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Science in Planning: Theory, Methods and Models

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Abstract

This chapter sketches the role of science in generating and testing theories that are applicable to urban and regional planning. A key distinction is made between theories in planning and theories of planning with the focus here being on the former rather than the latter. The idea of posing theory as hypotheses and then confronting these with observations through inductive and deductive processes, is outlined through the scientific method. The notion that one can derive good theory by continually confirming its applicability is laid to rest by introducing the key insight from contemporary science that all that can be done is to falsify or refute a hypothesis, an approach first articulated formally by Karl Popper. This has profound implications for the use of theory in any domain, particularly in planning where there has been a retreat from formal theories about how cities function in favour of deriving method and models that offer conditional predictions that inform our explorations of the future. This chapter also briefly discusses the role of digital computation and explores different environments in which real and virtual experiments can advance the use of science in planning. It concludes by pointing to theories about planning, arguing that this makes the planning task a little different from classical scientific method.

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Preamble

In his book *Planning Theory*, Andreas Faludi (1973) emphasises the point that there are theories in planning as well as theories of planning. His book was all about the latter, but he was very conscious that those studying and practising planning used theories within the activity of planning, specifically theories about their system, sector or domain of interest – the city and the region – which were very different from the theories that guided planning as an activity. This separation between cities and their planning has been long lasting although there is an argument in the social sciences that suggests that to produce a relevant view of cities and planning, the separation between them is something that should be resisted. As planners, so the argument goes, we need to consider ourselves as part of the city system and only in doing so are we able to produced an integrated and workable perspective on how to practice. Indeed both Alexander (2017) and Burton (2017) in their chapters in this book take a very different view of theory from that espoused here. They articulate theory as it relates to the activity and practice of planning, implicitly subsuming the city system as the domain that the activity applies to without inquiring into the science that might be used to progress our understanding of cities *per se*. Our treatment of the science of cities here however does not embrace the planning activity as such for we tend to divide the world into the objects that we study and ways in which we must change these objects; between cities and their planning, and it is particularly difficult to avoid this schism. So we will begin by accepting that this is the case and sketch ways in which conventional theory in both domains is elaborated.

This difference between cities and planning has a profound impact on the science that we develop to enable us to plan better. The science needed to integrate them both is highly variegated; some is structured in classic terms according to the way positivist physical science has developed since the 17th century Enlightenment in the west, some is based on powerful philosophies of political science and economy, but much is developed in more *ad hoc* and pragmatic terms in a practical context as Burton (2017) describes. This is reflected in both urban theory where planning is implicit and in contexts such as that presented by Alexander (2017) where he argues that planning theories have evolved through three perspectives: the radical-communicative model coming from rational action, the post-structuralist approach, and then the institutionalist focus, all viewpoints that are highly planning rather than city-centric, and somewhat different from the emphasis in this chapter. Here we will explore how the traditional science of cities has developed in planning, beginning with the classical scientific method and then illustrating how the power of theory has weakened as a much more pluralistic view of cities has emerged.

We will first focus on how theory is developed and then gradually show how models have come to supplant theory, how theory as a terminology has fallen out of fashion, and how a much more pragmatic approach to developing planning knowledge is now developing. We will also focus on the various tools and techniques that have been developed to aid and inform the planning task, showing how these depend in part on high theory but are developed and adapted in practice to deal with more immediate and practical concerns. Any essay on science in planning could cover an enormous range of theory and practice but we will bound our domain by focussing on more classical scientific methods. These are of course being rapidly changed as the content of our concern – the city itself – also changes dramatically as the world automates, and as cities become ever more complex. In this, we will also sketch how our view of cities as systems in which we intervene through planning and management is gradually giving way to a much wider ranging philosophy of complexity which is now one of the emerging paradigms of the social sciences.

Building Theory: The Scientific Method

The basic idea that most of us have grown up with is the notion that through science we are able to make firm predictions about the future. To do this, we need to understand the ways in which our systems of interest work and in the last 250 years, we have articulated this focus though the concept of mechanism. In general, we develop theories which are simplifications or abstractions of the salient points that concern the way the system functions and from these abstractions, we can make predictions. We usually do this using mathematics as the basis for such generalisations. If the generalisation – in essence the theory – works over and over again in predicting the system under many different conditions, we gain confidence in the theory and eventually this confidence may be so strong that it acquires the status of a law. The best examples are those of classical mechanics whereby we have developed laws of motion that tell us how objects move when forces are applied to them under all kinds of conditions that we are able to generate in terms of our immediate experience.

