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Educating the children of the Mode-2 revolution

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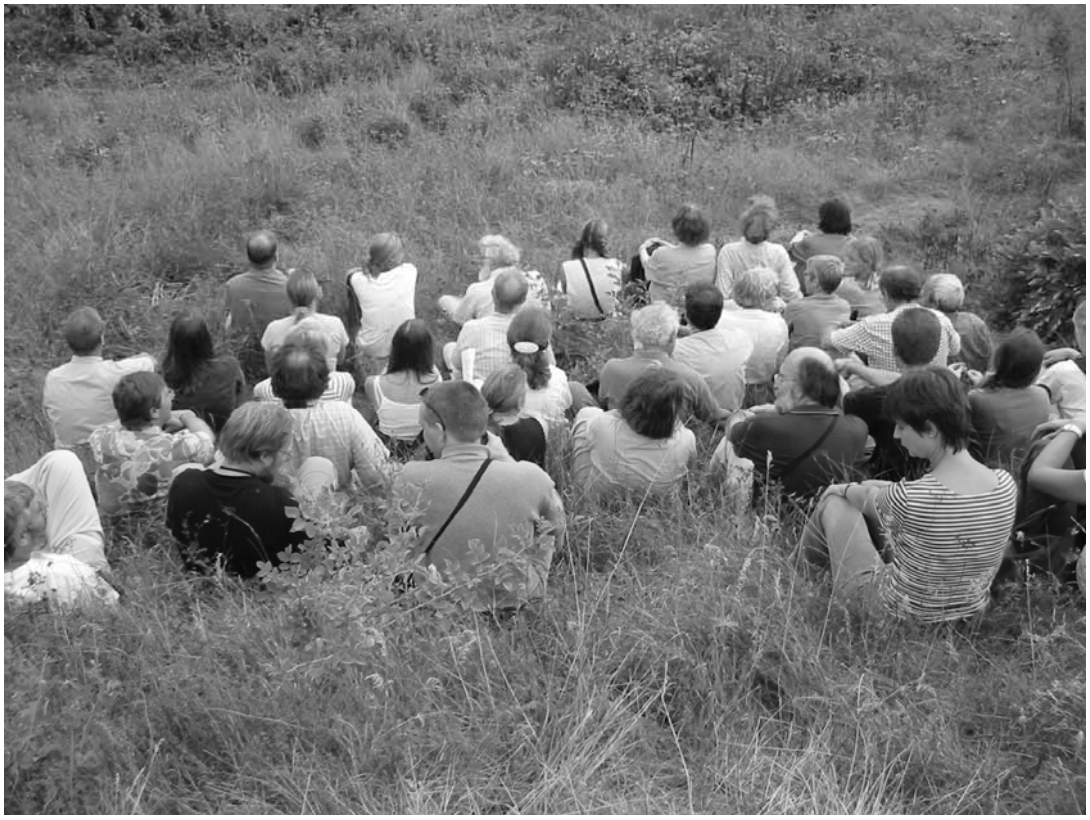

Abstract

Mode-2 researchers are trained in Mode-1 institutions where there is now a striking mismatch between what they are encouraged to believe and what actually happens. We are expected to believe in the knowledge-based society, that development can be competitive *and* sustainable and that any university teacher must publish four papers every five years. This is the party line that every competitive university must endorse. They do this by ignoring dissident views – those of humanists marginalized by the commercial scholarship or of biologists bounced into early retirement by the academic paper chase. In the spirit of Glasnost this chapter places Mode 2 in a wider post-war context and sketches the distinction of research management from regulation. Management is responsive, regulation normative. To educate innovators is to prepare them to take risks. This is difficult in an over-regulated command economy for knowledge services. The solution is to regulate lightly and delegate managerial

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responsibility as far down the institutional hierarchy as possible; encouraging people to make mistakes and learn from them while weeding out those who keep making the same type of mistake again and again. The chapter closes with practical advice for managers, regulators and students trying to develop Mode-2 skills in Mode-1 contexts.
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The case for Perestroika

The universities have experienced a revolution over the last fifty years and very few people now in post can remember what they were once like. These developments, viewed on one spatial and temporal scale, can be presented as unequivocal evidence of progress and enhanced quality and, viewed on another, seem disastrous. Debates about educational standards are a case in point. Many educationalists and politicians are convinced that young people are getting cleverer. They can do things their parents and grandparents could not do. Yet researchers like me are equally convinced that undergraduates entering university today lack strategic thinking skills and the ability to synthesize.

