

Guest Editorial

The Politics of Innovation for Environmental Sustainability: Celebrating the Contribution of Stewart Russell (1955–2011)

The focus of this special issue is on the politics of innovation for environmental sustainability. Environmental sustainability is a key issue facing society. It has become a central concern for many involved in science and technology studies (STS) who have sought to understand the form and direction of sociotechnical innovations, their implications for environmental problems and their remediation. Studies in this area require broad consideration of how people live and work, rather than taking as their starting point a particular area of scientific or technical innovation. By highlighting the politics of innovation we wished to particularly encourage contributions i) which situated sociotechnical changes in their historical context and current institutions and practices, and, coupled to this, ii) which considered the scope for influence and engagement by individual and collective actors. We were interested in exploring the type and extent of such politics and their impact on our sociotechnical systems and their environmental consequences. In an area which is dominated by high level policy announcements, which rarely deliver what they promise, and grassroots initiatives which, while often inspiring, frequently fail to transfer to other locations

or ‘scale up’, this political understanding of sociotechnical change is of critical importance.

The stimulus for this special issue was a symposium held at the University of Edinburgh in March 2012 to celebrate the contribution of Stewart Russell, who died in 2011 to STS (see annex for a brief biography). The one-day workshop attracted a diverse international community of colleagues who had worked with Stewart and had been influenced by his activities and his ideas. Some of the papers published in this special issue were originally presented at this event; others have arisen from a wider call for papers. The theme reflects Stewart Russell’s theoretical contributions to STS with their stress on a distinctive political approach which recognises structural constraints while exploring opportunities for action. It also reflects something of his broad empirical focus on environmental sustainability (including studies on cogeneration and district heating; renewable energy and electricity markets; water recycling and management and local energy planning). His work was also political in sense of having a deep concern for how a transition to more sustainable systems of production and consumption might be achieved.

Stewart Russell was one of a generation of scholars who moved from science and engineering to the newly emerging field of science, technology and innovation studies at the beginning of the 1980s. He

undertook postgraduate study at one of the early UK STS centres, the Technology Policy Unit (TPU) at Aston University. It was there he completed a MSc dissertation on *Autonomy, Determinism, Imperatives: A Review of thought on the loss of social control of technology* in 1980 and a doctorate on *The Political Shaping of Energy Technology* in 1986, followed by his first post-doctoral appointment.

The core concerns of his agenda for the politics of technology were shaped by a combination of research and political action which was a distinguishing feature of 1960s and '70s radicalism. This elicited an unusually broad interest in the social role of ideas on technology, progress and risk ranging from contributions to academic debates around elaborated and explicit theory through to engagement with everyday discourse and public debates. The ambition of this was further magnified by an acute awareness that relevant theories spilled over conventional boundaries and embraced not only the emerging field of STS, but also wider swathes of social and historical knowledge. The field of interest therefore had a breadth of engagement across

explicit theoretical writing on the social effects of technology, the way technology is treated in social science disciplines like economics and sociology, the way it is presented in history books, numerous prophecies of our future way of life, the way it is depicted in the media, the general attitude into which people are conditioned to think of it (Russell, 1981: 2).

The motivation for such an endeavour was “not only for the intrinsic value of understanding how technologies are developed” but to reveal how prevailing theories of technology “can legitimate

decisions, policies, actions and [...] obscure the real workings behind them” (Russell, 1981: 2). Political writings from the 1970s and studies from the ‘alternative’ and ‘appropriate’ technology movements (e.g. Illich, 1973; Dickson, 1974; Boyle & Harper, 1976) were also important to this project in showing potential different paths for technology.

Structure and Agency – Interest in Multi-Level Approaches

Thus the first broad element of Russell’s approach to the politics of innovation was to stress a need to be interested in patterns of power and influence across society as a whole, as well as to explore how individual and collective actors sustain or seek to change such power relations. This involved engagement with a wide range of social theorists concerned with structure / agency debates and with analysing power. Russell (1986a) develops principles which give considerable weight to structural features, while paying attention to the ways in which these are maintained by and potentially disrupted by actors. This leads him to “to view social systems as in a continuous process of construction, maintenance and change, even though specific institutions may be deeply rooted and relatively stable” and “to explore the connections between levels of social structure and areas of activity as parts of a total social formation, even though each has partial autonomy” (Russell, 1986a: 58).

