Complexity theory and the new public management

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This article explores whether complexity theory can inform a more realistic and democratic approach to achieving policy goals than the audit culture of performance management. The example of higher education is used to show how organisational systems interact with a policy landscape which can be tuned by government action. Universities exist at different attractors on this landscape and its ruggedness determines the extent to which transformative organisational change is likely to occur. Policy landscapes can be tuned to actively encourage transformation in performance. This is similar to the use of performance targets to steer organisations towards meeting their targets, but unintended consequences often follow from target-setting for organisations and individuals because it fails to recognise whole systems. Using examples from neighbourhood renewal, the article considers the alternative of scanning key parameter values and feedback to an organisation's planning and operational processes. Scanning and responding to key parameter values offers a more flexible and adaptable approach than performance management, but needs more autonomy and a greater degree of discursive democracy within organisations than is currently the case in the UK's public services.

Introduction

Complexity theory and the new public management have a common focus on monitoring and feedback in steering the behaviour of organisational systems. But they are profoundly different in their approaches to local self-organisation. New public management theory spawned the audit culture and its focus on results (Hughes, 1998; Strathern, 2000). It emphasises the measurement of performance against objectives, with defined responsibilities for achieving these objectives and the use of data - especially cost and output information - to evaluate performance and decide whether to apply sanctions or rewards.

Performance management has been described as one facet of the audit culture that ‘relies upon hierarchical relationships and coercive practices’ (Shore and Wright, 2000, p. 62). It involves the use of information centralised in the hands of the few to manage the performance of the many. A series of problems follows from the coercive accountability often associated with this paradigm, from ‘implementation gaps’ to the manipulation of performance indicators and frustration about being held to account for the effects of external factors on internal performance.

Complexity theory may offer an alternative that still recognises the importance of information and monitoring for the success of an organisation. ‘Complex management’ entails democratic problem-solving and decentralised experimentation rather than central control and conformity (Kauffman, 1995). It does not use feedback to serve an audit culture of coercive accountability but instead to inform a discursive democracy (Strathern, 2000; Dryzek, 1990). Management based on complexity theory is also a ‘whole systems’ approach and includes within its frame of reference the wider environment, so that organisational performance is seen not just as a function of organisational capability but also of the types of environment in which organisations work.

The paper explores this issue by considering a number of examples from different areas of public policy, starting with higher education. First, however, some basic concepts from complexity theory are introduced and their applicability to public policy considered.

Complex systems

Complex systems are found in nature and society. They are defined by relationships and networks rather than by their constituent elements. These relationships form to exchange information and through this information exchange the system evolves behaviours that distinguish it from the external environment. In social systems this includes shared meanings and practices.

A complex system interacts with its environment both in terms of feed-backs and feed-forwards, so its boundaries connect the system with its environment rather than separate it (Blackman, 2000). It is open and dynamic but control and/or co-operation need to be present so that the system does not simply dissipate. To self-organise in this way, complex systems need information about their external environment, particularly to be able to cope with being out of equilibrium due to environmental change by having the capacity to represent the environment, learn about it and communicate this learning. Communication, learning, common purpose or *alignment*, and continuous adaptation and improvement are essential features of complex human systems. Although dynamic, in the long run they may settle down to an attractor, which is a steady state with generic, describable features. If severely perturbed, they may shift along a trajectory to another attractor, changing qualitatively in nature as a result. Such 'phase transitions' are increasingly recognised as common in public policy as organisational systems adapt to new environmental parameters; these systems '… change radically, not incrementally over relatively short periods of time' (Ridgeway, Zawojewski and Hoover, 2000, p. 191).

Complexity theory is a realist epistemology in the sense that systems and phase spaces are regarded as 'real' rather than as social constructions, although the type of system that is accessed depends on how the system is framed for the purpose of investigation or intervention. A basic issue is therefore how a system is distinguished from its environment, while recognising that the environment actually comprises other systems, so the picture is one of systems *immersed in each other*. The environment outside a given system can be thought of as a landscape, which is essentially a set of parameters relevant to the behaviour of the given system, with attractors embodying a particular combination of parameter values. If a parameter changes, the effect may be sufficient to perturb the system and shift it to a new attractor.