It would be easy to present this as a debating-chamber proposition: "This house believes that educational standards are rising" and set the educational specialists to argue *pro* and the researchers to argue *con*, but this is unhelpful. Perhaps academic standards are not rising or falling, but simply changing. Set-piece debates in the media may amuse journalists and serve the interests of party politicians, but professional academics, teachers and students urgently need a consensus about what academic quality is and how to sustain it in a changing world.

We cannot use performance in standard assessment tests as quality indicators. Research projects do not fail because academics cannot write good English or solve simultaneous linear equations. These are stepping-stones to quality, not quality itself. Perhaps we should ask: "Is the process of research as fulfilling and enriching as we would like?" This question can be addressed both from the researcher's viewpoint and from that of the non-academic stakeholder (the taxpayer, perhaps). In both cases, I submit, the answer is an emphatic "No!" I will discuss the stakeholder's perspective later and will focus here on the academic's perspective.

Once upon a time a *theory* was a testable proposition and a *method* was a procedure practitioners found useful. Academics started their careers as practitioners (research assistants or demonstrators) and were not encouraged to publish or undertake advanced teaching until they had something really interesting to say. The doctorate was a jewel in the crown of a distinguished academic who, as the years went by, spent a little more time in administration or advanced teaching and a little less time in research. When they were young and flexible, academics studied and raised their children. When they were old and wise, they put their experience at the service of the rising generation. In this way the process of research was attuned to the biological cycle of growth, maturity and ageing and the roles of individual researchers were harmonized with their roles in the wider communities of which they were members.

World War II changed all that. Today *theory* is a polemic about method. Many academics start their careers as tenure-track lecturers – teaching a full load by day and trying to write papers while the children are in bed. The person who empties their office wastebaskets probably has a doctoral dissertation *in prep*. Universities now

house distinguished ‘theoreticians’ (who write about method, but seldom use it) and oafish ‘practitioners’ (who use method a lot, but seldom achieve distinction). Academic communities have become dysfunctional – viciously driving square pegs into round holes and round pegs into square ones. The Mode-2 revolution (Gibbons et al. 1994) is part cause and part effect, as we will see.

The tension between Modes 1 and 2

It began with the emergence of a new profession, the contract-funded academic, whose work is problem-oriented, applicable and crosses conventional disciplinary boundaries. This was the Mode-2 revolution. Mode-1 research, in contrast, was open-ended, usually focussed on a single discipline or problem-set. Mode 1 was the typical experience of the university-based academic in those halcyon days when the academic’s life cycle and career could run in harmony.

Mode 2 work runs on projects with a start date and end date and a deliverable. Those projects refer to technology, to institutions, to policy, management, regulation and law. The work addresses and manipulates the relationship between culture and agency, belief and environment. It is not natural, but *un-natural*, i.e. humanly-constructed processes that engage us. This is so of a group of archaeologists and Quaternary biologists trying to understand the relationship between climate and society in the Bronze Age or a group of planners and farmers trying to thrash out a policy for the management of a Bronze Age monument. Our research domain is that of *cultural ecodynamics.* Much of that work is directed across epistemic boundaries and policy-relevant.

Communities often shatter into factions identified by divergent beliefs. Epistemic factions are never politically neutral (though they often pretend to be). Value-judgments, reality judgments and operational (or policy) judgments are autocorrelated, so issues of equity become bound up with individual beliefs. Conflicts of interest are often hidden behind a smokescreen of rhetoric about reality and common sense (Winder 2005). When, as so often happens, epistemic factions become antagonized, their ability to *innovate* (to create new knowledge that helps them respond to threats or opportunities) is compromised.