These analytical concerns put Russell at the heart of debates as the field of technology studies became established as a domain of systematic study in the early 1980s. Here, he engaged critically with colleagues from the self-proclaimed ‘new sociology of technology’ who sought to apply tools from the sociology of science to the analysis of technological change (Pinch

& Bijker, 1984; Bijker et al., 1987). Their analysis focuses upon readily observable interaction between directly and recently involved actors or 'Relevant Social Groups' (Pinch & Bijker, 1984). Russell criticises the individualistic paradigm that "leads them to treat actors as if they come to the interactions studied somehow free from their past histories, free from preconceived objectives, free from constraints other than those imposed by other groups involved" (Russell & Williams, 1988: 4). Such a perspective (as amply exemplified by Latour's [1988] concept of *Sartrean engineers*) has difficulties in addressing the constraining effects of pre-existing structures, and, for example, overlooks the differences between individual and collective actors (Russell & Williams, 1988: 4). Early Actor Network Theory writings were remorselessly sceptical towards existing social science theory (which is sometimes portrayed as presuming that outcomes can simply be read off from structural influences/interests) (e.g. Callon & Latour, 1981; Latour, 1988). Though expressing opposition to such mechanistic readings of structural influences, as we see below, Russell argued that this analytical move exposed them to well-rehearsed social scientific criticisms of empiricism and behaviourist approaches to power – leaving researchers poorly equipped to address absences, marginalisation and the suppression of alternatives and other "socially constructed constraints on choice" (Russell & Williams, 1988: 2). Russell particularly highlighted the risks that actor-centred and other 'micro-sociological' approaches, which focused upon local interaction and its role in constituting social relations and technologies, tended to overlook differences between groups of actors in access to knowledge and resources – differences which were rooted in broader social and economic

structures – that conditioned their ability to be actors (Russell, 1986b; Russell & Williams, 1988). The 'flat ontologies' and simple methodologies of these approaches, with simple nostrums such as 'follow the actor' (Latour, 1987), left unanswered methodological questions about the choice of which actors to follow. Rather than counterpose local action and structural constraints, Russell's distinctive position argued that different modes of analysis were needed to examine immediate settings of action and the longer term patterning across multiple sites arising, for example, from entrenched institutional relations.

Russell later consolidated this theoretical contribution to what became known as the social shaping of technology as part of a European study group coordinated at the University of Edinburgh. This sought to systematise scholarship in the field and review what achievements had been made in the first decades of technology studies. Through a systematic review of analytical developments, Russell and Williams (2002a) drew attention to the extraordinary conceptual dynamism of the field, alongside a rich and growing body of empirical studies.

From this viewpoint, the 1980s controversies seemed indeed to have been a source of 'subsequent creative tension,' as Williams and Edge (1996) had anticipated. There were various attempts to find resolutions to conceptual dichotomies that had surfaced in those debates around a number of key axes, including: agency and structural influences, and fluidity and stability in sociotechnical forms. This led to some elements of convergence in the field between approaches that sought to integrate explanation across different timeframes and levels and between short-term local and broader long-term shaping processes (Russell & Williams, 2002a). In the course of this collective endeavour, a

more complex and intricate understanding had emerged of an innovation process characterised not only by potential speed and global reach but also by enormous uncertainty and unpredictability (Russell & Williams, 2002b).

This more intricate understanding of the dynamics of sociotechnical development also helped to identify a wider range of possible sites and mechanisms for public and policy intervention. This included recognition of the wider range of sites and actors involved in innovation including, for example, contexts of consumption and appropriation as well as of technology supply. Particularly in the area of information technology, but increasingly elsewhere (and today including energy, see Silvast et al., 2013), he noted the emergence of different forms of technology, differing in arrangements for its production and consumption (as exemplified then by Fleck's [1993] distinction between configurational and systems technologies, but now widely evidenced e.g. by various forms of 'open' innovation). Today, we find increasingly elaborate innovation processes, distributed across an ever-widening range of settings and players. This draws our attention to mechanisms for inter-mediation - enabling more reflexive mutual governance and knowledge exchange - between chains of heterogeneous actors who differ in their knowledge, expectations and commitments (Russell & Williams, 2002a). In such situations other kinds of intervention strategies may come to the fore, involving "modulation and orchestration of the existing dynamics of innovation or technology management" (Russell & Williams, 2002b: 145) in addition to/in place of traditional top-down public intervention strategies.