For this reason, discussion of the predictability of the behaviour of a complex system, in terms of predicting pattern or 'group property', must be qualified by noting the possibility of qualitative transformation following major perturbation. The world of complex systems is one of surprises but, as with scenario planning exercises, it may be possible to consider the range of possible attractors and work back to identify the early-warning signs that would suggest a new scenario – perhaps a new system state – is emerging.

If the system's behaviour is predictable this is a sign that it is either in a steady state equilibrium or a 'limit cycle' showing a regular periodicity in activity over time. If neither pattern nor path are predictable the behaviour is random, which would be the case if the behaviour is uncoordinated and occurs with no memory of the past – which seems unlikely in an organisational system. Chaotic behaviour, however, is present in organisational systems and takes the form of apparent randomness behind which it is possible to discern over time a qualitative order in the system's behaviour (Stroup, 1997). Chaos is a sign that a system is far-from-equilibrium and at a *strange attractor*. A feature of strange attractors is that they are structurally unstable, the kind of situation where the butterfly effect can occur when a small change in initial conditions magnifies into a large, possibly transformative, effect (Stewart, 1989). Clearly, whether a system is at a strange attractor is of great policy importance as it suggests that a parameter change may cause dramatic change for the system, beyond its ability to damp down the perturbation.

The next section of the paper considers how these concepts can be applied in public policy, using the example of higher education.

The higher education policy landscape

British higher education provides a good example of how organisational systems interact with a fitness or 'policy landscape' of attractors. It also provides an example of how such a landscape can be tuned to produce such a degree of ruggedness that the landscape is more important than a given system in determining its performance. Traditionally regarded as autonomous organisations, universities are now subject to government policy to a greater extent than in the past via tuning of their policy landscape, rather than through direct intervention.

As introduced above, the concept of an 'attractor' describes the long-term qualitative behaviour of a given system type; a kind of Weberian 'ideal type'. Policy can seek to define attractors by constraining system behaviour in certain directions, using control parameters such as selective research funding allocations that 'tune' the landscape as more rugged (selective) or smooth (universalist). Academic units within universities have essentially become research-intensive (R), mixed (X) or teaching-intensive (T) subsystems depending on their success in attracting public research funding following periodic national Research Assessment Exercises (RAEs) and success in attracting external grants, which is itself highly correlated with RAE performance (Beck and Drennan, 2001).

The nature of universities as systems is strongly influenced by their make-up of R, T and X subjects, and the policy has created R, T and X attractors for whole universities. There is some dynamism because the status of subjects can change over time. The main mechanism for this is periodic RAEs, a policy that was adopted with the claim that it gives scope for aspirations and rewarding achievements (Kogan and Hanney, 2000). But such evolution faces a rugged fitness landscape. Funding allocations 'lock in' to past success, there is strong policy selectivity which skews funding towards top performers, and less research intensive universities tend to attract students who need more time from their teachers, crowding out research time. This means that universities have become locked into R, T and X attractors.

