Session 5 Science in its social landscape

Matthew Harvey

A popular cliché tells us that science does not work in a vacuum. What is all the other stuff that populates the world that science operates in? More particularly, which aspects of this landscape support science, slow it down, allow it to happen, rival it, challenge it, champion it, govern it? How do scientists, as individuals and a community, operate in this setting? How does science travel around the land, and how do innovations make there way across the scene?

To begin to explore these and other questions, sketch out the geography of your scientific research. You might like to follow the step-by-step approach outlined in the box below. Follow each path of your map as far as you can, and look for inter-links between your nodes.

Activity 1

Mapping the landscape of science:

1. Consider the problem you are trying to solve/the technology you are developing/the theory you are working on/ the intervention you are trying to introduce. Make that the centre of the map
2. Map the hardware needed to support your work
3. Map the actors and structures that do/that would enable your solution to succeed/prevail (by enable, think those that support it, but also those that may licence or legitimise it)
4. Map the actors and structures that act as bottlenecks or which slow down or inhibit your progress
5. Map the people/groups who you intend to affect
6. Map any remaining people/groups who, a) do or try to impact on your science, and b) who are or should be interested (for whatever reason) in your science (this might include your rivals!)

This network map can be used to make some basic observations about the social and political life of science. As a start, consider the questions in the box below.

Activity 2

Some observations to make:

1. Are there non-intended groups affected by your work?
2. Does the presentation of your problem definition/proposed solution change with respect to different actors in the network? Imagine, for example, you were discussing your work with these different actors. How would you present it?
3. At what points in the network are the following either stressed or suppressed:
    - Expectation (of success)

- o Uncertainty

4. Are there any parts of your map that are *absolutely a requirement* of the very existence of your science/technology? In other words, are there nodes that exist only because of the type of work you are involved in?

Social scientists are interested in myriad aspects of the social side of science and technology. Your network map can be used to think through some of their observations, including thoughts on:

- networks
- stakeholders and science and technology policy
- expectations, vision and hype
- certainty and uncertainty

1. Networks

Perhaps the most basic observation is that things could have been (or could still be) different. There is little about the internal logic or essential nature of a theory, technology or other intervention that determines whether it prospers or dies. This seems contrary to our usual understanding that better technologies displace poorer ones, better or more accurate scientific theories, explanations and interventions replace flawed ones. This is certainly part of the story, but far from all of it.

To explain the contrary view, one form of social science theory starts with the observation that science and technology are embedded in a social and technical network. This is the map you sketched and it shows a depth of history, politics and social negotiation, as well as technical accomplishment and knowledge. It seems that the introduction of a technology or intervention needs the *formation* of a *stable* network of humans and non-humans. These actors are of a wide and varied nature and generating the network in the first place, and then holding it stable is a significant challenge (see case study below).

Networks emerge during the innovation process, and social scientists have attempted to describe and explain this process. Four approaches are described in an article by Benjamin Sovacool (2006). One of these – actor network theory (ANT), associated most closely with Frenchman Bruno Latour and Michel Callon – defines the processes and steps by which networks form. ANT is described in the Sovacool paper, and the emergence of an actor network is described by Barbara Czarniawska here using the story of the Wizard of Oz (the entire talk is quite technical and for a social science audience – the Wizard appears near the start).[1]

Case study: Building and stabilising networks – cytoplasmic hybrid embryos

The ability to produce embryos from the fusion of an enucleated animal egg (usually cow or rabbit) with a nucleus from a human cell seems first to have been demonstrated in the late

[1] http://www.lse.ac.uk/collections/informationSystems/newsAndEvents/2006events/Czarniawska.htm