One of the most significant developments has been the tradition of work that has subsequently achieved wide recognition as

the Multi-Level Perspective (Rip & Schot, 2002). This work has had a dual role in both enabling effective analysis and also in highlighting opportunities for political intervention - most immediately in relation to managing the transition to environmental sustainability (Geels, 2011). Russell saw this as exemplifying a broader set of analytical moves that would be needed to produce an adequate understanding of technological change. What was at stake was first a broader view of technology as a heterogeneous assemblage involving visions and practices and a dispersed array of actors as well as artefacts. Studying this in turn called for methodologies and frameworks for engaging with "a wider conception of relevant actors and of the terrain of transformation" not necessarily centred around particular artefacts or actors, but allowing "examination of multiple related strands of development" and activities (Russell & Williams, 2002a: 71). This call can be seen as a precursor of current discussions of the benefits of multi-local, longitudinal 'biographies' of artefacts and practices. Finally Russell pointed to the benefits of integrating historical and sociological/anthropological enquiry, and also drawing upon a broader range of analytical traditions, including studies on innovation and on technology policy and regulation arising from innovation studies, evolutionary economics and policy studies.

A Commitment to a Diversity and Plurality of Approaches

A second element of Russell's approach, which flows from the first, was a commitment to a diversity and plurality of inputs. His sympathies in the 1980s were with Marxist approaches but he was very critical of the direction that many accounts from this perspective had taken.

Technology studies emerged initially through a critical engagement with the ‘technological determinism’ of prevalent accounts of technological change. These accounts took the trajectory of technical advance as a self-evident process, not amenable to social scientific enquiry, but instead imputed to the technical or commercial superiority of a new technology over its predecessors. Here Russell made a distinctive contribution. Thus an early object of attention was the “single-path idea of progress, a prevalent and influential assumption” (Russell, 1980: 93), which might more commonly be described today as the ‘linear model of innovation’. The ‘single path’ concept was located as a specific and politically influential manifestation of a diverse body of thought proposing the autonomy, determinism or imperatives of technology (Russell, 1980). This prevailing view of technology, which Russell labelled as ‘technicism’, was one in which technology was seen as “self generating, self directing, and the main determinant of social patterns and change” (Russell, 1981: 6). Under this ‘technology-out-of-control’ thesis, technology is regarded as

autonomous, independent, the product of a sphere of activity outside social influence. It develops according to its own logic; it has its own internal dynamic. Human choice plays a limited role; we can at best perhaps speed it up or slow it down. [...] Metaphor somehow assumes the role of explanation: momentum, acceleration, force, speed, inertia, thrust. Technology takes on its own plausible dynamics. (Russell, 1981: 3.)

Russell had no doubt that this was “an inherently conservative view” primarily because it “rules out significant intervention

and conscious redirection”. Apart from this political essence it was also inadequate analytically in that it obscured both the ‘process’ of technological development and its ‘purposes’ regarding motives and interests (Russell, 1981: 6). In his response he contributed to the general critique, through which the field of technology studies emerged in the 1980s, of the technological determinism of prevailing accounts of technological change.

Russell’s STS starting point was Langdon Winner’s *Autonomous Technology* (1977) which introduced the notion of a specific form of ‘technological politics’. While finding this ‘conceptually appealing’ he was critical of two particular aspects: first the reliance on “technical imperatives” which led to a lack of attention to “differing expectations” and social conflicts, and second the emphasis on large “megatechnical systems” which he felt was too limited in its scope and oversimplified the continuing diversity of technologies (Russell, 1980: 83–84). While he was persuaded of the need for specific attention to the ‘technological’ dimension of politics, he continued to hold the view that human agency and social action, with different interests and intentions, remained fundamental (Russell, 1980: 84). Rather than treating the technological system as an “inseparable whole” it was “difficult but essential to disentangle social and technical components” (Russell, 1980: 83, 95).