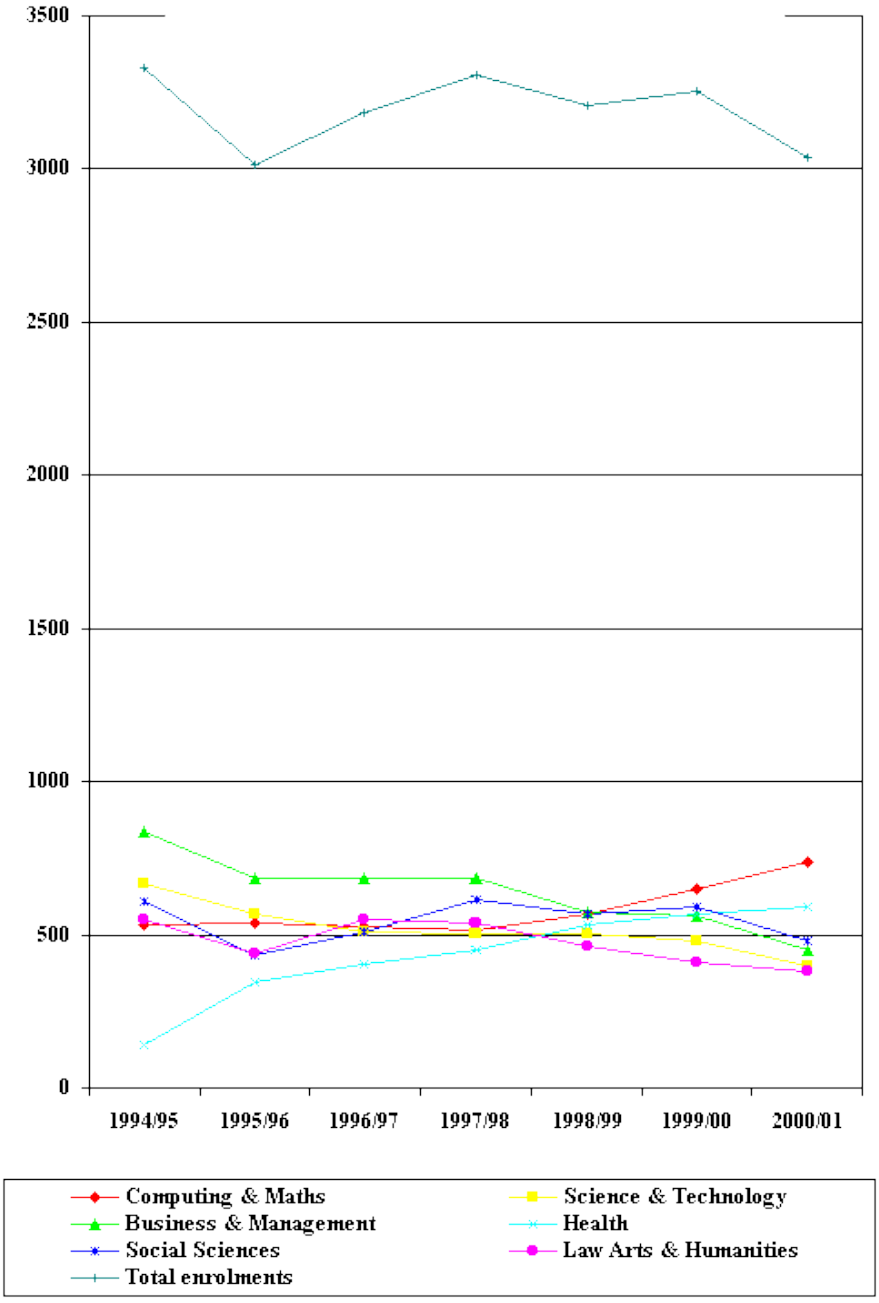
My own institution, the University of Teesside, is at a T attractor, despite a small number of subjects that are well-rated for research and a general policy commitment to aspire towards the X attractor. The university's budget is dominated by T income from government grant, which has grown over recent years as more students have been recruited, but any under-recruitment creates a funding gap between income and expenditure because of the high dependence on this single source of income. In an environment where many students will aspire towards R and X universities for reasons of reputation, and some evidence of a national over-supply of HE places currently, Teesside faces major challenges in maintaining and growing its student numbers. It appears to be at a strange attractor in that change in a single parameter – recruitment of domestic students – will fundamentally affect its state.

If Teesside is at a strange attractor there should be signs of chaotic behaviour. Figure 1 shows trends in Teesside's first year student full time enrolments from 1994/95. After a period of rapid expansion, enrolments fell significantly in 1995/96, with a reduction in particular in demand from non-traditional entrants. After recovering over the next two years, the introduction of fees caused another more sustained fall in enrolments from 1998/99. These overall trends mask different School trajectories. For example, there has been a sustained and policy-driven expansion in School of Health numbers, while the School of Business and Management was in decline throughout the period. Within Schools, the growth and decline of recruitment to different subjects has followed non-linear trends. In the School of Social Sciences, for example, the Social Policy degree course was forced to close in 2000 following a collapse in applications from 220 in 1996, to 74 in 1997 and then 17 in 1998. On the other hand, degrees in Sport and Exercise have grown unexpectedly rapidly, with the School attracting an increasing share of national recruitment to these courses.