This is as true of the community of researchers as it is of any community one might name. However, when a Mode-2 research team shatters, it can easily destabilize stakeholder communities, especially those whose cultural and natural life-support systems have been compromised. Every Mode-2 researcher must know how to manage tensions within the research team. Without this skill a Mode-2 project cannot innovate or serve the needs of vulnerable stakeholders. For Mode 2, therefore, managerial skills are at once ethically indispensable and powerful research tools in their own right. However, most of us are trained in universities (Mode-1 institutions) where management is often perceived as a threat or, at best, a necessary nuisance. The lessons we learn there leave us ill-prepared for the work we do. This aggravates tensions between Mode 1 and Mode 2 and exacerbates the problem of integration.

Mode-2 research is new, but the problem of integrating Modes 1 and 2 is as old as western civilization. Although fashions may change and paradigm shifts can sweep Mode-1 communities away, Mode-1 work is sustainable. The universities actually claim to own the fields of knowledge and arrogate the right to determine who is and who is not able to practice in those knowledge domains.

This is a remarkable situation. The fields of conventional knowledge are part of the shared intellectual heritage of western society – they belong to us all. The universities

too are publicly funded – they also belong to us. Yet the universities (which we subsidize through our taxes) restrict access to our own intellectual heritage. The older universities have been doing this since the twelfth century. In some cases (the training of medics, for example) one can argue that a system of accreditation is ethically necessary, but the social control and professionalization of, say, history, philosophy or pure mathematics is very difficult to justify except by appeal to custom and tradition.

The myth of the professional 'expert' even creates tensions among professional experts. Mode-1 academics often resent the incursions of Mode-2 researchers who not only challenge their beliefs, but threaten the security of their tenure. When Mode-2 researchers also bring non-academic stakeholders into the university system, the conflict of interest becomes palpable. Mode-2 research is anarchic; it threatens Mode-1 interests by undermining intellectual property rights and weakening the boundary between academe and society.

Mode-2 researchers are journeymen whose only holdings are the tools of the trade. They reject the claims of Mode-1 academics to own the fields they cultivate, take what they want without a 'by your leave' and even laugh at the beliefs and customs of sitting tenants. Innovation is threatening if you really value what you stand to lose. So Mode-2 researchers are more likely to be innovators than Mode 1 and this further antagonizes the two communities.

Innovation is rare – both in research and in commerce and it should be so. We don't need nearly as much innovation as policy makers and spin-doctors pretend, but we do need some. Mode-1 work is cool and durable, that's how it endures. Mode 2 is hot and malleable. Mode-2 researchers can forge a ploughshare and temper the metal until it is fit for service, but often have less skill in ploughing and no fields of their own. Mode-1 researchers can use our tools, reject the malformed and ill-tempered product and help us improve our work. Even if we have nothing to offer of value to you, then say so without setting the dogs on, and we gain from your experience.

Mode 1 and Mode 2 are not so different. Many Mode-2 researchers, particularly experienced practitioners, long to settle down and would be perfectly comfortable in Mode-1 settings. If there were room for us to do so, perhaps you could gain from *our* experience. Similarly, many younger Mode-1 researchers have innovative skills that are used so seldom they never really sharpen them up. They could spend a little time on the road with us – there is always work for another journeyman and much less stress if you have a safe home to go back to. Perhaps we can tweak our respective educational systems to accommodate both experiences for the good of both communities. To do this effectively, however, we need to know a little more about the historical and social antecedents of Mode-2 research and, for this, we must consider the origins of Big Science in World War II.

Big Science and complex systems

Information technology, cybernetics, systems and operational research (an approach to managing industrial and commercial systems) were all rooted in developments that had begun between the wars and combined to form a new type of science in which similar methods were used to solve problems that crossed conventional disciplinary boundaries. The 'Manhattan Project' that produced the first atomic bomb is arguably the 'type specimen' of what came to be known as 'Big Science' – large, centrally funded projects, usually focussed on massive technological developments. The Apollo programme, CERN and Hubble were also Big Science projects.

