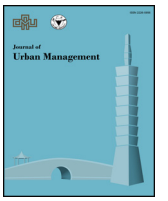
Journal of Urban Management xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Journal of Urban Management

journal homepage: www.elsevier.com/locate/jum



Forum Essay

The "Illinois school" of thinking about plans

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1. Making and using plans: development of the "Illinois School"

Ideas about plans are sometimes neglected aspects of planning theory and practice. Scholars at the University of Illinois at Urbana-Champaign have been thinking about plans—what plans are, how they work, and how to make and use them–since the appointment of Charles Mulford Robinson as Professor of Civic Design in 1913. We identify five aspects of a current version of this thinking and label these "The Illinois School of Thinking about Plans." The 100 years of planning education and scholarship at Illinois have also influenced, and continue to influence, other aspects of planning, but here we focus specifically on plans.

Much of planning scholarship focuses on the phenomena that might be planned—such as land use, transportation, economic development—and much of the scholarship on planning processes focuses on collective action, market failure, government, regulation, and deliberative collective choice. In contrast, the Illinois School of Thinking about Plans builds on the following ideas:

1. Plans themselves are an important object of research, not only cities, political processes, policies, or justifications for government regulation or investment.
2. Concepts from economics, operations research, and regional science are useful in thinking about how plans work, in particular the dynamics of adjustment, uncertainty, and sequential decisions.
3. Intentional shaping of the future through actions that influence it is important, not just accommodating a population or economic projection or correcting market failures.
4. Plans analyzed as signals, in the sense of information economics, enable consideration of multiple actors, multiple plans, institutional organization of plan making, uncertain futures, and use of plans strategically over time, whereas considering plans only as targets to be implemented makes it difficult to recognize or consider these relationships.
5. All of this is pertinent to what land use and infrastructure planners do in practice by explaining the planning we observe and justifying the planning we do.

These aspects are not independent of each other. While elaborating each in turn, we build a narrative about how these ideas developed into a distinctive school of thought about plans.

1.1. Sources and connections

The early faculty at Illinois, Charles Mulford Robinson, Harland Bartholomew, and Karl Lohmann, came from backgrounds in journalism, engineering, and landscape architecture. As scholars, they all wrote about planning, including not only the content of plans, but also the functions of plans (e.g., Bartholomew, 1932; Lohmann, 1931; Robinson, 1901). Robinson (1916, p. 301) referenced estimates of cost savings from foresight rather than correction in the development of urban infrastructure. The focus on streets and lots was in clear recognition of durable, difficult to reverse decisions, and included recognition that minor streets provide more

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https://doi.org/10.1016/j.jum.2019.02.001
Received 4 February 2019; Accepted 4 February 2019

flexibility over time compared to major streets (p. 293). Robinson also included extensive discussion of regulation and legislation as distinct from the plan itself. He also recognized that private, public, and third sector actors were making plans. The ways in which these ideas have been expressed have changed over time, in part to account for the salient issues of interest in particular scholarly conversations, but they remain crucial to the Illinois School.

In 1970, Lew Hopkins came across an interesting book, *Local Government and Strategic Choice* (Friend & Jessop, 1969). Having read it on the plane, he discovered it was on the reading list for a class that fall at the University of Pennsylvania. Russell Ackoff and Robert Mitchell taught the class. Robert Mitchell graduated in architecture from the University of Illinois in 1930 and taught planning students at Illinois for two years before going east, eventually becoming planning director in Philadelphia and founding chair of the planning program at the University of Pennsylvania. Mitchell and Rapkin wrote a well known early analysis of traffic and land use (Mitchell & Rapkin, 1954). The strategic choice or Institute of Operations Research (IOR) School, as it is sometimes called (e.g., Faludi & Mastop, 1982), was of interest because it linked the analytical perspective of operations research, the interest of Ackoff (Ackoff & Sasieni, 1968), to the "on the ground" doing of planning (of interest to Mitchell) that Hopkins was combining in courses from Landscape Architecture, City Planning, and Regional Science at Penn.

