Commentary

A modeller’s utopia

Combtorial evolution

Thomas More’s Utopia, first published in 1516, was a description of a good life on a far away, nonexistent, island. It was a rather daring way of criticising the then current regime in England. In the same spirit, I found myself musing on what a modeller’s utopia might be like—perhaps in an Institute for Urban and Regional Science and Planning, even a global scattering of such institutes, working together, Internet linked. These musings were in part prompted by Brian Arthur’s book, The Nature of Technology (2009). He mainly writes about ‘hard’ technology but I take as foundations for my argument two ideas: that technology is underpinned by science; and that both technology and science evolve through what he calls ‘combinatorial evolution’. With some oversimplification for the sake of argument (or by making the definitions suitably broad), I would then see urban and regional modelling as the science that underpins the ‘technology’ of planning (and indeed, of much policy making and politics).

The idea of combinatorial evolution rests on a systems view of the world. A ‘technology’ such as an aeroplane is constructed from many subsystems, which in turn are constructed of other subsystems, and so on down a hierarchy. The core of Arthur’s argument is that the evolution of new high-level technologies usually arises from new combinations of subtechnologies further down the hierarchy. These new combinations are the roots of much ‘inventiveness’. Against this picture, we can articulate the planning system as a ‘technology’ with subsystems that could be developed; the design element of planning is an invention of solutions to problems in new situations. However, I want to focus first on the science, the models.

Beyond silos

Urban and regional modelling as we know it has almost sixty years of history(1). There is a wide variety of approaches, often rooted in different disciplines, many elements of these representing the subsystems of Arthur’s picture. It is very fragmented; there is, as yet, no ‘normal’ science in Kuhn’s sense. This is partly because it is a young field, partly because it has never been a ‘big’ science as, for example, elementary particle physics. Relative to its potential contribution to problem solving, it has been underresourced. However, some of the fragmentation arises because of modellers’ tendencies to leap into camps (or silos), each camp arguing that their method is ‘best’—or at least not engaging with alternatives. The full possibilities of combinatorial evolution are then lost. The first principle for a utopia, therefore, is ‘no silos’! A corollary of this principle is to extend horizons—cross and link scales, cross and link disciplines, work on neglected problems(2).

On ‘interesting and important’ research

A second principle, stated rather subjectively, but to be illustrated below, is to make sure that the elements of modelling research are ‘interesting and important’—the science should be interesting, the applications important! A lot of progress has been made in developing

(1) This was brought home to me as I edited five volumes of the history of urban modelling (Wilson, 2013).
(2) Although the argument here relates to contemporary problems, there are enormous opportunities for modellers in areas such as history and archaeology—for a toe in the water, see Wilson (2012a) and Bevan and Wilson (2013).
the science—albeit fragmented. Much less progress has been made in using this science to support various forms of planning. There are exceptions: transport in the public sector and retail in the private sector, for instance. There seems to be an acute disconnect between the modelling and planning communities. This is true at an elementary, basic level; and perhaps less surprisingly, in relation to the most difficult, ‘wicked’, problems. A corollary of this principle, therefore, is that at least part of the modelling community should ensure that they are fully contributing to planning problems of all kinds; and that the planning community should receive this help, and possibly pay for it! In relation to both principles, there is a need to be ambitious!

**Utopia**

What should my utopian institute (or network of institutes) be doing? I will illustrate the argument with examples from my own experience and prospective future research—though this is a small contribution: potentially, this kind of thinking opens up a very extensive agenda.

We can now take for granted computing power, high levels of visualisation skills, data in abundance through the ‘big data’ movement. We have an extensive existing ‘kit’. We have excellent account-based models of demographics and economics; we can model the functioning of most subsystems, though these skills are not universally applied; we have the beginnings of an understanding of dynamics with its implications of path dependence and phase changes; there are new ‘kids on the block’ with, for example, agent-based modelling. So what are the ongoing challenges? Examples are:

- interdisciplinary integration at the research front line;
- dealing with the high dimensionality of the algebraic arrays which constitute our models—which I would argue means the full integration of microsimulation with other methods;
- a fuller understanding of structure generating mathematics—at the moment we are good on approaches which build on Lotka–Volterra models and the beginnings of Turing-style reaction–diffusion models, but not much else;
- articulating ‘best practice’ so that the kit is fit for purpose in policy making and planning.

