and succession mostly referred to residential turnover from more to less affluent households as neighborhoods became devalued. While there are ambiguities regarding the benefits and liabilities of affluent urbanites moving into inner city neighborhoods, there is consensus that gentrification does generate homelessness and loss of jobs for displaced residents. From the ecological viewpoint, this phenomenon is a reflection of an inherently rational process in which residents respond to the internal mechanisms of the property market. The conflict involved in the gentri-

fication process is simply viewed as the means to the ends. Again, within this framework, the role of public policy is not to prevent the process from occurring, but rather to ameliorate the situation for those who are displaced. In the case of gentrification, planners should, for example, either help find alternative accommodations for the previous residents or ensure that low-income housing in the area is a viable option for potential real estate developers.

### **Urban Sociology**

The historical roots of urban sociology are as varied as the issues that this perspective attempts to address. One theoretical strain comes out of the theories of urbanism and community championed by Simmel and Wirth in the 1930s. The sociological effects of urban life on people and communities were much debated during the rapid urbanization of pre-WWII Europe and the US, but Simmel and Wirth fueled an anti-urban bias by describing the urban way of life as superficial and isolating. Another strain focuses on Marxian urban political economy developed by Castells and Harvey beginning in the 1970s (Castells 1977; Harvey 1989). Although criticized for its emphasis on formal Marxist theory via class struggle analysis, urban political economy crucially highlighted the conflictive nature of spatial competition, as opposed to the benign competition of the urban ecological perspective. Many urban sociologists have identified a paradigm shift within the field since the 1980s that attempts to unify as well as challenge the fundamental assumptions and explanations in the field (Zukin 1980; Gottdiener and Feagin



1988). In particular, the assumption of a free market system with perfect competition has been replaced with a more sociological interpretation of how markets are organized (Logan and Molotch 1987). With respect to property markets, the interplay between use and exchange value of property serves as the crucial mechanism by which cities and systems of cities are organized. However, due to the pervasiveness of the ecological framework, empirical research of urban systems tends to ignore the role of the state itself in creating the urban structure. According to Zukin:

...it is impossible to find interpretations that either contradict state policy or offer alternative sets of assumptions on which policy should be based.... For most of their history, urban sociologists seemed to serve the needs of the state... (1980: 575).

In general, the three main issues that this perspective attempts to address, absent from the previous perspectives, include: 1) the increasingly interventionist role of the government has direct effects on the urban system; 2) change within the urban system occurs via conflict, which is attributable to the economic mode of production; and 3) the cause of regional variation is a function of the interrelationship between the structure of the urban system and the local characteristics within each city (Gottdiener and Feagin 1988). Although there is considerable theoretical diversity among urban sociological approaches, they collectively emphasize the importance of distributional transactions in socio-spatial systems. The fact that limited resources must somehow be distributed

within the system is the fundamental characteristic of the overall urban structure, although the content of the exchange between cities (labor, capital, information) and the controller of the resource (political elite, oligopolies, developers) varies within the urban sociology perspective. Centrality, or importance within the urban system, then becomes a function of access to resources by some cities and the corresponding exclusion from these resources by other cities.

Dominant cities are those that are able to control access to resources and exclude them from network-wide circulation. Domination or restriction, therefore, is the basis of interactions between cities. But unlike the previous two perspectives, this assumption is quite explicit. Urban sociology certainly privileges interactions within the system, but as the discussion of prominent authors below shows, change within the system is structurally determined. Change is still difficult to anticipate; once a city or area is able to dominate the flow of resources, only external forces can change the existing pattern of domination. Therefore, according to the urban sociology perspective, the overall system dictates the nature of interactions between cities. Complexity theory suggests that the opposite is true; the nature of interactions between cities determines the overall system.

Urban sociologists envision variation and hierarchy among urban spaces not as the outgrowth of natural or spontaneous processes, but rather as the manifestation of the inherent inequities and contradictions of imperfect competition in the capitalist mode of production. Unequal benefits accrue to social classes that are politically powerful or informationally privy

enough to manipulate the urban landscape and urban infrastructure (Zukin 1980). According to Smith, urban development within the capitalist state is influenced by the contradictory structure of capitalism, which tends towards both the “equalization of conditions” as well as their “differentiation” (Smith 1996). Equalization occurs as the economy expands in search of greater profits, and differentiation emerges out of the geographical variations prior to the introduction of capital. This dynamic involves various spatial scales, and Smith suggests that gentrification represents the confluence of both local and global forces at the urban scale. The local forces that influence the “invasion and succession” process refer to the history of investment and disinvestment at the neighborhood scale, whereas the global forces are connected by worldwide political and economic change. Smith views gentrification as a harbinger of spatial restructuring at regional and even global scales:

And while the urban scale may in the end be the least significant in terms of the overall restructuring of the world economy, the internal logic of uneven development is most completely accomplished there (1996: 87).