Many of the mathematical methods used in Big Science were actually developed in Little Science contexts (engineering, physics, chemistry, applied biology and economics). As the pioneers of Big Science began to seek peacetime employment some speculated that these methods could be fused into an over-arching meta-science that would unite the natural sciences, life sciences and social sciences. Ludwig von Bertalanffy had called for a 'General System Theory' before World War I (Von Bertalanffy 1968). Bertalanffy's book gives what seems to me a misleading impression of unity and intellectual coherence. The systems community was rather diverse, even from the earliest days. The systems approaches described by Ashby (1956) and Boulding (1978), for example, have a very different look and feel to Bertalanffy's.

Indeed, the idea that we should move towards a natural-science approach to social behaviour is hardly new. It can easily be traced back to Auguste Comte's calls for a physics of society based on 'positive' evidence in the nineteenth century. Indeed, there always seem to be a few natural scientists convinced that, given the right data, their superior methods and training will solve problems that have hitherto defeated specialists in the field. General System Theory was sublimely arrogant, but not unprecedented.

However, General System Theory had a number of interesting attributes that gave what one might loosely call 'the systems community' an edge over other demands for an over-arching meta-discipline. Firstly, many of its exponents had seen the excesses of Stalinist science and Nazi eugenics and were willing to contemplate a model of science in which some problems were too complex to reduce to a handful of axioms and solve by deduction. Secondly, some of the methods employed, particularly digital computers and database management systems were genuinely new and it seemed natural to explore their peacetime application. Finally, economies were being rebuilt and there was spare money enough to invest in 'blue-skies' research, particularly if there was a prospect of commercial spin-off.

The foundation of IIASA (the International Institute of Applied Systems Analysis) in Vienna and a series of Cold War Big Science initiatives from the Space Race to the Strategic Defence Initiative guaranteed the survival of this new meta-discipline. General System Theory became a banner under which Big Scientists could unite without making concessions to intellectual unity. It was an idea whose time had come.

The falsification of General System Theory

The only *theory* in General System 'Theory' is that mathematical methods can be generalized to environmental science and the humanities. While many natural scientists and politicians were cheerfully treating it as an established fact, operations researchers and other systems practitioners with an interest in social dynamics were making a rather alarming discovery. In military applications and centrally funded Big Science, the purpose of a social system was well understood and this consensus imposed constraints on human behaviour that made the system manageable. Without the imperative of war-time unity or some equivalent constraint, however, social systems lack coherence and their management may be vitiated by irreconcilable conflicts of interest.

These conflicts of interest are manifest as arguments about reality, common sense and ethics. It seemed that value judgments and reality judgments were autocorrelated (Churchman 1979; Vickers 1965; see also Naess and Rothenberg 1989). Moreover, attempts to solve managerial problems using technical methods often made matters

worse. As Ackoff (1979) explained: “managers do not solve problems, they manage messes”.

As one moves from military through commercial to anthropological studies one sees that the ‘boundary judgments’ we make to define interesting or policy-relevant categories co-incidentally determine who is and who is not an authentic stakeholder (Flood and Jackson 1991; Midgley, Munlo and Brown 1998; Rittel and Webber 1973). A researcher interested in ‘social exclusion’ and another interested in the problem of ‘urban delinquency’ evidently have different stakeholder communities in mind even if they are working in the same policy arena.

Soft science (the science of socially constructed systems) is difficult enough when two insider communities disagree about reality (Beer 1979; Boulding 1978; Checkland 1993; Rosenhead and Mingers 2001) but when one of those communities is socially excluded, reality judgments can be artefacts of ideology and prejudice. Terrible crimes have been committed in the name of science. Continued ethical scrutiny, not just of the practice of research, but of its unintended impacts on stakeholder communities, is imperative.

Mode-2 research is an applicable, self-referential science in which a definition constructed innocently ‘for the sake of argument’ can become a self-fulfilling prophecy with disastrous consequences for some stakeholders. Consequently, practitioners now accept, as a fundamental result of empirical research, that General System *Theory* – the conjecture that quantitative methods can be generalized to socio-natural systems – has been refuted by empirical evidence. Mathematical methods only work for mechanistic systems, or for socio-natural systems so tightly constrained as to resist all attempts to innovate.