These data do seem to reveal chaos. Wider system parameters (demographic, economic, financial), the system's initial conditions (subjects, staff numbers, contract student numbers, reputation and popularity) and large numbers of decisions by self-organising student applicants produce unpredictable outcomes. The single variables used in Figure 1 essentially trace complex interactions that have produced these recruitment outcomes each year. Overall, though, the university's total student enrolment is fairly stable. This is partly because of the significance of past intakes and partly

because the annual student number contract sets an aggregate target that the university aims for by adjusting many sub-processes (e.g. new course developments, marketing focus, recruitment of students rejected from other institutions, work with local schools and colleges). These are essentially negative feedback mechanisms designed to dampen the effects of external changes. Chaos would be more obvious if it was not for these stabilising processes that impose some order and predictability (Puddifoot, 2000).

Figure 1 University of Teesside full time first year enrolments



Complex systems evolve to damp down exogenous shocks. The collapse of social policy recruitment at Teesside is an example of this. Although on its own this was not a transformative event at institution level, several subjects at Teesside were affected in this way during the same period, and the effects cascaded across many inter-related elements of the system. A series of planned redeployments and voluntary redundancies followed which dampened these effects. This type of early intervention, which may also be required by the Higher Education Funding Council in its role of managing instability in the HE system, seems likely to produce periodic rather than chaotic behaviour. This is because there are sufficient negative feedback mechanisms, internally and externally, to prevent an initial perturbation cascading through the system to produce a transformation.

Policy landscapes of boundaries, limits and constraints create the conditions for self-organisation within institutions and differentiation of structure between them as they compete for resources (Cilliers, 1998). Dooley and Van de Ven (1999) comment that transformative events are rare when set against the more normal long periods of numerous incremental adaptations that organisations make. However, this very much depends on the fitness landscape. The ruggedness of today's higher education fitness landscape reduces the likelihood of transformative change, although possibly with the exception of some institutions that have evolved to a size larger than future student recruitment or research funding will support. These institutions may indeed be at strange attractors, but feedbacks and policy instruments exist to manage a course back to equilibrium if serious perturbation occurs. Extinction of organisations is generally avoided, but extinction of certain activities – such as research or a particular subject in a university – is allowed to happen.

Complexity and change

The ruggedness of the higher education policy landscape is illustrated by the lack of institutional mobility in university league tables over recent years. The policy landscape appears to be tuned to maintain a hierarchy of institutions with little possibility of a university making a phase transition. This is almost certainly because the focus of government policy is on the sector as a whole – its total student recruitment and research base – with the consequence that autonomous organisational action is stifled by the rugged fitness landscape.

In other areas of public policy the fitness landscape is tuned to be less rugged, especially in areas where there is political sensitivity about variation in standards across the country. Here, performance targets are used to define a future state that is expected of an organisation when its performance is compared with other organisations, specifying the expected performance of its units and routines in a limited number of internal dimensions. Variation is regarded as an issue because government policy aims to create a smooth fitness landscape by funding services to deliver comparable standards across the country. The 'best value' regime in UK local government is a case in point, whereby poorly performing local authorities are expected to transform their performance on the basis of like-with-like comparisons with other local authorities (DETR and Audit Commission, 1999).

However, one of the problems has been that by coercing organisations to change in this way unintended consequences have followed which have undermined wider policy objectives. For example, an important current education policy objective is to raise standards in primary and secondary schools, and as a result there is now extensive data available on children's educational achievement to enable targets to be set and progress to be monitored. These data have recorded some impressive rises in standards in recent years. However, Tymms and Fitz-Gibbon (forthcoming) marshal a range of evidence to cast doubt on the reality of this improvement:

> 'Reasonable conclusions for secondary education are that standards in external examinations towards the end of secondary schooling have been adjusted downwards to meet the needs of a larger cohort and a more inclusive system.'

Tymms and Fitz-Gibbon are suggesting that perhaps nothing 'real' has happened with regard to standards. The targets may have brought about new behaviour but in a way that has subverted the overall policy aim. This seems likely to be because the fitness landscape is in fact not smooth: it is just as rugged as with higher education but not so much (yet) because of policy selectivity. The rugged landscape that schools face is a socioeconomic one: the examination performance of their students is determined more by their home background than by any school effect (Byrne and Rogers, 1996). This is not to deny that performance cannot be improved through benchmarking, but that there has to be an alignment between the aims of policy and the capacity of organisations to deliver, and this includes considering the fitness landscape which each organisation faces.