The cyclical or circular logic of uneven development is visible at the urban scale—development of one area hinders further development in another, thus leading to underdevelopment that in turn creates opportunities for a new phase of development. Smith calls this geographic development pattern a “locational seesaw”. The gentrifiers (or capital) occupy and are continually in search of the optimal

space for the domination of inner city residential areas. Clearly, this conceptualization of intra-city spatial competition is distinct from that envisioned within the urban ecology framework, where the people that are displaced cannot possibly compete with the gentrifiers.

For Zukin (1980), the two fundamental elements of urban sociology are: 1) the permeation of the local by national levels in both economy and polity; and 2) the coordination by an urban “matrix” of switches in investment strategy which relates consumption and production in fundamentally new ways. Similar to Smith, Zukin views the history of urbanization as intricately intertwined with national growth and national states. The rise of the capitalist city critically hinged upon its integration into first regional, and then national and even global, markets, and this interconnectedness of all scales in the urbanization process contributes to varying levels of centrality among cities. State intervention into city politics created a “fragmented” system at the local level in which the underprivileged classes contended for a localized set of resources while the privileged classes had access to a national set of resources. In this way, growth at either spatial scale perpetuates growth in the other. The second element within capitalist urban systems assumes that investment strategies have become the most important type of interactions between and within cities. Centrality among cities refers not only to the locus of decision-making, communication, or accumulation processes, but also to “setting a matrix for the transformation of investment strategies” (ibid.: 592). Zukin conceives of the term “matrix” as the “logical construct for organizing the economic,

political, and ideological structures of a given mode of production” (ibid.: 595). In other words, switches between types of investment strategies behave like levers and pulleys so that the city as a whole, rather than a particular neighborhood or sector, can facilitate a transition within the process of capitalist development. The interconnectedness of all parts of the capitalist urbanization process contributes to varying levels of centrality (uneven development) among cities. However, Zukin’s view remains structural; she posits that the city situates and perpetuates the mode of social and economic control within the broader, national system.

The attention of urban sociology to interactions in an urban system is most explicitly articulated in Castells’ latest work (1996). According to Castells, changes within urban systems are attributable to the “networking logic” of the new information technology economy and the resulting post-Fordist social and economic transformations. As opposed to the linear or serial set of relationships during the Industrial Revolution, epitomized by Fordist mass production, new information technologies are facilitating more complex interactions that are organized by networks. Castells argues that new information technologies, such as the internet, allow this organizational type to pervade social and economic processes. The network of communication among cities creates a new “space of flows” that is superceding the “space of place” within urban systems. This network of flows consists of three layers: 1) the connective structure; 2) the physical locality of “nodes”; and 3) the organizational structure. The first two layers alone are very reminiscent of the urban ecological perspective,

where interaction between cities is a function of the state of technology. The third layer incorporates the concept of domination as the architecture of the technological infrastructure as designed by institutional and social actors in the urban system. Segregation occurs both within cities between the elite and local communities and also among cities between those that can and cannot control network-wide flows. Although less so than Zukin’s, Castells’ formulation of the interaction within socio-spatial systems gives more authority to the structure of the network rather than to the agents. While the managerial elite attempt to position themselves for perpetual domination, they are at the mercy of changes within the space of flows itself.

## **Conclusion**

For planners trying to understand the growth and decline of cities, the basic contribution of complexity theory is its focus on systemic interactions at various scales of urban systems. The basic implicit assumptions regarding interurban linkages within the three perspectives outlined in this paper are: 1) unidirectional flow in the central place framework; 2) multidirectional flow in the urban ecology viewpoint; and 3) dominated/restricted flow from the urban sociology perspective. By distilling urban systems down to the characteristic nature of interactions between cities, complexity theory suggests that macro-level phenomena can be viewed as emergent properties of those interactions, so that change within the system can be better anticipated.