The theories that are generated are often very different from the systems that they are applied to but nevertheless are sufficiently close to enable them to be good predictors of some aspects of the system of interest. The way we generate these theories and of course any laws we are able to derive from them, is called the *scientific method*. This consists of two interrelated processes which we call *induction* and *deduction*. The most basic way of deriving theory usually begins with a succession of observations that seem to imply some degree of regularity in the system of interest (Batty, 1980). To fix ideas, let us consider observations about how population is distributed in cities. Several commentators looking at big cities over the last 100 years have observed that the density of city population declines with increasing distance from the city centre. By the mid 20th century, enough observations had been accumulated for the idea to be considered seriously that one could fit well-defined regular functions of density versus distance to such phenomena. In 1951, Colin Clark became one of the first to do so, illustrating that if one was able to fit such a function to a city, then one could make predictions about future population densities. This is not a strong theory *per se* but it has sufficient force to be a promising way of thinking about how populations are distributed in cities and it provides a rationale for further explanation. It is hardly a law but it is illustrative of what happens as observations mount up and as theorists begin to infer generalisations of the kind first developed by Clark (1951). This, in essence, is the process of induction.

If we then assume that this theory has the status of a law, we might use it to generate predictions that all present and future cities would have population density profiles that decline with increasing distance from their city centres. This process of generating a prediction is in fact deduction. You could argue that if you started with a theory and had no observations, you could then deduce predictions from it over and over again under different conditions and if the predictions matched reality, then this would be akin to the inductive process of gaining confidence in the theory. In fact, no one ever starts with a blank slate – we always have preconceptions about how the world works and we have observations – facts that we can agree on – and thus we have rudimentary hypotheses. We improve these by a circular process of scientific reasoning which involves a loop between induction and deduction where we infer or induce theory and then deduce predictions following the logic of the loop and making our theories stronger and stronger, hopefully generating insights that eventually reveal laws. In fact, in our world, anything approaching a law is rather rare although even in the harder sciences, we now consider that laws are never as firm or as strong as previous generations of scholars and practitioners considered them to be. To illustrate the scientific method, the block diagram in Figure 1 demonstrates the significant features of this process.

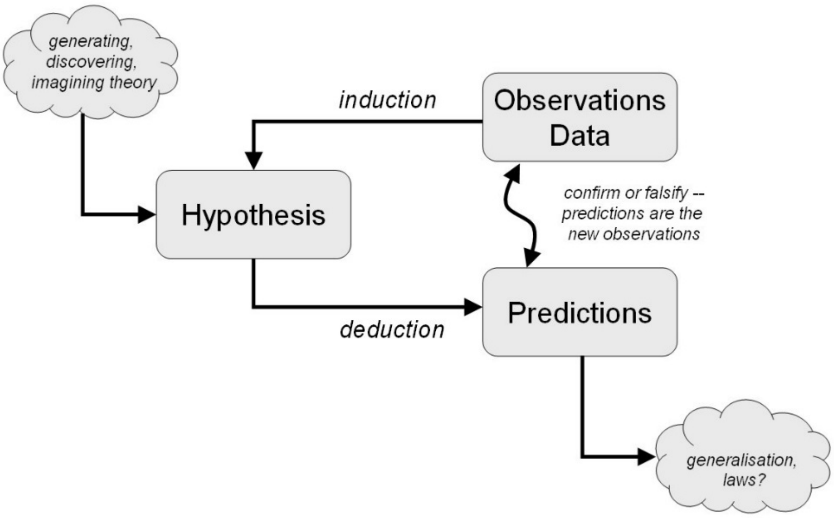

Figure 1: The Classical Scientific Method

Before theories are assumed to be laws, they are often referred to as hypotheses and as such, the scientific method is a process of testing hypotheses – by confronting them with data to see if they can be confirmed. In fact, simple hypotheses constitute the subject matter of statistics for most observations contain noise and error which means that exact confirmation of a hypothesis against data is rare; data tends to confirm or reject a hypothesis but within certain statistical limits and this is usually a matter for interpretation and judgement.