This also led him to question the limitations of both a very narrow “simplistic attention to hardware” or an overbroad “danger of including so much as to render technology useless as a working concept”. His sympathies were with a middle range approach of “fairly discrete, if interconnected and mutually reliant, technical systems, of the hardware, information, organisation and techniques associated with a specific product or purpose” (Russell, 1980: 12). Technology

was not an “indivisible package” and included “knowledge” abilities and potentials, as well “manifestations” through application (Russell, 1980: 12).

He argued therefore that a useful framework was required to focus on the relationship between both the social and technical. If one dimension was given priority then the outcome would be unsatisfactory:

[A]ny theory which takes technology as its starting point is in danger of obscuring the human intention behind it. The very act of conceptually abstracting technology tends to sever social links or mask its social content. (Russell, 1980: 97.)

Here and in his later work, Russell sought to address both the forces leading to the entrenchment of particular technologies and the suppression of alternatives, and also the factors that might open up the scope for choice and for political intervention. At that time the tools for analysing these challenges were not well developed (whether the pessimism of the technology-out-of-control thesis, or the naïve voluntarism of critical projects for appropriate or human-centred technologies). He sought a more nuanced understanding drawing upon a range of intellectual traditions including neo-institutional theories, Gramsci’s theories of alliances and work on routines and practices to propose a broadly Marxist approach that seeks to explain both stability and dynamism, and how these are shaped by local contingencies and broader historical settings. From this, his work offers a set of principles and guidelines for analysing change as unfolding at various partially autonomous levels, and proposes theoretical tools for analysing specific arrangements/outcomes and the linkages between different levels of analysis.

Here Russell had embarked upon an ambitious intellectual project. He wrote that his goal was

to eschew the notion of a general theory and instead provide the theoretical tools with which specific social arrangements and phenomena can be analysed (Russell, 1986a: 58).

To provide scope for exploring his interests in structure and agency in understanding both change and continuity, he developed a methodology whose aim was to

identify, locate and characterise the collective actors in the sector, trace the network of relations between them and their connections outside, and situate the sector, all with reference to a general substantive model of the whole social formation (Russell, 1986a: 103).

This often required a historical analysis since the aim was to understand how structures had been stabilised or disrupted by actions of various parties. He stressed the need to “trace the historical development [...] in terms of internal dynamics and effects of change in the wider society” (Russell, 1986a: 103). He argued that change was more likely to happen in some historical moments than others, and hence that such an analysis could provide the opportunity to

acknowledge the presence of contradictions – the more or less temporary coexistence of incompatible or inconsistent features of various types – throughout social systems, within and between levels of structure and spheres of activity, and created, recreated, transcended or exacerbated by action [...] [and] to view change as produced by these contradictions, providing incentive, scope and

constraints for action against the existing order; and to expect that change rather than forming a smooth process, to be punctuated by crises. (Russell, 1986a: 58.)

Focus of Empirical Work on Contestation

Russell's commitment to the social goal of environmental sustainability, and his concern to understand the politics through which this had been progressed or frustrated led him to argue that empirical work in STS should focus on contestations over the direction of technological developments. Through his emphasis on the interplay between structural constraints and the actions of actors he argued that there were particular moments when the opportunities for change were greater than others. Through his doctoral work on the limited take up of combined heat and power and district heating in the UK, he was as interested not only in those trying to achieve change, but also in the power of established interests to frustrate change. As such he mapped out a methodology for studying specific interactions, involving tracing the historical trajectory leading the parties to interact, and understanding their interests as derived from their location in relation to the potential outcomes. These interests could then be considered in terms of how they were represented in objectives and policies, and through the internal and inter-organisational procedures by which they are generated (Russell, 1986a). He then argued it would be possible to

identify the structural elements drawn on by actors in the process of interaction, looking for economic, political and ideological components, and considering the different modes of their mobilisation: in devising conscious strate-

gies and tactics, in following accepted procedures, in acting within existing constraints, in attempting to challenge them (Russell, 1986a: 103).

He stressed that this was an analytical device rather than a 'formula' which could generate outcomes from interests and structures. He wrote,

there is no simple correspondence between interests, objectives, strategies, actions and outcomes. Each process whereby outcomes are produced in interaction needs to be *reconstructed* and *argued*. There can be no 'reading off' and comparison of capabilities and resources from social structure to arrive at a predictable outcome. (Russell, 1986a: 105, his emphasis.)