If we turn to another policy area, neighbourhood renewal, the same problem is evident. Current policy defines certain neighbourhoods as eligible for special treatment such as neighbourhood management (Social Exclusion Unit, 2001). But environmental parameters are neglected. A run-down neighbourhood is likely to be at a strange attractor and neighbourhood renewal is a type of energy input that seeks to move the neighbourhood towards equilibrium. This may or may not be sufficient to transform the neighbourhood system to a new attractor, depending on initial conditions and whether parameters which define the neighbourhood's location at its attractor are changed sufficiently to transform its system state.

A recent study of neighbourhood abandonment in North West England concludes that the key parameter change in the 1990s was falling unemployment, which is associated with economically active households leaving social housing and unpopular types of private housing (Nevin *et al.*, 2001). As employment levels rise, neighbourhoods where certain socioeconomic and housing conditions occur together are likely to lose population and ghettoise. The situation is dynamic not just because employment levels change but also due to another key parameter, the cost of owner occupation. In areas with low demand for social housing, falling mortgage interest rates may bring owner occupation costs near or below social housing rents, leaving social housing areas vulnerable to abandonment (Kiddle, 2001).

It is extremely difficult to achieve a relevant parameter change within the local system because most of the parameters are governed by larger systems of relationships in which the neighbourhood system is immersed. Improving neighbourhood quality and management with local resident participation has worked in some circumstances but the relationship between local energy input and transformation is not linear. Similar amounts of spending have brought about very different outcomes in run-down neighbourhoods. This is because the likelihood of achieving a shift from say a 'ghetto attractor' to a 'sustainable neighbourhood attractor' depends on initial conditions and feedbacks.

Iteration is a feature of all social systems because they reproduce themselves (autopoiesis in the language of complexity theory). Policy intervention seeks to reproduce something different. Feedbacks are events that are triggered by intervention and these events may drive the system to a renewed and sustainable state or fail to do this. Lee (1997, p. 23) describes the general process as follows: 'Feedbacks produce a range of probabilities for "conditions of action" at local levels, which in turn lead to events that coalesce into new macroscopic assemblies …'. Initial conditions at local level could include a core of longer-term local residents committed to working with a local authority on improvements, or the presence of an anti-social element in the neighbourhood. Both can have a considerable impact on whether a ghettoised neighbourhood can be turned around by local action.

Risk indicators may be able to identify neighbourhoods where initial conditions indicate a possibility of abandonment but it is very difficult to predict where and when this might happen. Newcastle City Council has undertaken research to identify whether change in certain parameters gives an early warning of neighbourhood decline (Blackman, 1995). In one neighbourhood, long-standing tenants terminating their tenancy was found to work as an early warning indicator but in other neighbourhoods there was no such pattern. What is apparent from this is that neighbourhood systems encompass a range of initial conditions which makes prediction of future trajectories very difficult.

Initial conditions at neighbourhood level are important and justify locally-based initiatives, but wider system parameters must also be within the frame for urban policy to work. For example, small area

and individual level studies are likely to demonstrate that variables such as low education, ethnicity, age or interview technique predict risk of unemployment, regardless of the actual level of unemployment (Davey Smith, Ebrahim and Frankel, 2001). Intervention at these levels could seek to improve educational achievement or interview skills. These individual characteristics, however, are only relevant insofar as they interact with a wider system parameter, the unemployment level. At population level, individual factors are not likely to be important determinants of unemployment because what matters is the *level* of unemployment. The point is also demonstrated in a study by Mitchell, Dorling and Shaw (2000). This uses statistical models to show how inequalities between English parliamentary constituencies in a number of health indicators narrow when certain system parameters are changed (a redistribution of wealth; full employment; and eradication of child poverty). Changing these parameter values – a re-tuning of the policy landscape – is likely to be more effective in improving public health across deprived areas than area-based initiatives.