The focus of much planning scholarship on collective action, market failure, government, regulation, and deliberative collective choice derives in part from the short lived but highly influential planning program at the University of Chicago for a few years around 1950. Referred to as the "Chicago School" in planning (distinct from the more widely known "Chicago School" in economics), faculty there brought concepts from economics, political science, and sociology into planning scholarship (Sarbib, 1983).

Britton Harris, who was a student in the University of Chicago planning program, was Hopkins's PhD advisor. Gerrit-Jan Knaap's advisor at the University of Oregon, Ed Whitelaw, was a student of Bill Wheaton who was a student of Brit Harris. Harris's intellectual scope enabled him to use mathematical analysis not only to address computational, operational modeling, but also to frame conceptual ideas of what the models were about and what these models could and could not do (Harris, 1960, 1965; Harris & Wilson, 1978). The University of Pennsylvania at this time included a strong Regional Science department as well as a City and Regional Planning Department and this synergy mattered. Advocacy planning (Davidoff, 1965), urban design as a dynamic emergence from a succession of designs (Bacon, 1974, pp. 260–62), modeling of urban development (Herbert & Stevens, 1960), and ecological planning (McHarg, 1969) were all happening at Penn, and students were finding ways to make sense across these diverse ideas. Lew Hopkins and Andy Isserman, Penn grads made their way to the University of Illinois in the 1970s, joined at various times by T. John Kim, David Boyce, Peter Schaeffer, Alex Anas, Kieran Donaghy, Gerrit Knaap, and Luc Anselin, all with links to the spatial economics perspective of regional science.

1.2. Plans as the object of research

One legacy of the Chicago School is the use of economic concepts in making sense of the activities of planners. Two distinct paths emerged from the neoclassical focus on economic analysis of equilibrium systems: market failure and dynamics failure.

Most planning scholarship built from economic analysis has focused on the market failures of externalities and collective goods. These phenomena break the conditions under which a market economy will reach an equilibrium that has optimal, or at least desirable, characteristics of allocating resources efficiently. The generic responses to externalities and collective goods are regulation and provision by government or collective institutions (Coase, 1960; Ostrom, 1990; Samuelson, 1954). These responses, in turn, require collective choice. Much planning scholarship has thus focused on deliberative collective choice in the form of competitive advocacy, consensus building, collaboration, or institutional design. These questions manifest themselves in questions about relative power, mechanisms and skills for deliberative practice, and regional institutions. Plans in these frames are incidental artifacts expressing the decisions made by government entities, and, with a few significant exceptions such as Hoch (2007, 2009, 2016), the particular work that plans do is largely ignored. The caricature of this approach is to forecast population for a point in time, then, based on deliberative collective choice, design a land use pattern and infrastructure investments for this population, and implement this design through zoning to control for externalities and a capital improvements program to provide collective goods. The plan making based on this perspective is most closely associated with the University of North Carolina, and might be labeled the "North Carolina School", updated over five editions of *Urban Land Use Planning* (Berke, Godschalk, Kaiser, & Rodriguez, 2006; Chapin, 1957).

Dynamics failure, well recognized by economists (e.g., Intriligator & Sheshinski, 1986) but seldom acknowledged in planning scholarship, raises a different set of issues based on breaking a different set of conditions for the desirability or expectation of equilibrium outcomes. First, correcting the market failures so that the optimal equilibrium is achieved fails to ask the question of whether the resulting equilibrium based on neoclassical economics is indeed a desirable one. Second, correcting for externalities and collective goods ignores the underlying mathematical conception of an equilibrating process, the dynamics by which the equilibrium could be achieved rather than simply maintained once arrived at. Third, correcting market failure through government has tended to create a focus on one decision situation at a time, a collective choice by a government entity, perhaps labeled as a plan. Fourth, this focus on one decision situation, one plan, at a time also tends to ignore uncertainty, presuming that the plan once chosen will continue to be correct and need only be implemented. The Illinois School builds more directly on dynamics failure, arguing that plans work to cope with these dynamics failures. Thus plans, rather than policies, regulations, or deliberative collective choice, become the focus of research.