In his work on the limited take-up of combined heat and power and district heating in the UK from the interwar period up to the mid-1970s, he stressed the extent to which many aspects of the energy system were 'black boxed' by most commentators – that is their structure and approach had a taken-for-granted character. In particular his strong commitment to historically and institutionally informed analysis of energy led him to stress the extent to which producer interests and perspectives dominated the debates. He wrote:

the energy sector [...] must be situated in the organisational and technical development of the key institutions [...]. These characteristics and relations must in turn be linked to the specific character of the [...] economy and state. (Russell, 1993: 43.)

Such an analysis, he argued, showed that

much energy politics [...] [consists of] interests organised around production

[...] and relations between these as regulated by the state [...]. Producer interests have generally sought to consolidate and maintain the structure of the sector. (Russell, 1993: 43.)

This overall argument about ‘black boxing’ energy analysis might seem less true today. We now have a more detailed body of empirical research (including in this journal) – engaging in far more depth than early studies were able to achieve with various settings of innovation and decision in the energy sector. This arguably allows better understanding of the dynamics of the sector as well as of opportunities to modulate these dynamics. The energy system has by no means stood still in this period – indeed, in the UK and beyond it has been radically reworked. This includes, notably, the turn towards the creation of novel market mechanisms as a means of governing investment, generation and (with the recent shifts towards ‘smart’ meters and grids) consumption – a move in which unpredicted outcomes have stimulated further reflection and reworking.

Some of these issues were discussed in the recent Special Edition of Science & Technology Studies on ‘Energy Systems and Infrastructures in Society’ (Silvast et al., 2013). That this special edition needed to be published as three parts [26(3), 27 (1 and 2)] is indicative of the rich vein of studies as STS provides tools for analysing energy and environment challenges. Energy policy continues to be the subject of extensive debate and the issue of what parts of the system are being opened up is still very relevant. It could still however be argued that the ‘black box’ is only being selectively opened up with some parts left unexamined, or being given only secondary consideration. In reflecting on this it is also worth considering whether our current dominant theories for understanding

sustainable innovation (most notably transitions theory and technological innovations systems theory) provide only selective and partial readings of energy innovation (Winskel & Radcliffe, 2014).

Articles in This First Part of the Special Edition

A focus on heat provides a very distinct perspective on energy issues and, in particular, highlights consumer interests in a way absent from many debates. After moving away from the study of combined heat and power and district heating for many years, Russell had returned to this problem shortly before he became ill as part of a research project *Heat and the City* (www.heatandthecity.org.uk). It is fitting therefore that the first part of this special issue has three papers on this topic, including two arising from this empirical project.

We start with an article by Weber that includes a substantive analysis of Russell’s theoretical approach to understanding sociotechnical change. Weber focuses on Russell’s rich theoretical approach and its distinctive position from the, then, more accepted micro-sociological approaches. Since this was never fully articulated as an integrated theoretical approach, Weber brings together its strands and, through this, argues that Russell’s approach can be seen as a precursor of much recent interest by science and technology studies in multi-level approaches. Weber goes on to assess the utility of this perspective to understanding the finding that three countries, apparently in similar situations for example in relation to their climates and historical and political trajectories, have very different levels and types of combined heat and power (CHP) adoption, and that this adoption occurred during different historical periods. This problem

is in the spirit of Russell's approach, with its analysis of the reasons for stasis as well as change, and in particular how certain policy options become excluded. But, as importantly, the analysis highlights the significance of historical moments when it appeared there were opportunities to break with existing path dependencies and other structural factors, and considers the role of political interventions which were more or less effective in allowing such opportunities to be realised. Weber provides a nuanced analysis of both the reasons why change in complex systems is so difficult to achieve, and a non-deterministic account of the way in which combinations of 'structural' change and political interventions can provide opportunities to disrupt path dependencies.