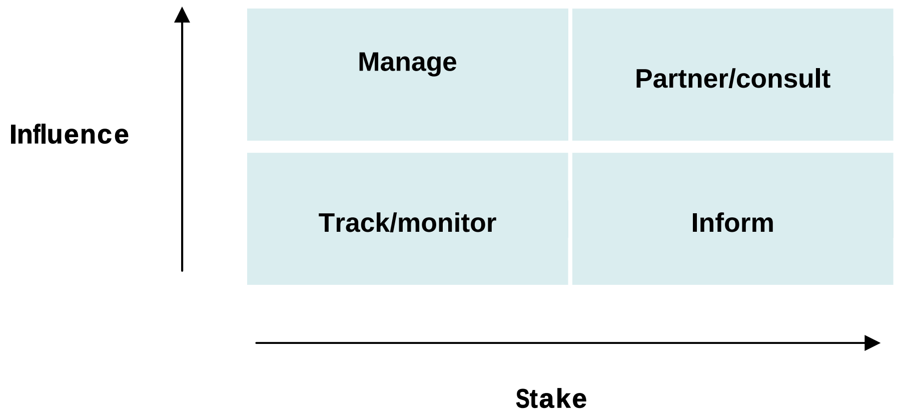
1990's (http://news.bbc.co.uk/1/hi/sci/tech/371378.stm), although the first widely accepted demonstration waited until 2003 (http://www.cell-research.com/20034/251.htm; http://www.nature.com/nature/journal/v424/n6950/full/424711a.html). Cytoplasmic hybrid embryos can overcome two limiting factors on the success of stem cell therapies: rejection by the human immune system (overcome because stem cells will, effectively, be derived from a clone embryo) and the short supply of human eggs. British scientists were initially excited by the technique (http://www.guardian.co.uk/science/2006/jan/13/medicalresearch.stemcells) and the first license applications arrived at the Human Fertilisation and Embryology Authority (HFEA) late 2006. However, the HFEA were not sure that they could licence the work, let alone whether they should, and stalled a decision pending consultation. More trouble came in May 2007 when the draft Human Tissue and Embryos Bill, published by the Government that month, looked to prohibit the creation of cytoplasmic hybrid embryos. The scientific establishment and others quickly built alliances and mobilised resources to campaign against prohibition. Public interventions included a letter to The Times signed by, amongst others, three Nobel prize winners and the President of the Royal Society (http://www.timesonline.co.uk/tol/news/article1291238.ece), and submissions to various Government committees and consultations. Some of the Royal Society's interventions can be viewed here: http://royalsociety.org/landing.asp?id=1202. Meanwhile, the HFEA consulted legal experts and ran a public consultation (http://www.hfea.gov.uk/en/1517.html), and the Houses of Lords and Commons set up a joint committee to scrutinise the bill. Each actor in the emerging network came to the same conclusion: that there should be no prohibition. So in January 2008 the HFEA granted licenses to Kings College London and Newcastle to undertake research using human-animal cytoplasmic hybrids, and the Government relaxed its position on prohibition. With proof of technique, a (mostly) clear regulatory frame and other key actors aligned, the network is in place for this technology to proceed.

This story omits that at the same time, other actors attempted and are attempting to destabilise the network (e.g. The Scottish Council on Human Bioethics, http://www.schb.org.uk/, Comment of Reproductive Ethics, http://www.corethics.org/), but will they have the resources to enrol powerful actors into a new rival network and end cytoplasmic hybrid research?

This BBC news clip announces the decision to award licenses to Kings and Newcastle, discusses the technique and shows protesters outside Westminster.

2. Stakeholders and science and technology policy

Theories of network building and the diffusion of technologies are of interest to social scientists. The essential principle – that a stable network of heterogeneous actors is essential to the success of science and technology – can however be of some practical use to science researchers. Thinking of network maps assists the identification of key actors and bottlenecks (some of which may be surprising). This can feed into stakeholder engagement and management strategies. A common device to map stakeholders and what one might do with them is below:



Thinking in terms of networks may also lend itself to science and technology policy and decision-making. For example, the aim of the formal process of technology assessment (TA; also Constructive Technology Assessment, e.g. Schot & Rip1997, and Participatory technology Assessment, e.g. Leonhard 1999) is to identify and coordinate technical, organisational, social, economic and ethical considerations to manage the process of desired technological change and introduction. It should be noted that the extent to which this process is actually open to management is moot; Guston & Sarewitz (2002) note a 'central truth about the development and proliferation of technology in society: that this process is largely unpredictable, and thus not subject to anticipatory governance'. Naturally, the very idea of a science policy strongly assumes that it is.

3. Expectations, visions, hype

Any attempt to manage the introduction of a technology or intervention constructs a vision of the future, as well as the pathway required to get from the present state to that future state. These visions of the future are used to organise the present and used to mobilise actors and resources. These take different forms including: research funding programmes; the design of technologies; regulatory regimes; creation of firms, research institutes and journals; policy initiatives and so on and so forth. Expectations are also exercised in many places (labs, scientific papers, funding applications, government and its agencies, media sources, the marketplace, the pub etc.). The extent to which expectations are balanced against uncertainty and chances of failure might shift at different points in your network map. For example, with colleagues you may be more open about chances of failure than with funding agencies or rival groups. But when does legitimate expectation and excitement over new discoveries and new ways of thinking turn into damaging hype?