This discovery produced a genuine schism between hard and soft practitioners; a schism aggravated by financial conflicts of interest. Hard system practitioners were able to win Big Science money to apply quantitative methods to technical problems. Softer practitioners found it harder and many became small-scale consultants using qualitative methods to solve social problems – the Big Science community effectively marginalized them and ignored the empirical evidence they had gathered. Parallel developments in the universities, however, were handled rather differently.

The universities and Mode 2

As the armies demobilised after World War II, many unorthodox students entered the universities forcing universities to expand teaching facilities to accommodate them. The students themselves were culturally diverse; their education had been unorthodox, they were willing to take risks and intolerant of humbug – a truly brilliant generation of undergraduates who took the universities by storm.

The universities did not shrink to their pre-war size after the veterans had graduated, but actually created even more places and removed barriers to entry. Baby-boomers filled their places and standards undoubtedly fell. Students were able to matriculate who, before the war, would not have had a chance. This process accelerated as a Cold War spending boom built new universities and gave charters to technical colleges that allowed them to award degrees.

Soon we were over-producing graduates and governments needed to find work for them. Substantial investment in research sent some Little Science disciplines into a veritable feeding frenzy as many biologists, social scientists and humanists were able to win money to apply systemic methods in their own fields. Mode 2 really began to impact on the universities when the baby-boomers got a piece of the Big Science

action because the work they started scuffed up the boundaries between pure and applied research; Big and Little Science. Some of this research was pure scholarship and much more was policy-relevant but not policy-led.

Putative revolutions were initiated in geography, sociology, anthropology, archaeology, systematic biology and environmental science, and many of these projects were directed at the interface between the sciences and humanities. Some of it was frankly farcical. Throughout the 1960s and ’70s any hard-systems guru, however innocent of case-study experience, could hold forth about the obvious advantages of the scientific approach for humanists and social scientists. Funding agencies cheered them to the echo. Ambitious baby-boomers established successful careers as the interpreters of complex systems method.

The balance between teaching and research shifted dramatically over this period and fuelled a trend towards research-led tertiary education that was sustained up to the end of the twentieth century. Academics publish more papers *per caput*, *per annum* now than ever before. This was all part of the ‘information explosion’, an academic paperchase that gave us the aphorism: ‘publish or perish’.

Much of the research was funded through fixed-term contracts and this produced a glut of contract-funded problem solvers with no job security and a career expectancy of less than ten years. Ambitious academics avoided these contracts by competing for a few figurehead roles. The academic community gradually became accustomed to this and students learned almost subliminally that contracting was a lower status activity than that of a tenured academic. Universities closed ranks and revised the boundaries of ‘reputable scholarship’ to drive contractors beyond the pale. Contractors became second-class academics.

Much of the early investment was in data-rich case studies intended to generalize hard-system method to the humanities and life sciences. Many of these databases are still unpublished forty years later. Part of the problem was inept database design (Winder 1997), but that was not the whole story. The baby-boomers also discovered that system method did not generalize. Sadly, instead of announcing this as an empirical result, most took the money and kept quiet. This was no more than an error of judgment – probably motivated by a desire to protect contractors from the stigma of public failure – but it left them vulnerable to public denunciation.

Science is like selling soap

Funding agencies were pathetically ill-equipped to sort the wheat from the chaff and, although the funding stream was sustained into the later 1970s, the promise of novelty eventually became more important than the quality of the work. As the archaeologist Eric Higgs (my doctoral supervisor’s doctoral supervisor) used to joke, science was like selling soap.

A form of semantic inflation kicked in. Methodology became redundant because every methodologist claimed to be a theoretician. System theory, for example, is not a theory at all but the comparative study of system methods. Few people talk about method any more, if we must describe a new method we call it a ‘new methodology’ – as though a new species of beetle is ‘an entomology’.

It was fifteen years before funding bodies accepted that the number of useful case studies was too small to justify the level of investment. No sooner had the plug been pulled on the first wave of projects than chaos theory came along. Chaos theory (now called ‘organization theory’) was another damp squib. After twenty years of well-funded research and hundreds of popular books about fractals and strange attractors,

everyone now knows that there never was a coherent theory of chaotic systems and the theory of non-linear dynamical systems, while occasionally providing useful insights is astonishingly difficult to apply to ecological and social systems. The principal impact of these 'revolutions' on mainstream humanistic and social-science research was jargon. Where once we were merely confused, now we speak of the 'non-linearity of socio-natural systems' to show we are confused on a higher level.