The other two papers focus on the situation in the UK and on the current and future prospects for forms of district heating in the UK. They both draw on detailed work with local authorities currently attempting to implement urban heat networks. As such, both papers move from the country level account of Weber's analysis to explore in greater detail the ways in which policy, cultural and organisational issues shape the opportunities for changing heating system. Most significantly this level of analysis allows an exploration of the ways in which practitioners attempt to counter dominant heating approaches and find their projects shaped by them. Webb's paper focuses on the ways in which innovative financial models, through which new urban heating projects have to be justified, make it difficult to make a 'business case,' despite a favourable environmental assessment. Weber highlights the liberalisation of energy markets as one of the disruptive movements when the case for CHP / district heating might be remade, and when indeed a rapid uptake was seen in the Netherlands. But as well as disrupting embedded institutional

structures, liberalisation and privatisation were associated with changes in the way in which financial risks and benefits were assessed and, in some cases, particular technical choices were encouraged. Drawing on the sociology of markets and social studies of finance, Webb's paper explains why the financial innovations that emerged in the UK have been hostile to urban heat networks. However, through detailed work with practitioners she is also able to point to ways in which some individuals find ways to challenge these constraints through, for example, novel ownership or governance models.

Hawkey's paper starts from a recent UK policy commitment to achieve a radical change in heating provision in favour of district heating. Noting that such attempts to change direction had been made in the past (as analysed by Russell) he asks whether the current policy is being pursued in a way that addresses the reasons for past failures. His particular concerns are with governance issues and regulatory approaches which seem likely to undermine the intentions of national level policy yet again. The paper details the ways in which local government bodies attempting to implement national policy commitments are frustrated by continuing restrictions on their competencies, and by the ways in which the ending of a monopoly nationalised industry has failed to disrupt a centralised system of generation or a separation of producer and consumer interests. Thus a vicious circle is again apparent, consisting of attempted projects constrained in scope or by assessment criteria which are only able to achieve a limited impact, which is then used to undermine the policy ambitions which promoted them. He looks to devolved powers to the constituent parts of the UK as potentially able to provide the political leadership to break this cycle.

Thus all three papers in their distinctive ways take forward the theoretical and analytical approaches which were initiated by Stewart Russell, and in particular his concern to understand the difficulties in adopting a technology which, though environmentally beneficial, proved challenging for a number of linked reasons – the scale and capital costs of a large-scale fixed infrastructure, and its compatibility with wider sets of assessment criteria and institutional arrangements.

The next part of this special issue, to appear in 2015, will explore some of the wider challenges posed by Stewart Russell's work, particularly regarding the transition to an environmentally sustainable society.

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Editorial written by the guest editors with Fred Steward, professor of Innovation and Sustainability Policy Studies Institute, Westminster University, and President of the European Association for the Study of Science and Technology (EASST).

Appendix:

Brief biography of Stewart Russell (6th August 1955–17th September 2011)

After completing a Natural Sciences degree at the University of Cambridge (UK), Stewart Russell moved to the Technology Policy Unit, Aston University (1980–1986) for his postgraduate studies and some post-doctoral work.

From 1988 to 2006, he was Lecturer and later Senior Lecturer in Science, Technology and Society at the University of Wollongong, New South Wales, Australia. There he was a member at various times of UoW's Research Programme in Science and Technology Analysis, Science and Technology Policy Research Group, Technology and Environmental Strategies Group, Environment Research Institute, Institute for Social Change and Critical Inquiry, Centre for Research Policy and Innovation Studies, and the Centre for Asia Pacific Transformation Studies.

Stewart Russell joined the University of Edinburgh in 2006 as Deputy Director of the Research Centre for Social Sciences. He helped to build the interdisciplinary research programmes

of the Institute for the Study of Science, Technology and Innovation. His sustained efforts, particularly in developing joint postgraduate programmes with the Science Studies Unit, paved the way for the establishment of the Science, Technology and Innovation Studies subject group.

As well as his important contribution to the development of the field of Science and Technology Studies (STS) over many years, outlined above, Stewart was tireless in his support for colleagues in their work – always available for students wanting to explore some knotty analytical question. He was keen to build links between STS and other scholarly communities and with wider audiences. At Edinburgh, for example, he developed an innovative *Understanding Technology* public lecture series with the National Museum of Scotland.

The Institute for the Study of Science, Technology and Innovation has established a fund to create a studentship to commemorate Stewart's commitment and passion in helping students achieve their full potential and to carry forward scholarship in this area. Further details can be found at: www.stis.ed.ac.uk/news/2013/the_dr_stewart_russell_student_award_fund.