We then need to move on to the challenges in planning—particularly the ‘wicked’ problems. Examples are (illustrated in the context of England but noting that there will be similar lists for other countries):

- economic development at the urban and regional scale—routine application of input–output–models at these scales, understanding the future of (un)employment, impacts of changing technologies;
- education—failing schools, parental choice;
- health—evaluating structural reorganisation in attempts to solve the problems of the NHS;
- the welfare benefits’ system;
- housing—the shift to rental, homelessness;
- police reform;
- the criminal justice system, prison reform, prisoner rehabilitation;
- joining up—multiple deprivation;
- inner-city regeneration;
- major UK infrastructure planning—beyond shopping lists.

In all of these areas, although we have the modelling tool kit which could be used at least for short-run analysis, there is very little modelling work. The modellers’ agenda has been too narrow. Indeed, it could be argued that these wicked problems could be treated as operational research. (Is it the existence of subdisciplinary silos that means operational researchers and urban modellers now barely intersect?) And the policy and planning communities are unreceptive.

(3) See Wilson (2012b) for a sketch.
We need comprehensive models with all the subsystem models stitched together. We might then begin to see the extent to which problems such as poor health, housing, and unemployment are essentially income problems, that these are access-to-work issues, and these in turn are skills issues. Is the education system the key? Probably, the answer is ‘yes’, but we have not analysed it in these terms. We could use models representing the middle and longer runs to estimate, on the basis of alternative policies and plans, how long it would take to have any serious impact on this kind of agenda.

It needs to be emphasised of course that few of the wicked problems can be solved through the kind of capital investment and structural reform for which models provide a good base for evaluation. In most cases, there are also deep problems of culture and working practices which demand different kinds of analysis and policies to be developed in parallel.

The stitching together, more broadly, needs to be accomplished within government—local and national. The data are available; information, understanding, and knowledge can be generated through the application of models. Plans can be designed and test results recorded. The joining up would be through what might be called an IGIS—an intelligent GIS—an information system that could house the GIS-type data as now but would be fundamentally enhanced by the addition of plans and policies and tests of these through being able to call up appropriate model runs and visualising and evaluating the outputs.

It is clear that not all of this can be done within my utopian institute, however large, though it could lead: developing best practice and articulating the research front line. Government agencies would have to play their part with substantial in-house integrated units. Universities would have to play their part with seriously large interdisciplinary centres, each substantially bigger than typical core departments—so a major restructuring is called for. There would be major battles as disciplines went into defensive mode. The vision has to be for an extended utopia.

New directions

Utopias, by definition, are not achievable. However, it is possible to use them to chart new directions. Local government should have cross-council units that would construct an intelligent information system for a city or region, incorporating basic data through a GIS, policies, and plans, and a model-based analysis and evaluation system. A best-practice system is needed to chart the way. An example should be provided in the UK: the Technology Strategy Board—a kind of research council for innovation—has funded a £24 million project for Glasgow as a ‘Future cities demonstrator’, particularly to show the benefits of integrating services. More broadly, the UK Department of Communities and Local Government should lead a cross-department ‘joining-up’ initiative. Universities should take interdisciplinary challenges more seriously and some, at least, should use ‘cities and regions’ as a case study of what can be achieved. They would need to invest themselves, but would also need partners among research councils, consultants and government agencies. A new kind of cooperative structure is needed here. There are significant implications for education: new courses will be needed for both young and mature students to generate an expanding skilled workforce in modelling and planning. The modelling community should break out of silos, should extend horizons, and work in the major public services (and the private sector), possibly reinvigorating operational research en route. This is nontrivial and, with some notable exceptions, is not what we have now. The policy and planning communities should embrace intelligent analysis.

This all turns on a commitment to ambition in both the science and in policy and planning. The science needs to become ‘big science’—exciting in its own terms but able to contribute to solving some of society’s biggest problems. This is not essentially a funding problem: universities and government agencies could reorganise and commit from existing resources.
It is a cultural problem with many dimensions. For example, academic researchers, in inefficient silos, have become accustomed to working on ‘small’ problems, often on ‘toy’ systems, because they are manageable; policy makers and planners typically have short-term perspectives and do not have the backgrounds to see that the science can help. They are also unambitious in that part of their own territory they should be good at: inventing and developing radical plans for problems that need radical solutions. These cultures are deep seated but perhaps dreaming the utopian dream could be the beginning of something new. Brian Arthur’s argument shows that, if the breaking down of the boundaries of silos and extending horizons in both modelling and planning could be achieved, then combinatorial evolution would ensure more rapid progress than we can at present envisage.

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