By the late 1970s most of the classically trained humanists of the '50s had retired. Many of their places had been filled by systems thinkers who had publicly committed themselves to hard-systems approaches and by deconstructionists equally convinced these methods had nothing to offer. A decade or so later these two communities (and their students) were still locked in pseudo-gladiatorial combat while the rest tried to clean up the mess and complete a few case studies.

At the heart of this fiasco was a breakdown of communications. Many 'post-modernists' recognized that later modern science could not handle socio-natural complexity. The reason physicists win prizes, they argued, was that God gave them all the easy problems. They also realized that financial and professional conflicts of interest had not been handled well. For every systems wizard winning distinction, dozens of practitioners and more conventional scholars had fallen by the wayside. The natural resentment and bickering that followed soon degenerated into name-calling. Things got worse as the recessions of the '70s and '80s started to bite and governments were bounced into action.

Recession and entrenchment

European governments were initially pleased by the growth of the educational sector, which reduced unemployment statistics, satisfied demands for open access to education and promised economic spin-off. Many even became worried about the 'brain drain' and tried to create incentives that would prevent researchers moving out of Europe. It started to go sour with the student unrest of the late 1960s as the post-war boom began to falter. The emergence of a highly educated class of anarchic thinkers became a threat. The new universities had to be tamed. Soon the recessions of the early '70s and '80s focussed attention on disappointing rates of commercial spin-off.

Governments responded by tightening standards of audit and creating contracts for researchers that allowed them to work but required them to waive their statutory rights and severance benefits. The darkest days were probably the late '80s. During this period I worked on some contracts that allowed me to gather data and write reports, but forbade me to any 'research' on the data. Among my colleagues were some who received enhanced unemployment benefits to work on fixed-term contracts, but were required to be unemployed for six months before they were 'eligible' to take another contract.

These circumstances seem to have been designed to force Mode-2 researchers out of the system. Yet waivered contractors were doing 80% of the research in many universities. The universities stood to lose substantial income, both in direct revenue and in loss of supplementary funding from research assessment audits. So they redoubled their efforts to meet audit criteria. Contractors were highly committed to the work too and found ways of working round the rules (moving from one country to another to cash in on local opportunities, for example). Governments and regulators changed the audit criteria to block up loopholes and handled the resulting chaos as

well as they could. That is how the academic life-cycle lost touch with fundamental biological constraints.

One of the strategies governments used was to turn technical colleges into pseudo-universities. This was part of a bid to counter the brain drain by giving the technical professions the same status as the liberal arts. Initially, neighbouring universities accredited the degrees awarded by the colleges, but later many colleges were granted charters and became universities in their own right. Students began to enter these 'universities' who would once have taken traditional apprenticeships. Apprenticeships themselves were implicitly devalued and eventually disappeared, creating a chronic skills shortage in many sectors. Governments began to invest even more in 'training'; costs rose and standards fell.

One of the ironic effects of this was to shift our understanding of what it was to innovate. In academic language (and common usage) it means the development of new conceptual structures and techniques. However, in the language of government regulators, 'innovation' means commercial spin-off. Innovation was a good thing and universities were expected to innovate continually. This was a remarkable reversal. Whereas mediaeval universities committed to innovation defended themselves from the charge of heresy by claiming they were re-discovering timeless truths, post-war inquisitors were more likely to accuse scholars of failing to innovate. Academics defended themselves by shifting the definitions of words too. Of course, we are really 'innovating' all the time – look at the number of papers we are publishing.

Make no mistake, we were publishing quite a lot, but as research activity increased, the impact of any single project on society as a whole was naturally lessened. As the number of papers hitting the library shelves exploded, the likelihood you will find the jewel you seek diminished. Academics published more papers sooner, so quality fell too – there were fewer jewels in proportion to total output than there once were.