No True Theory: The Role of Falsification

Until the 18th century, most philosophers and scientists assumed that theories about the world could be true or false but once the scientific method became institutionalised, doubts about the truth of any generalisation gained ground. In the late 19th century, the edifice that had been erected in modern physics from Newton onwards, widely regarded as the ultimate truth, no longer appeared as solid as had been assumed and nagging doubts through inconsistent facts eventually led to an enormous paradigm shift in which these inconsistencies were found to be key to the limits of classical science (Kuhn, 1962). These limits did not mean that the science of Newton was 'wrong' but that it was limited in scope and could not deal with the very large – vast distances, or the very small – sub-atomic interactions. Relativity and quantum theory stepped into the breach and an entirely new paradigm (or set of paradigms) was developed to deal with these respective scales.

In essence, what happened alongside these paradigm shifts was the gradual realisation that where human systems are involved, the future is largely unknowable. If we are in charge of our own destinies, then we are in a position to invent the future and thus the notion of predicting the future – accurately and precisely – is inevitably flawed. In terms of the scientific method, no amount of new facts which confirm a hypothesis can lead to the truth for there is always the possibility that a new fact will emerge that refutes the theory or hypothesis under consideration. Thus induction is fatally flawed. Continuous induction cannot lead to truth for there is always the possibility that a contradictory fact will emerge. This notion is encapsulated by the idea of the black swan (Taleb, 2007). "All swans are white" was the empirical law until Australia was discovered where there were black swans. Bertram Russell's concept of the inductivist turkey is even more graphic. The turkey woke each morning, day after day and at 9am was fed. Being a good inductivist, the turkey assumed that this would always be the case until the day before Christmas when it woke, to have its throat cut! (Chalmers, 1999). The turkey did not consider, could not consider, the wider context.

In short what this means is that all one can ever do is falsify a hypothesis. One cannot confirm it. But the wider question relates to why this is so and in the case of our swans and turkeys, it is because the system of interest onto which the hypothesis or theory is anchored, is bounded. If we had known of Australia before its discovery (which to some extent is a contradiction in terms), then we would already have observed back swans. Had the turkey been able to stand back and look at what happened to successive generations of its kind, it would have realised that the good life always ends. In short by broadening the frame of reference, the context changes and what was considered impossible, becomes possible and vice versa. This realisation has to an extent always been part of science but it was Karl Popper (1959) who first articulated it formally by arguing in his book **The Logic of Scientific Discovery** that all that science could do was falsify a hypothesis, not confirm it. He popularised the notion that good science should seek conjectures that could be refuted with progress in science being measured by the extent to which a hypothesis resisted falsification but set against a background where any hypothesis could always be wrong.

Popper's demonstrations of the idea that science can only falsify not confirm are nicely illustrated by his reference to the closed solar system. In this system, we can apply the complete laws of Newtonian mechanics as we do so routinely in launching satellites and unmanned probes to the planets. In short, we can use Newton's equations to compute the trajectories of rockets within this system with complete certainty but once we scale to the universe, all this breaks down and we are forced to consider relativities. An even more profound example relates to our science of economics and the increasing doubt we have in the scientific policy instruments that were established in the early years of the 20th century. The conventional wisdom of the modern economy is that monetary policy such as the control of interest rates is able to change patterns of demand and supply. If the economy is growing too slowly, then lowering interest rates will increase the demand for loans – for investment because it is cheap to borrow – whereas when the economy is growing out of control, raising interest rates will suppress demand. For many years this kind of policy was the *modus operandi* of the central banks and their governments. But these policy measures no longer work and one of the reasons (amongst many) is that new factors have entered the way the economy functions: it has become more complicated, producers and consumers second guess one another in much more complex ways than hitherto, information technologies now intervene, and globalisation makes our individual and even collective behaviour more convoluted than ever before. Network effects beyond our understanding are increasingly rife. Moreover, historically once interest rates fall below a certain threshold, it was always assumed that people would no longer save but spend and the economy will reverse any decline. In fact, it would appear that these forces no longer work to reinforce one another and that the economic system no longer behaves as the theories assume it does. This is similar to broadening the context by broadening the system of interest but with the notion that it is now impossible to know how broad the context is.