The scale of analysis in this paper has mainly been at the level of inter-urban interactions, as opposed to

intra-urban interactions, mainly because at this spatial scale, the relativity of “top down” and “bottom up” forces acting upon cities and the urban system is most ambiguously felt. How local specificity and global generality intersect at this level is uncertain, and it is in this area that complexity theory can possibly contribute most. Certainly, the theories of socio-spatial interaction reviewed in this paper provide interpretations of intra-urban interactions as well. For example, each perspective offers insights into the impetus of residential gentrification. Central place theory assumes a unidirectional flow of consumers and commuters from the periphery to the core in order to access centrally located goods and jobs. By determining the geographic market size of goods according to time instead of transportation costs, people who place a premium value on time will tend to locate in the center to reduce travel. Gottman has recognized a new “quaternary” sector of economic activity (activities related to information and knowledge) that not only organizes highly specialized personnel into an interwoven community at work, but also has a market size that is more dependent upon time than space (Gottman 1990). Therefore, given the implicit assumptions of central place theory, geographers may attribute gentrification to the post-industrial informational economy. As discussed previously, from the urban ecology perspective, gentrification is the natural succession of capital over culture. Gentrifiers are the holders of capital, which is an indirect measure of technology and, hence, more adaptable to external innovation. And finally, from the urban sociology framework, the struggle between the use and exchange value for land in the inner city is a well-orchestrated attempt by developers to domi-

nate the property market to ensure future profitability. Each interpretation of gentrification offers different policy recommendations: economic development planning that attracts high-tech firms to inner cities, or assistance to displaced residents in finding housing elsewhere, or anti-growth machine initiatives that help un-align local government from land speculators (Logan and Molotch 1987).

The data required to empirically measure or validate the nature of interactions between cities varies according to the type of linkages emphasized by each perspective. To identify a central place-type urban system, the most appropriate data would include the magnitude of exchanges along dyadic relationships, since the interaction between cities terminates with the purchase of consumer goods. For example, commuting patterns between cities can indicate either central city dominance within a region or a more polycentric metropolitan community (Giuliano and Small 1993). Data requirements for the urban ecology perspective need to incorporate interconnected flows of information or raw materials, since interdependence within the system implies greater frequency of contact. Some attempts to operationalize this perspective have relied on systems analysis in order to include the dynamic interaction between population, organization, environment, and technology. Airline passenger flows have been used to show the change in the global urban structure as the number and frequency of flights has increased worldwide (Smith and Timberlake 1995). Research based on the urban sociology perspective seems to be moving in the direction towards case study analysis in order to establish connections between the specific local characteris-

tics within a city and the global forces that interact with them. The new agenda for research in urban sociology is to identify those aspects of urban interaction that equip each city to uniquely respond to global forces and to understand how some cities are able to resist general regional trends (Giddens 1984; Flanagan 1993).

Although these perspectives follow a historical train of thought (albeit central place theory and urban ecology are mostly contemporaneous), their continued relevance is based on the fact that each emphasizes different yet vital aspects of the nature of interactions between cities. Changes, modifications, and contradictions from one perspective to another have occurred in order to reflect the ongoing, evolving process of urbanization primarily within the US and Europe. None of them is invalidated, as empirical examples of each type of urban system can be identified simultaneously not only throughout urban history but also across geographic locations. For example, there exist metropolitan areas dominated by the central city, for example Oklahoma City (Irwin and Hughes 1992), such that urban areas interact according to the central place model. Global cities that have transcended the purview of the nation-state are mutually dependent upon each other and are propelled or limited by available information and communication technology; these systems of cities can be described according to the ecological framework. And perhaps in the middle of these two extremes, where the local meets the global, is the network of urban areas that can be described according to the urban sociology perspective. The point for researchers and policymakers is that the nature of interactions within urban systems should

be explicitly examined in order to guide research and public policy.