Professional academics who prospered in this environment were those who degraded the distinction of innovative from normative work, wrote impenetrable prose and marketed every piddling change of emphasis as an earth-shattering revolution. This nonsense took the heat out of political conflict between universities and regulators but it also made it much harder to explain the simplicity, generality and antiquity of great ideas (Winder 2005, Section 1).

Recent academic literature on post-modernism, post-feminism, new archaeology, new geography, new systematics, post-structuralism and the rest, the silly marketing speak of Big Science and the changing demands of funding agencies, are perfectly rational responses to the unsustainable command economy for knowledge that demands endless innovation without any clear indication of what innovation is, why we might want so much of it and whether it is actually possible to innovate all the time.

Perhaps more seriously, schoolchildren and undergraduates began to reject the party line and many abandoned the natural sciences altogether. This was the age of the 'post-modern revolution'. All human action was a text that had to be deconstructed. No text could ever be fully understood by its readers, so human action was irreducibly arcane. Every attempt to categorize was an exercise in control (this is undoubtedly true, by the way) and every attempt to control was 'hegemony'. When your life is falling apart, the only ethically acceptable course of action is to lie back and think of hermeneutics.

I am being a little unfair here, but not very. Post-modernists, in general, have a lively understanding of the ethical problems of Mode 2. They are also absolutely right, in my opinion, to criticize hard-science colleagues for managing economic

conflicts of interest badly. A great deal of post-modern case-study work is excellent, but post-modern polemic is unscholarly and divisive. The idea that science is a quest for socially constructed knowledge is hardly new. William of Ockham argued this in the fourteenth century. Moreover, it is not post- (or even 'anti'-) modernism. Fifteenth-century theologians in Northern Europe had to choose between the 'ancients' and the 'moderns'. Ockham was a modernist; I am a modernist; what these neo-modernists call 'modernity' is dogmatic social engineering.

The post-modern backlash filled the new universities with historians, hairdressers and accountants. Politicians committed to the social engineering programme were naturally dismayed and began to look for a cause. It could not possibly be that they had lost their way and were now throwing good money after bad. Soon the elementary schools were being audited in a desperate attempt to buck the anti-science backlash. Students now enter university with better grades than ever before, but it takes a year longer to prepare them for research than it did twenty years ago.

These *ad hoc* reforms created a central, 'command economy' for knowledge services in Europe. Some of this was funded nationally and yet more by supra-national agencies. Measures to promote 'innovation' and curb costs began to pull in different directions. Governments found themselves driving the knowledge economy with one foot on the accelerator and the other on the brake. This imposed severe stresses on the universities because they had to train academics to work in two very different research settings. To do this effectively they had to be active in both.

Mode-1 business (teaching and scholarship) tends to be focussed in a single (often very narrow) discipline. A large proportion of the costs are fixed, the business cycle is slow, job security good and profits are low. Mode-2 business, however, is handled by institutional consortia and demands multi-disciplinary input. It has a rapid business cycle, variable costs and lousy job security. Mode-2 business can make a handsome profit or go bust and, because it is critically dependent on a few, highly motivated individuals, may do both within the space of a single decade. Few institutions can accommodate both business cycles successfully.

Over the last forty years the cost of education has increased dramatically. The benefits have been eroded. Graduate unemployment has been a problem from the mid '70s onwards and post-doctoral unemployment took off in the '80s. The twentieth century 'information explosion' is not, as the bean-counters pretend, evidence of unstoppable progress, but of an over-regulated command economy for knowledge services that has gradually paralysed the knowledge sector.

Balancing regulation and management

It is always useful to know how we got into the state we are in because that knowledge helps us to make a distinction. Some policies have consequences that were fully foreseen and accepted by the policy maker. Genocide and ethnic cleansing are cases in point. Here it is reasonable to argue that we are dealing with vicious intent. However, in many cases vicious policies originate as unforeseen consequences of earlier initiatives. For example, many historians believe that the Treaty of Versailles in 1918 created an environment in which the German economy was so paralysed it was bound to collapse, allowing political extremists to win popular support. Vicious policies often ride pillion on earlier interventions.