There are several features in developing scientific theory that need to be noted. First, no theory produces perfect predictions as there are always limits to the way we measure and observe. A theory may appear to be very promising when confronted with observations but there may be some uncertainty over the observations. There may be a tendency to discount uncertain or ambiguous observations but this does not increase the veracity of theory, quite the opposite. Sometimes the theory is altered to omit the suspect observations by adding auxiliary hypotheses that reduce its power but if this is continually done, eventually the theory loses any power that it has. Another key feature relates to observations themselves. For any science, there needs to be agreement about what the observations constitute. There may be substantial disagreement about what the relevant observations are and if this is the case, then there can be no scientific theory. Any theory that is proposed cannot be falsified if there is no agreement about what the relevant facts are. Indeed in science, facts like theory are slowly built up and established and there are countless cases where theory has ultimately been abandoned because what were once seemingly incontrovertible facts are no longer agreed upon. Indeed facts represent the strongest of all observations but there are much weaker forms of these to test theory which are sometimes called ‘factoids’ or ‘factlets’. These tend to be observations which are not confirmed in any way and often appear as fictional but plausible information. Indeed recently the notions of ‘alternative’ facts and ‘fake’ facts have been introduced (https://en.wikipedia.org/wiki/Alternative_facts). However, some facts are much clearer in their meaning for when a theory cannot be tested, a synthetic but plausible situation can be generated as a sort of average of many situations. This produces ‘stylised’ facts. Wikipedia says: “A stylized fact is often a broad generalization that summarizes some complicated statistical calculations, which although essentially true may have inaccuracies in the detail.” (https://en.wikipedia.org/wiki/Stylized_fact). What is clear from this is that that science like much of life is an ambiguous and ill-defined activity, especially when it comes to the social domain. In short, science and its facts are socially constructed, never neutral.

Theories and Models

If you trace the history of the term ‘model’ you will find that its growth in usage dates from the mid-20th century, about the time when digital computers first appeared (Batty, 2007). In scientific method, we can define a model as a means of transforming a theory into a structure that is testable against observations. A model is clearly an abstraction or simplification as is a theory but it is more starkly so for a model only contains that which is relevant to the prediction in hand whereas a theory may contain substantial information of a qualitative kind that is not immediately relevant to operationalising the prediction. In our world of cities and planning, models developed hand-in-hand with theory, and it is worth describing the way urban economic and geographic theory has been used to develop models that not only test theory but also enable one to make predictions which inform planning.

In the 1950s and 1960s, three theoretical perspectives were drawn together to provide a rudimentary basis for forecasting the future form and function of cities. First, theories of transportation flows and interactions were developed in analogy to models of force in social physics, picking up on a long tradition of building analogies between gravitation and potential with social dynamics. Second, notions about how populations were distributed in cities with respect to their social group and density relative to their work were articulated by urban geographers in such a way that these ideas led to good qualitative explanations of how the western city in particular was structured as a series of concentric rings of different activity and land use around the central business district (CBD). Third, theories of spatial structure and location were developed from notions about how individuals traded-off distance for space where economic utility theory was invoked to construct models of the urban economy which could explain why densities declined with distance from key economic centres. This led to the development of a new urban economics that provided a basis for thinking of cities as markets where what ultimately came to established in terms of densities and prices (rents) was seen as a process of market clearing. Added to this, industrial location theory, economic base theory and input-output analysis all complemented what quickly became a series of ideas around which predictive models of the urban system could be fashioned.

These theories became the rationale for the first wave of urban and transportation models developed in the 1960s. These models essentially took basic ideas about how aggregate populations in different areas of the city interacted with respect to retailing, housing, and work and introduced a series of algebraic functions that enabled predictions to be made of the location and density of these activities. But in the first instance, these predictions needed to be confirmed against actual observations, so the first stage of the model-building process was to engage in testing the model theory against an observed situation. These processes involved verification and validation of the model against data, in short testing how good the theory was with respect to observations, which lies at the heart of the scientific method shown in Figure 1. In Figure 2, we elaborate this for the model-building process, introducing the concept of calibration which represents a kind of fine tuning of the model, a tuning that establishes how well the model fits the particular situation. No model or theory however good can be applied ‘cold’ so-to-speak to the real world. There are always parameters that pertain to the real situation that have to be calibrated and thus the first stages of model building are to find these as well as to validate how well the model reproduces what we observe, be it in the past or the present or both.