1.3. Conceptual modeling

There is an underlying ambiguity that confounds equilibrium analysis in neoclassical economics, seemingly confusing some

economists as well as those in other fields trying to make use of these concepts. The mathematical formulation of a free market economy is identical to an optimization problem of the allocation of resources to meet a set of demands based on budget constraints for demanders and resource constraints for suppliers. Thus the same mathematical model is both normative, what should happen, and positive, what will happen. But each of these claims is contingent on a large number of properties of the modeled system. The measures of desirability for outcomes may not be the same as the incentives for behavior necessary to achieve them. Externalities and collective goods are specific instances of this, but not the only instances. That is, we can choose a system outcome that is not simply the market failure corrections for the system's individuals. Similarly, if we use an equilibrium model to predict what will happen, it may not be what we want to have happen.

This understanding became particularly salient from the development of the Herbert Stevens Model (Herbert & Stevens, 1960) because the model was designed to predict patterns of urban development in the Philadelphia metropolitan region by simulating a market for land as an optimization problem. Harris, the leader in operationalizing this model, understood the fundamental distinction between its role in prediction as distinct from plan, as expressed in “Plan or Projection” (Harris, 1960). An optimization to choose a plan would not be the same as an optimization to simulate a market. Others developed and worked at operationalizing models explicitly intended to choose optimal plans (e.g., Schlager, 1965).

Even with this distinction, there remains an unaccounted step. In a course paper written at Penn, Hopkins (1974) used a mathematical programming framework to argue that there were three separable tasks, each of which could be framed as an optimization program: choosing a target land use pattern as in Schlager's model, predicting the outcome of current behaviors (as an equilibrium solution) as in the Herbert Stevens model, and minimizing the cost of changing price signals to change behavior so as to yield the target (instead of what would have resulted from current price signals). This argument was entirely conceptual, intended to clarify the role of plans rather than to aspire to operational modeling for particular instances. For plans to do work, a target outcome had to function or be translated somehow as a signal to actors deciding what to do. And, these signals could be information. That is, plans could work directly as information, rather than only as the preliminary expressions of decisions about regulations or collective goods.

Modeling of urban development based on economic concepts went far beyond the simple optimization models of the 1960s, including important work by Illinois faculty (Alex Anas, David Boyce, Jan Brueckner, T. John Kim). These models identified general properties of urban form in relation to economic efficiency and estimated implications of various policies and market interventions. This use of analytical modeling for conceptual understanding and for empirical investigation has continued to be characteristic of the Illinois School.

1.4. Intentional shaping of the future through actions

Conceptual recognition of the distinctions between plan, prediction, and action merely frames the question of how, in particular instances, we can link actions to futures in the face of uncertainty. One approach has been to focus on design concepts implemented through advocacy and regulation, as for example the New Urbanists and Smart growth advocates have done with noticeable success, including by Illinois faculty (Emily Talen, Gerrit Knaap). The Illinois School has retained its heritage in analytical modeling, not by attempts at direct optimization, but by embracing a mode of using models to learn how the world can work. Such modeling asks not only, what scenarios are possible or plausible in imagining the results of actions by others, but also what scenarios are possible and desirable through our own actions?

One way in which the basic equilibrium model of economics breaks down is when certain mathematical conditions lead to more than one equilibrium solution, more than one optimum. When there are multiple optima, then equilibrium models cannot predict a unique outcome. Thus, even if the model were a perfect simulation of the system, the outcome would be uncertain. Contrasting the optima, for example as distinct spatial patterns, may yield insights about what futures are plausible. If issues not modeled mattered, which they almost always do, then optimization models with multiple optima may still be useful in combination with human deliberation. Other optimization work in the 1970s focused on multiple solutions, not just multiple objectives. The major results from this work were 1) that alternatives that were very similar in objectives space could be very different in geographic space, and 2) this matters because it means that a) we can use models and still consider unmodeled issues, and b) even if we are seeking particular objectives, we can achieve them in spatially different ways that allow us to adapt along the way (Brill, Flach, Hopkins, & Ranjithan, 1990; Hopkins, 1973; Hopkins, Brill, Kurtz, & Wenzel, 1981; Hopkins, Brill, & Wong, 1982).