An interesting feature of the Mitchell, Dorling and Shaw (2000) study is that health indicators in certain constituencies did not change to the extent that would be expected on the basis of their linear statistical models. Other studies have found that the relationship between health and deprivation is far from uniform across localities (Congdon, 1995). There are important local contextual effects which mean that attention must be paid to local systems and their initial conditions as well as to landscapes. Pawson and Tilley's (1997) programme evaluation methodology places great emphasis on local contextual effects and argues for research designs of the type Context + Intervention = Outcome. From a complexity perspective, however, it is not valid to isolate specific outcomes from a context in a situation where there is a set of highly interdependent variables evolving over time (Stroup, 1997). A complexity formulation would instead be Initial System State + Input = New System State, with the idea that a system may shift from one attractor to another as a result of an input of resources which alters all key parameter values. If employment rises, a neighbourhood may continue to decline because its housing is unpopular. It is necessary to act on all the key elements of the local system to shift it to a new attractor.

The extent to which system behaviour is chaotic, moves towards a steady state or enters a limit cycle depends on key parameter values and the way they feed back into the system's iterative processes. The relationship between feedback and the self-organisation which follows produces an emergent structure (Stroup, 1997). Structure arises dynamically from agents' patterns of common or coordinated responses to given conditions, repeated over time. It has been suggested that one of the reasons why systems succeed in adapting to new landscapes, produced by either environmental change or change in the behaviour of other organisations, is that there is some redundancy in the system, an observation generalised from research on biological systems (Kauffman, 1995). Redundancy in this sense is the availability of spare or reserve resources within the system that enable multiple strategies to be developed and deployed as necessary, often on a trial-and-error basis as options are explored either through feedback or scenario exercises (Elliott and Kiel, 1997). Following Stonier (1992), options that work are ones that enhance the survivability or reproducibility of the system, or enhance the achievement of pre-defined goals. The system locks into these options because feedback reinforces their efficacy, new iterations occur and system structure changes.

However, there is much more to successful organisational behaviour than this. Two other important aspects derived from complexity theory are *memory* and the capacity to learn from past behaviour, and *representation* or the ability to make associations and identify patterns and their meanings (Cilliers, 1998). There are obvious echoes here with the management concept of a 'learning organisation'.

Sanderson (2000), in his discussion of evaluation in complex policy systems, draws on Habermas to argue that organisational learning requires communicative competence, or 'open discussion and argumentation free from "distortions" due to the coercive exercise of power and ideology' (p. 451). An interesting question is how memory, representation and communication work together to achieve a successful organisation, and complexity theory again offers a concept that may help. Complex systems have been found to display *fractals*, or patterns of similar relationships which repeat at multiple scales. Such repetition would, for example, be important in ensuring that an organisation can benefit from coherence between individual learning, group level learning and organisational level

learning (Morel and Ramanujam, 1999). The concept also captures the strategic management idea of 'alignment' between the values and purposes of the organisation and those of its employees.

Complexity and democracy

Complexity theory provides new tools to think with in public policy and points to some key problems with new public management thinking. The main problem is its anti-democratic tendency. This threatens to undermine the improved performance that the new public management seeks to realise.

According to Cilliers (1998), a complex system is a system of inter-relationships between nodes, with the nodes deriving their significance not as atomistic units but as products of the particular inter-relationships embodied at each node. This is how complexity theory has been associated with democracy. As far as accepting the need for regular monitoring of important outcomes so that problems can be identified, complexity theory and the new public management have common cause. But the new public management has tended to see the results fed back within a coercive and hierarchical audit culture. In contrast, feedback in complex systems goes directly to the elements running relevant parts of the system and problems are explored openly rather than in an atmosphere of blame and sanction. Fitz-Gibbon (1996, p. 50) argues that one of the implications of the unpredictability of complex systems and the need for local organisation is that:

> 'The people involved in running the system are the people best placed to improve it – constantly – since they may often be best placed for problem location and have the greatest amount of information relevant to the problem, information above and beyond that provided by the monitoring.'