Figure 2 elaborates this sequence, building on the scientific method in Figure 1, but extending this to the use of such theories and models to make predictions in situations which we have not yet encountered. Strictly speaking, if we want to really test a theory, we build a model and calibrate and validate it on one set of observations, generating its parameters, and then taking it to another situation and seeing how well it works there. So for example, in our many models of the London metropolis, we first use observations, say, from the 2011 Census, then we apply the same model to 2001, then we apply it to another city at a different date and so on, building our confidence in its ability to make good predictions, as we go along. What we rarely do is divide the data set into two and develop the model on one part of this, using the fitted model to predict the other part. This, of course, is what happens in remote sensing where one has considerable volumes of satellite image data where you can define a training sample on one part of the data, use this for interpretation, and then transfer these interpretations to the whole data set to see how good they are.

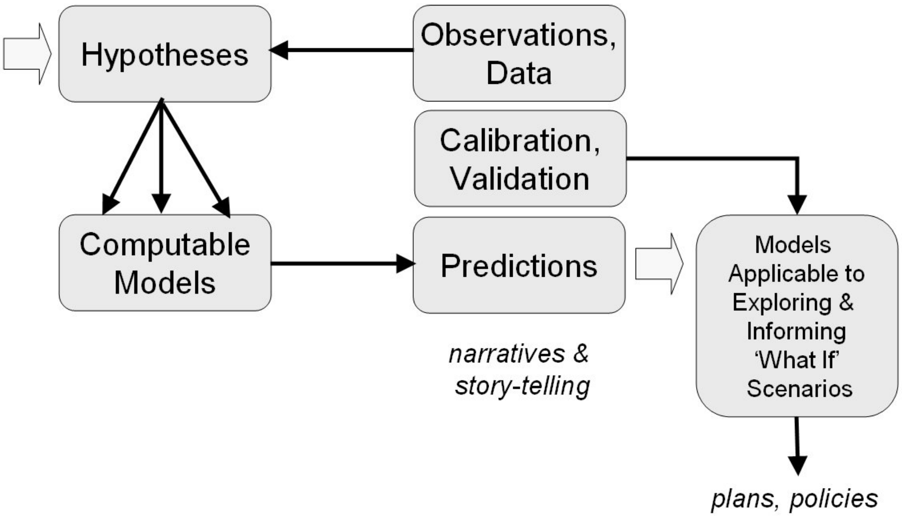

Figure 2: Models in Scientific Method

In fact the situation of developing these kinds of theory for use in planning is even more different from the received wisdom than one might imagine. Rarely if ever do we build a model on a real city and then transfer its results to some other city or the same city at another time. This is largely because the effort of doing so is so great that merely to get the model working on one city is a huge feat. It is also compounded by the fact that data is often only available for the cross-section or time interval for which the model is to be built, and in terms of any scientific quest, very often the model builders do not have the luxury of being able to apply their model elsewhere because of organisational and resource constraints.

The sort of theories and models we have in mind here are considerably more intricate and involved than a simple testing of gravitational theory or economic base analysis. Large scale models for cities have many details and idiosyncrasies that make their construction expensive and lengthy. The computational problem has almost disappeared compared to their beginnings half a century ago, but the models are ever bigger in scale and detail and many additional features involving visualisation are now essential in their interpretation and usage. In short, new elements to these models are being always added and there are now classes of urban model that are highly detailed, operating at the level of individuals or agents, over multiple time periods. Their construction is often plagued by missing data, despite advances in open data and the emergence of big data during the last decade.

In general in science, our quest is to simplify and develop the essence of any explanation taking away details which are irrelevant to the task in hand. In this sense, science tends to value parsimony in developing theory which as Einstein once said should be "… as simple as possible but not too simple." However parsimony is often not consistent with the need to incorporate features that are plausible but untestable and thus many theories and their models contain assumptions that appear correct but cannot be tested because data is not available. In social situations where we are modelling human behaviour, frequently the processes of decision-making are simply not observable or if they are, we find it difficult to observe the factors that are important to making such decisions. New classes of model have emerged in cities during the last 20 years involving very rich descriptions of how individuals behave which contain multiple assumptions that cannot be tested and will never be because of limits on observation and data. In terms of classical science, these kinds of model do not meet the standards of testability and validity that we assume, nor do they meet the criteria of parsimony but they are nevertheless useful. This implies that we must take a different view of science than the one that most of us have been conditioned to believe in and that science is a good deal more uncertain and unclear than we always hoped for.