Andy Isserman wrote an essay “Dare to Plan” in 1985 and related articles about using forecasting models (Isserman, 1984, 1985, 2007). “Dare to Plan” was a call to consider what should happen and to imagine aspirational futures without rejecting the possibility of analysis of how systems change, without rejecting the possibility of useful forecasting. He builds directly on Harris's 1960 “Plan or Projection”, but focuses on population forecasting rather than urban development modeling. Among the tactics for using models, Isserman suggests using different chunks of history, longer or shorter sequences from which to project, as one way of thinking about how the world can work. In the most fully developed version (Isserman, 2007), he shows how considering economic modeling of employment and cohort component population models, both with interregional flows, we can investigate questions of labor supply, population, commuting, migration, and industrial structure to understand how a piece of the world is working and other ways in which it could work with consistent relationships among employment, population, and space.

Fundamental to the use of forecasting or plan making is recognition of uncertainty. We cannot know with certainty what will happen or what we can cause to happen. The traditional approach to this problem has been to bracket population forecasts between a high and low, a familiar graph in many comprehensive plans. As Isserman's work, among many others, has made clear, the uncertainty is not simply about the size of population. It also includes industrial and employment structure, technology change,

preference change, and politically driven regulations and governance structures. Working with this range of possibilities requires the kind of deliberative modeling with distinct but interdependent models of economic, social, and political systems.

Another approach to uncertainty is scenario planning, adapted from business management and military applications. Current work framing scenario planning in the context of urban development, has been compiled in Hopkins and Zapata (2007). The key idea is that we should imagine several plausible futures to gain insight into different ways in which the world can work. We can then choose strategies of action that can cope contingently or robustly with emerging futures rather than pretending to choose a particular future as if we are in complete control. The scenario approach is often confused with displaying possible futures, then choosing one, a longstanding traditional planning practice. It is important to be clear about what aspects are taken as external, differences among futures that are largely beyond our influence, and aspects that we can influence. Keeping this distinction in mind is crucial in designing coping strategies, which include robust, flexible, adaptive, and portfolio actions (Hopkins, 2001, pp. 74–75). Chakraborty, Kaza, Knaap, and Deal (2011) have demonstrated the feasibility of using urban development modeling to consider multiple futures and strategies for coping with such multiple futures from the perspectives of different agencies. In the same tradition, the National Center for Smart Growth developed four alternative scenarios for the Baltimore-Washington region (National Center for Smart Growth, 2018). These scenarios, developed using a complex and integrated set of models, were prominently featured in the Washington Post and have stimulated considerable discussion on the role of autonomous vehicles in the region. Uri Avin, a seasoned practitioner and strong advocate for scenario planning also draws heavily on this tradition (Avin & Goodspeed, 2019).

1.5. Plans as signals

In the “Illinois School” plans are information. Information, in economic theory terms, is a signal that may influence decisions, our own or decisions of others, depending on how the information is shared. In economics, the quintessential signal is a market-generated price, but in planning, the signal need not be price information and may be intentionally created and made available for strategic purposes.

The starting point in this approach is a single actor's decision about how much planning to do. Think of this as deciding how much information to collect, how much time to spend figuring out what can be done, and how much signaling of intentions to send to others. Building on Friend and Jessop (1969), this question can be framed as a decision analysis problem, analogous to sampling from a population to determine attributes of the population based on Bayesian statistics (e.g., Hopkins, 1981; 2001 Ch. 4). Using decision analysis and information economics, in particular, plans as information and their role as signals, Hopkins and Schaeffer (1983) considered who would have incentives to make plans, send signals, and some of the institutional implications.