This is a scientific as well as a democratic approach to policy. It chimes with Habermas' communicative rationality and Dryzek's discursive democracy, as well as with Emirbayer's 'manifesto for a relational sociology' (Habermas, 1979; Dryzek, 1990; Emirbayer, 1997). Emirbayer's relational sociology also argues for the importance of relations rather than entities, and suggests that the best resolutions of problem-situations occur 'in an ideal mode of mutual engagement or transaction' that:

> '… entails a free and open communication of actors in a universal community, a relational matrix within which both cooperation and conflict are rationally regulated. This 'mode of associated living' – in a word, democracy – embodies moral intelligence on a transpersonal scale; it involves 'conjoint communicated experience' in which practical reasoning is undertaken in common, through enquiry into moral and political problems on the model of an experimental science' (Emirbayer, 1997, p. 310).

A complex system is a 'conjoint communicated experience' but this is, crucially, experience of the external landscape as well as the internal environment. This experience needs to be shared across the organisation, as does the learning and control necessary to adapt to external trends. Cilliers' (1998, p. 110) general observation seems particularly relevant to this issue:

> 'The system will waste its resources trying to follow every fluctuation instead of adapting to higher-order trends. Being able to discriminate between changes that should be followed and changes that should be resisted is vital to the survival of any organisation (or organism). This is achieved optimally when the control of the system is not rigid and localised, but distributed over the system, ensuring that the positive dynamics of self-organisation is utilised effectively.'

For a self-organising system, scanning the external environment is at least as important as internally-focused performance indicators. Interaction between environmental conditions and internal states is especially important, such as the effects of mortgage interest rates on the sustainability of neighbourhoods of social rented housing. Interaction between service providers and service users is

also of great relevance to a public services organisation where results are co-produced by its internal resources and the resources of its users.

Above all, organisations need to have the autonomy to initiate innovation rather than be constrained by pre-defined performance targets. This is increasingly being revealed by studies of performance management (Newman, Raine and Skelcher, 2001). Working with the self-organisational capacity of local systems acknowledges local agency and democratic participation. Prescribed performance indicators, such as those recently defined for neighbourhood renewal, leave little room for local debate and decision about what to prioritise and how (Social Exclusion Unit, 2001). Indicators are still needed to trace, anticipate and intervene in organisational or neighbourhood trajectories, but they are needed alongside indicators that track the big picture as well. This extends beyond what is happening to what is possible: to tuning the fitness landscape and exploring future system states and how to get there. For example, is the fitness landscape tuned to a level of inequality that makes deprivation for many neighbourhoods or underachievement for many organisations inevitable? By mapping the range of attractors in a phase space, political debate and action can refer not only to local system conditions but also to the wider systems that set limits and define futures at local level. These are as much a target for action and change as the local system. Thus, Byrne (1998, p. 147) discusses the use of feedback to guide urban policy-making – in particular, the possibility for democratic participation in shaping urban futures, informed by data on trends and modelling of alternative outcomes. This feed-forward from local systems to wider systems can change the state of these larger systems, a process called second-order emergence in complexity theory (Gilbert, 1995). The British welfare state is itself a prime example.

Complexity theory does not deny the need for monitoring performance. But it goes beyond the confines of new public management by recognising public services organisations as complex systems within policy landscapes. The efficacy of complex systems in public policy depends on their communicative and democratic capacity to use monitoring information rather than on the imposed targets and managerial control typical of the new audit culture. Complexity thinking also encourages an outward-looking perspective. It brings into the frame the environment as well as the system, and looks for solutions in new landscapes as well as reforming old systems.

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About the author

Tim Blackman started his academic career at the University of Ulster in 1982 after completing a PhD at Durham University and spending a year as a community worker in Belfast. As a Lecturer in Social Policy he worked on housing, planning and public health issues, moving in 1990 to Newcastle City Council where he was Head of Research for five years. He first encountered complexity theory in Newcastle through working with Professor Carol Fitz-Gibbon on a research project about educational achievement and later through Dave Byrne, his PhD supervisor. He moved back into higher education in 1995 as Deputy Head of the School of Social Sciences and Law at Oxford Brookes University, where he also co-directed the Oxford Dementia Centre. In 2000, Tim was appointed Professor of Sociology and Social Policy and Director of the School of Social Sciences at the University of Teesside.

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