This new view of science as being useful rather than truthful is entirely consistent with our view of how we might use theory and models in helping us to plan. Half a century ago, the prevailing attitude was that we should be able to build models that could at least predict the short term future. In fact as daily events now show, this is a pious hope. As we learn more about the world and as it gets ever more complex as we invent new technologies and evolve new behaviours, we can never be certain our theory is equivalent to the task of using it to predict even the shortest term events. Why we ever thought we could is something of a mystery for now that we have absorbed the chilling message of Popper (1959), all we can hope for is falsifiability. In any case, it is now widely agreed and in some senses this is an inevitable consequence of our view of cities as social systems, that theories and models are not primarily for prediction but for structuring and focussing debate. This is widely acknowledged in economic forecasting where, quite routinely, a basket or ensemble of model predictions is assembled from many different groups who build their own econometric models. These predictions are then pooled and some average agreed upon. This reflects the diversity of views and the uncertainty of theory and it is slowly but surely becoming the *modus operandi* of using any theory or model in thinking about the future of cities.

In Figure 2, we go one step further and show that a plurality of models needs to be considered from any one theory which can be tested against the same sets of observations. The notion that we might build more than one model in a policy context is something that emerged very quickly when it was found that the uncertainties of modelling were such that to get some perspective on policy, different models were required. The idea of counter-modelling emerged where alternative models were developed to not only enable us to construct the future but also to deconstruct it (Greenberger, Crenson and Crissey, 1979). To some extent, many of these notions are now included in the way we are developing decision and planning support systems. Here a variety of models, techniques and tools are being implemented to support what is an eclectic process of to-ing and fro-ing between future alternative plans in such as a way that one is able to converge on a plan or policy that reflects a balanced view of many different theoretical perspectives (Brail, 2008).

Theories of Planning and Theories in Planning

The study of cities crosses the boundary between the social and physical sciences but it is widely accepted that unlike the physical sciences, we cannot develop and test our theories on the subject matter of the city itself, largely for ethical reasons. In various unguarded moments, commentators talk of our experiments with 'new towns', 'social housing', 'pedestrianisation', and so on but rarely do we consider these akin to laboratory experiments that are conducted to advance physical science. In fact, when we refer to these kinds of experiment in the social sciences, we usually mean schemes that were never intended as experiments but in hindsight, almost appear as though they were, often with disastrous consequences. A term which recently has grown in popularity in the social sciences is 'natural experiments' which exist in the 'wild' so-to-speak and these are defined as situations where outcomes appear which are relatively well-defined but outside the control of any particular scientist or investigator (Dunning, 2012). In this sense, they occur 'naturally' in that they meet some of the requirements for traditional experiments without being planned or controlled from the top down. Traditional experiments in science essentially set up environments (sometimes these are called media) whose conditions are very closely controlled to the point where slight variations lead to changes that confirm (in a limited sense, of course) or falsify hypotheses. Usually such experiments endow these artificial environments with the same reality as that in which the phenomena exist, and in this sense, there is an intuition that confirming instances of these hypotheses are somewhat more satisfying than in non-physical environments that dominate many social experiments.

In a world where experiments cannot be in the same medium as the phenomena being explained, there may be as much control but the environment is virtual, artificial in that the investigator has total control over the form of the media. The best examples of this kind of theory development are through the medium of thought experiments which are logical deductions based on formal reasoning – mathematical, symbolic, verbal – defined as a way of demonstrating the principles associated with any hypothesis through derivations of outcomes and ancillary hypotheses. These experiments are entirely theoretical in that they are not confronted by facts of any kind and purely consist of deductive consequences. These kinds of experiment may vary much more widely than traditional experiments in that they might consist of generating counterfactuals based on all kinds of 'what if' scenarios and in this sense, they can be close to planning situations. To an extent these types of experiments are dominated by analogies and metaphors between different types of system and their value lies in providing a context for informed discussion and speculation.