Schaeffer and Hopkins (1987) used this frame to consider how land developers might decide how much planning to do at successive stages of the development process, taking into account costs of planning and expected changes in net benefits. They recognized that developers might want to keep some of this information (i.e., the resulting content from their decision to plan) secret from other developers and thus the public. Intriligator and Sheshinski (1986) framed the single agent planning model in continuous form with a single state variable and explicit consideration of the interval between plans, the time horizon of each plan, the planned future values of the decision variable, and the cost of planning.

These ideas were also applied to the effects of urban growth boundaries and plans for infrastructure investments. Considering the effects of growth boundaries as regulations or infrastructure investments after they occur is distinct from assessing the effects of plans, of information, about what may happen. Framing urban growth boundary expansions as an inventory control problem implies that infrastructure providers and developers can view the expectations of change in the boundary over time as information (Knaap & Hopkins, 2001). Expectations as information result not only from plans for regulation, but also from plans for investment. Knaap, Ding, and Hopkins (2001) showed that plans for light rail affected developer decisions on parcels potentially influenced by light rail. Other work showed that developers responded to plans for sanitary sewer infrastructure (Hanley & Hopkins, 2007) and that considering changes in treatment plant location over time in the face of uncertain population growth patterns could yield financial savings (Hopkins, Xu, & Knaap, 2004). Thus information in plans, the signals, may be of use to an agency making the plan, not only in signaling to others but also in signaling to itself about likely future decisions.

If plans are signals within and among organizations, this raises the question of how such signals can be effectively represented. One response is to devise graphic devices for representing contingent actions in the face of uncertainty (Hopkins, 2007). Another is to design information systems of plans that enable sharing of information (Finn, Hopkins, & Wempe, 2007; Hopkins, Kaza, & Pallathucheril, 2005; Kaza & Hopkins, 2012).

The ideas of plans as signals make sense of observed planning from a “coherentist” philosophical perspective (Donaghy & Hopkins, 2006). These ideas also provide a distinct explanation to economists as to the capabilities and questions pertinent to planning (Kaza & Knaap, 2011). Plans as signals also provide particular research designs for assessing whether plans matter (Hopkins, 2012; Knaap, Hopkins, & Donaghy, 1998). This frame has been used to interpret case studies of plans in New Orleans, Louisiana (Hopkins & Knaap, 2016; Hopkins, Olshansky, Chandrasekhar, & Iuchi, 2011) and Charlotte, North Carolina (Boyer & Hopkins, 2016).

Game theory enables us to consider strategic behavior that takes into account in a decision to plan the interacting strategies of other players. Hopkins (1981) used the formulation by Harsanyi (1967) of games with imperfect information and Bayesian players to explain situations in which actors might form voluntary groups to provide plan making for themselves or others or might seek enforceable regulations about paying for the provision of plan making. These explanations are based on oligopoly leadership in voluntary group formation and on the pure collective good concepts from economics. These explanations recognize that the contents resulting from such plan making, using distinctions by Levine and Ponssard (1977), may be secret (keep others from knowing you

have planned so that they cannot infer what to do by observation of what you do from your presumed better knowledge), unshared (others know you know more, but not what you know), or shared (others know what you know). Kaza and Hopkins (2009) consider these questions for urban development planning generally. Examples of such behaviors include voluntary groups developing large schemes, primarily for themselves, of new development (e.g., O'Mara, 1973), business group led plans for action by others, for example the Chicago Plan of 1909, and regional planning agencies that provide planning services to municipalities on a voluntary membership basis.

Using a Stackelberg game in continuous form, Knaap et al. (1998) argue that a provider of major infrastructure, such as light rail or sewage treatment, is likely to plan for its own purposes at its own expense because its own gains from planning for itself are likely to exceed its costs of plan making. This will occur despite the recognition that its plan has characteristics of a collective good because developers will benefit from knowledge of these plans even if developers do not pay for their creation. And the infrastructure provider will be better off sharing its plans because that will increase the likelihood that developers will behave as the infrastructure provider expects. Thus, the infrastructure provider will not want to exclude any developer from knowledge to enforce paying for the plan making. Assuming developers find the plans credible, neither the infrastructure provider nor the developers have reasons to diverge from this equilibrium. This interpretation was used to show that light rail plans in Portland, Oregon were credible and had the predicted effects (Knaap et al., 2001). This does not mean, however, that developers are not also making plans about their own decisions, which may or may not be shared.