Paul Martin and colleagues (e.g. Nightingale and Martin 2004, Hedgecoe and Martin 2003) have studied the dynamics of expectations around biotechnology, and particularly pharmacogenetics and personalised medicine. In the 1990's, a great deal of hope was imported into these emerging fields:

> ‘We will soon have the ability to predict the variation in drug responsiveness of large numbers of individuals … a dramatic change in the practice of medicine over what we know today is certain’ (Cantor 1999:288)

The UK Government adopted this vision and began to structure policies according:

> ‘The new genetics knowledge and technology has the potential to bring enormous benefits for patients: more personalised prediction of risk, more accurate diagnosis, safer use of medicines and new treatment options. A revolution in healthcare is possible, but it will not happen overnight’ (Department of Health 2003:22)

New research institutes and funding programmes were born, and genomics firms were created or established firms retuned their attentions. Over time however any talk of ‘revolution’ seemed increasingly misplaced. Instead, in a paper provocatively tilted *The myth of the biotech* revolution, Nightingale and Martin observed that:

> ‘Rather than producing revolutionary changes, medicinal biotechnology is following a well-established pattern of slow and incremental technology diffusion. Consequently, many expectations are wildly optimistic and over-estimate the speed and extent of the impact of biotechnology, suggesting that the assumptions underpinning much contemporary policymaking need to be rethought’ (Nightingale & Martin, 2004: 564)

The DoH was therefore right to caution that there would be no overnight ‘revolution’, but for Nightingale and Martin the use of the revolution metaphor was unfortunate and led to misplaced activity and hope. Who promulgated these wildly optimistic over-estimations? Read Nightingale and Martin! But some clues might be gained from considering the ‘certainty trough’.

4. Certainty and uncertainty

Mackenzie (1997) describes the relationship between a science/technology, social distance, and uncertainty in the following way (for reasons that will become clear, the relationship he described was termed ‘the certainty trough’ and you might like to think about this relationship with respect to your map). For those directly involved in the manufacture of knowledge about the science/technology (‘insiders’; the very centre of your map), perceived uncertainty on matters such as safety and unpredictability is high. However, for those one step removed from knowledge production, yet intimately involved in the success of that technology (‘committed’; those most directly connected to you at the map centre), such as product users or project managers and financiers, uncertainty is much lower. Often at the public face of technological development, these actors have a vested interest in buying into, or indeed achieving the assurance of certainty. These actors inhabit the ‘trough’ of certainty.[2] However, for those furthest removed from the point of knowledge production (‘outsiders’; who may be at the periphery of your map) such as those opposed to the technology, committed to alternative

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[2] An example can be found in Dreyfus and Dreyfus (1986). They note that early enthusiasm for artificial intelligence was entirely unjustified when one compared what computers could do with what a human could do. But if computers can't attain the skill level of expert humans, why, Dreyfus and Dreyfus asked, aren't developers willing to admit or even acknowledge this? 'The answer is that the spokesmen for the artificial intelligence community have a great deal at stake in making it appear that their pure science of artificial intelligence and its engineering offspring, experts systems, are solid, established, and noncontroversial. They will do whatever is required to preserve that image' (p13).

technologies, or alienated from the knowledge producing institutions, uncertainty is again high.

Actors such as scientists ('insider') do actually move, at least between insider and committed, depending on who they are seeking to persuade and who they are communicating with (for example, uncertainty might be downplayed when seeking funding, or when communicating results with the public and peers), and in the face of the scepticism of outsiders, the resolve of the committed needs to become stronger. It is perhaps deep in the trough that optimistic, even wildly optimistic claims are generated.

References

Cantor, C. (1999) Pharmacogenetics become pharmacogenomics: wake up and get ready, *Molecular Diagnosis*, 4 (4), 287-288.

Department of Health (2003) *Our inheritance, our future: realising the potential of genetics in the NHS*. http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4006538

Dreyfus, H. and Dreyfus, S. (1986) *Mind over machine. The power of human intuition and expertise in the era of the computer*, Oxford: Blackwell.

Guston, D. and Sarewitz, D. (2002) Real-time technology assessment, *Technology in Society*, 23 (4), 93-109. http://www.nanoandsociety.com/ourlibrary/documents/RTTA.pdf

Hedgecoe, A. and Martin, P. (2003) The drugs don't work: expectations and the shaping of pharmacogenetics, *Social Studies of Science*, 33 (3), 327-364.

Leonhard, H. (1999) Participatory technology assessment: a response to technical modernity?, *Science and Public Policy*, 26 (5), 303-312. http://www.ingentaconnect.com/content/beech/spp/1999/00000026/00000005/art00003

Mackenzie, D., (1997) The Certainty Trough, in Williams, R., Faulkner, W., and Fleck, J. (eds.), *Exploring Expertise: Issues and Perspectives*, Macmillan: Basingstoke, pp325-329.

Nightingale, P. and Martin, P. (2004) The myth of the biotech revolution, *Trends in Biotechnology*, 22 (11), 564-569.

Schot, J. and Rip, A. (1997) The past and future of constructive technology assessment, *Technological Forecasting and Social Change*, 54 (2), 251-268.

Sovacool, B. (2006) Reactors, Weapons, X-Rays, and Solar Panels: Using SCOT, Technological Frame, Epistemic Culture, and Actor Network Theory to Investigate Technology, *The Journal of Technology Studies*, 32 (1), 4-14. http://scholar.lib.vt.edu/ejournals/JOTS/v32/v32n1/pdf/sovacool.pdf