## References

- Allen, Peter M. 1997. *Cities and Regions as Self-Organizing Systems Models of Complexity*. Amsterdam: Gordon and Breach Science Publishers.
- Axelrod, Robert. 1997. Advancing the Art Simulation in the Social Sciences. In *Simulating Social Phenomena*. Edited by Rosaria Conte. Berlin: Springer-Verlag.
- Axtell, Robert, and Joshua Epstein. 1994. Agent-Based Modeling: Understanding our Creations. *Bulletin of the Santa Fe Institute*. 9 (2): 28-32.
- Castells, Manuel. 1977. *The Urban Question a Marxist Approach*. Cambridge, MA: MIT Press.
- . 1996. *The Rise of the Network Society*. Cambridge, MA: Blackwell.
- Christaller, Walter. 1966. *Central Places in Southern Germany*. Englewood Cliffs: Prentice-Hall, Inc.
- Durkheim, Emile. 1933 [1893]. *The Division of Labor in Society*. New York: Free Press.
- Eckstein, Harry. 1998. Russia and the Conditions of Democracy. In *Can Democracy Take Root in Post-Soviet Russia? Explorations in State-Society Relations*. Edited by Harry Eckstein, Frederic Fleron Jr., Erik Hoffmann, and William Reisinger. Lanham, MD: Rowman & Littlefield.
- Flanagan, William. 1993. *Contemporary Urban Sociology*. Cambridge, MA: Cambridge University Press.
- Friedmann, John and Clyde Weaver. 1979. *Territory and Function*. Berkeley: University of California Press.

- Giddens, Anthony. 1984. *The Constitution of Society: Outline of the Theory of Structuration*. Cambridge, MA: Polity Press.
- Giuliano, Genevieve and Kenneth Small. 1993. Is the Journey to Work Explained by Urban Structure? *Urban Studies*. 30 (9): 1485-1500.
- Gottdiener, Mark. 1985. *The Social Production of Urban Space*. Austin: University of Texas Press.
- Gottdiener, Mark and Joe Feagin. 1988. The Paradigm Shift in Urban Sociology. *Urban Affairs Quarterly*. 24 (2): 163-187.
- Gottman, Jean. 1990. Urban Centrality and the Interweaving of Quaternary Activities. In *Since Megalopolis: The Urban Writings of Jean Gottman*. Edited by Jean Gottman and Robert Harper. Baltimore: Johns Hopkins University Press.
- Harvey, David. 1989. *The Urban Experience*. Baltimore: Johns Hopkins University Press.
- Hawley, Amos. 1986. *Human Ecology: A Theoretical Essay*. Chicago: University of Chicago Press.
- Irwin, Michael and Holly Hughes. 1992. Centrality and the Structure of Urban Interaction: Measures, Concepts, and Applications. *Social Forces*. 71 (1): 17-51.
- Isard, Walter. 1956. *Location and Space-Economy*. Cambridge, MA: MIT Press.
- Kasarda, John and Jurgen Friedrichs. 1986. Economic Transformation, Minorities, and Urban Demographic-Economic Mismatch in the U.S. In *The Future of the Metropolis: Berlin, Paris, London, New York*. Edited by Hans-Jurgen Ewers. Berlin: Walter de Gruyter.
- Krugman, Paul. 1996. *The Self-Organizing Economy*. Cambridge, MA: Blackwell.
- Kuhn, Thomas S. 1996. *The Structure of Scientific Revolutions*. 3d ed. Chicago: University of Chicago Press.
- Logan, John R and Harvey Lusk Molotch. 1987. *Urban Fortunes: The Political Economy of Place*. Berkeley: University of California Press.
- Lösch, August. 1954. *The Economics of Location*. New Haven: Yale University Press.
- Mckenzie, Roderick. 1933. *The Metropolitan Community*. New York: McGraw-Hill.
- Park, Robert. 1925. *The City*. Chicago: University of Chicago Press.
- Saunders, Peter. 1985. Space, the City and Urban Sociology. In *Social Relations and Spatial Structures*. Edited by Derek Gregory and John Urry. London: MacMillan Publishers.
- Smith, David and Michael Timberlake. 1995. Conceptualising and Mapping the Structure of the World System's City System. *Urban Studies*. 32 (2): 287-302.
- Smith, Neil. 1996. *The New Urban Frontier: Gentrification and the Revanchist City*. London: Routledge.
- Zukin, Sharon. 1980. A Decade of the New Urban Sociology. *Theory & Society*. 9 (4): 575-600.

SEEMA D. IYER is a third-year doctoral student at the University of Michigan. She received a BA and MA from the University of Pennsylvania in Mathematics/Russian Studies and Regional Science, respectively. Her dissertation examines the changes in urban interactions in Russia since the dissolution of the Soviet Union in 1991 and how such changes are affecting the planning process at the local level.