Of course, most models in planning are now essentially developed and tested in computational – digital – environments. The original motivation for computer models was to provide an environment where non-intrusive experiments could be developed for generating robust and relevant theories that could explain human systems of various kinds. In fact during the time such models were being first developed in the social sciences, computation was also being extended to complex physical as well as human systems. Now computer modelling and their ability to compose, predict and test futures without actually having to construct them has become the *modus operandi* of many varieties of theory building. The computer thus constitutes a virtual environment in which the future can be explored – in which many digital futures can be computed – with a view to converging on the best with this being the focus of the plan or policy to be developed. This was one of the basic motivations for applications of computer models to urban systems in the 1960s where computers themselves were regarded as laboratories in which to experiment about the future without letting it run its course. The argument was that this strategy could produce the best possible future or at least avoid the worst. More recently, the most extreme of these contexts have emerged as virtual environments where users can experiment with the actual environment itself by immersing themselves totally within an artificial context.

Theories in the form of computable models do not exist in a vacuum. Because our ability to predict the future is highly limited, and because we still need computer models to structure the debate, the debate must be accomplished with a whole series of different media which support formal modelling. Thought experiments thus pervade this usage and so does 'story telling' which has become popular in softening the outcomes of models and introducing qualitative information and data that cannot be formally part of the computation itself. Morgan (2012) has sketched the many ways in which economic modelling and forecasting is enriched by such story telling which, she argues, is an essential part of any formal application of modelling to policy making. Her view that such narratives are an important test bed for model development, particularly in the domain of economics, resonates extremely well with processes that broaden the experimental context to include thought experiments and virtual environments.

We now need to return to planning theory rather than theories in planning but before we do so, we must say something of the major styles of philosophy that dominate our world of cities. Essentially classical and contemporary science tend to assume a weak positivist position where theory is always to be confronted with facts or facts with theory. This is in contrast to theory which is largely regarded as normative, pertaining to norms or standards that may have everything or nothing to do with the real world. In terms of theories about how cities work, these are largely positivist but there are some that suggest that how cities evolve is highly individualistic and not susceptible to theorising about the kinds of behaviour that make this possible. Much of the theory about the cognitive powers of individuals in manipulating processes and structures that constitute cities tends to be normative.

Theories of planning themselves are largely normative although there has been a strong imperative to attempt to ground them in the social and political context of everyday behaviours. Such theories however tend to be prescriptive rather than predictive in that they instruct how planners should proceed by solving problems and generating solutions to them. In computational modelling terms, such theories deal with optimisation. For example, blueprint planning where an end state is articulated as an ideal, is an example of such normative thinking while incrementalism is somewhat less idealistic but equally hard to ground in any factual basis of how planners and the planned might engage in rational planning. Theories of planning as advocated by Faludi (1973) which were first formally posed half a century ago are much more diverse than theories about cities but these tend to pertain to a much wider style of theorising more akin to philosophy. We will not explore these any further here but simply note that elsewhere in this book, the chapters by Alexander (2017), Burton (2017)and Lieto and Beauregard (2017) approach planning theories in this more direct manner. A useful and wide ranging compendium of the views of many well established planning theorists whose ideas have been developed over the last half century is a good complement to the arguments introduced here (Haselsberger, 2017).

Prospects: A Science for Planning?

There is no magic procedure for deriving the best theories and models to inform our plan-making. As we have hinted in this brief synopsis, the path to discovery is paved with obstacles and challenges pertaining to data, observation, insight, and intuition. Science is as much a voyage of inspiration as it is of painstaking, routine analysis and to use it effectively in exploring and designing the future, is a matter of assembling many different perspectives which range from formal computational simulation to effective and enticing story-telling, from reflecting on what is feasible and possible to thinking laterally and unconventionally about the nature of the planning problem (Guhathakurta, 2003). Even though science is a generic activity, it needs to be adapted to context and the particular idiosyncrasy that is featured here, is the fact that we require at least two kinds of theory – a theory of cities and a theory of how we should best plan. Fifty years ago, it was assumed that these were one and the same. Indeed the systems approach to planning suggested that cities were like cybernetic systems which had structure, purpose and function that could be steered or managed, controlled or planned but this model like many, ignored the pluralistic nature of society whose artefacts were cities which revealed the many problems of fashioning a world composed of many different viewpoints. It ignored the definitional issues about what is planning, what are its methods, how is it and how should it be implemented in different contexts such as those noted by Alexander (2017) and others in this book. Readers of this chapter are urged to reflect on how science as we have portrayed it here might help inform the wider task that makes planning function better, all of which are woven through the contributions to planning knowledge and research collected here.

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