The Stackelberg game emphasizes two important distinctions. First, an actor might participate in creating the content of a plan, or at least influencing that content, but not participate in paying for the cost of plan making. We need to consider whether developers will try to influence the content of the infrastructure provider's plan as well as whether they will participate in paying for it in a given strategic situation. Second, the participants in plan making are not necessarily the same as the participants in plan using. Developers might participate very little in influencing or paying for the infrastructure provider's plan making, but both the developers and the infrastructure provider have incentives for developers to use that plan in deciding what to do.

Wies (1992) used game theory to explain how counties, municipalities, and interest groups participated in the stages of a traditional transportation planning process for the Chicago metropolitan region. Some counties and municipalities chose not to participate actively at the goal setting and objective setting stages but then engaged in strategic coalition building to influence the choice of specific projects or project attributes, such as interchange locations. This could be interpreted as analogous to first choose not to join the plan making regional coalition, relying instead on local plan making. Then, then use these local plans to find coalitions among localities to participate in the third phase of regional planning to influence the inclusion of particular projects.

1.6. Land use and infrastructure planning practice

These ideas, especially their basis in analytical mathematical modeling, may seem distant from practice. Much of this work has, however, been closely linked to prototypes for practice and is influencing practice. *Urban Development: The Logic of Making Plans* (Hopkins, 2001) tried to bring these ideas together, at least to record them in coherent fashion, and ideally communicate them to a broader audience of planners through illustrative applications and interpretations. Shih-Kung Lai translated the book into Chinese (Hopkins, 2009) and linked it to complexity theory (Lai & Han, 2014).

The most frequently picked up ideas are agenda, design, policy, strategy, and vision as different ways in which plans work and “the four I's”—interdependence, indivisibility, irreversibility, and imperfect foresight—as the aspects of situations necessary for plans as strategy to be useful. Excerpts were included in two readers aimed at practitioners or professional planning students and some of the ideas were included in the most recent edition of *Urban Land Use Planning* (Berke et al., 2006), the textbook of record for planning practice. *Engaging the Future: Forecasts, Scenarios, Plans, and Projects* (Hopkins & Zapata, 2007) presents a planning approach based on these ideas and framed as a request for proposals for planning services, which has been recognized as communicating effectively to practitioners (Knowlton, 2009; Seltzer, 2008).

2. Conclusions: shaping the future of the Illinois school

Most planning theory (non-Illinois School) actually focuses on reaching decisions, not on making or using plans. Making a plan is seen as identical to reporting a decision after it is made. The question for a planner is then, how do I help a bounded group reach a decision? There is no consideration of signaling, uncertainty, or other decisions in the future or by others. But, in the Illinois School, a plan is a strategy in a dynamic Bayesian game with incomplete information. Plans are imperfect signals sent intentionally or inferred from observed actions, not reports of decisions. From an economic analysis perspective, the Illinois School is based on dynamics failure: What matters is the sequence of price signals during the process of achieving equilibrium, not the observed price after equilibrium is reached. We cannot focus on plans as the object of research if there is no difference between a plan and a decision, between making a plan and making a decision.

After 100 years, the Illinois School continues to evolve and to influence practice and scholarship through the professional work of its alumni and the dispersion of former faculty and graduates of its PhD program. Whether the particular aspects of these ideas about plans that are retrospectively salient now—plans as objects of research, analytical concepts, intentionally shaping the future, plans as signals, and pertinence to land use practice—will be sustained in the future is less important than continued contributions to thinking about plans.

No competing interests

We declare no competing interests.

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