You can seldom undo a vicious policy simply by reversing the course of history and un-making those mistakes because the experience of those policies has changed people's attitudes. This was true on the hideous scale of world wars and genocide and

is also so in the regulation of institutions. You cannot un-make bad decisions but must simply make new decisions that respond to the new situation. However, you can improve the likelihood of a happy outcome if you can stop demonizing those who made the mistake and start negotiating an exit strategy. That is what the study of history is for, in my view.

We are now at a stage in my chapter when we can start thinking about possible exit strategies for Mode 2 and, for this, we need to use some words in a rather precise way. In particular, I want to tighten up the way we use the words 'management' and 'regulation'. Every institution is Janus-headed. One face points outwards, participating in debate that sets its policy environment. The other points inwards and is responsible for executive action. The extrovert competence is a *regulator* accountable to external stakeholders (shareholders, funding agencies and those who consume the goods and services it produces). The introvert competence is project *management* responsible for the timely, lawful, efficient delivery of those products. The regulator sets norms that constrain the manager. The manager protects the institution from sanction by respecting those norms while helping it to meet its contractual and commercial targets.

In situations where regulation is weak, managers have complete freedom of action. The result is a permissive, or *laissez-faire* environment in which managerial expedient has a priority over ethics and law. The nineteenth century was the heyday of *laissez-faire*, a time when the accumulation of private capital and the laws of supply and demand took priority over the interests of the weak and socially excluded. In situations where regulation is strong, however, the demand economy is replaced by a centralized *command economy.* Managers are not only set targets by the regulator, but told how to meet those targets. Command economies are less capable of innovation and inclined to stagnate.

Between these extremes are *mixed economies* in which managers have some latitude of movement and so can respond to market forces, threats and opportunities, but regulators set policy norms that fix ethical and legal limits within which institutions must operate. In a sector that is over-regulated, managerial 'wriggle room' is destroyed and the scope for innovation is severely curtailed. In a sector that is under-regulated the gap between the weakest and strongest members of society is allowed to widen. In extreme cases people are allowed to die or even enslaved.

Regulation and management in Mode 2

The contracts on which Mode-2 projects run are drawn up between employers and funding agencies in respect of intellectual property. Researchers are effectively technicians with no financial stake in those products. Our employers own and can trade in the knowledge we create. If the authors of a research proposal also receive a salary they may even be forbidden to claim authorship and have to find a surrogate 'author' to front their own work and, in effect, to take credit for their creative effort. Yet the products of integrative research are usually ideas – technically outside the intellectual property legislation, though the distinction has not been tested well enough to give contractors a defensible stakeholding in their own work. Intellectual authority and the dissemination of ideas are prerequisites of a successful research career. Yet it is almost impossible to distinguish intellectual property from intellectual authority and this creates damaging conflicts of interest between Mode-2 researchers and their employers.

Unsurprisingly, many researchers resent this bind, especially if their contracts are insecure. Research institutions are often inept and sometimes downright unethical. There have even been occasions when the contractor who wrote a successful research bid was not offered renewal of contract and the budget devolved to the sleeping partner. This leads to a skills haemorrhage among contractors which, coupled with pressure to reduce costs by shedding the most expensive (and experienced) personnel, drives chronic over-delegation. Tasks requiring professional judgment and experience are commonly handed to PhD students, many of whom have been hamstrung by new undergraduate programmes.

We cannot blame the students for this. The best of our contemporary student input (those we recruit onto doctoral programmes) are as good as we have ever seen. Indeed, even the worst have usually had educational opportunities unprecedented in the history of western society. The problem is caused by inept regulation. Courses are often reduced to short modules and regulators require that desired 'learning outcomes' be formally specified and audited. The ability to integrate what has been learned in one module with that learned in another is impossible to objectify, so strategic-thinking skills are often neglected.

Universities have become forcing-houses of conventional knowledge and are now very good at it. Early-stage researchers know a great deal (and have certificates to prove it) but are poorly prepared for the transition from student to early-stage researcher. They are like cooks who know how to prepare every dish needed for the feast, but have never tried to prepare all those dishes simultaneously and bring them to the table at once.

Part of the problem is that we no longer distinguish skills transfer from technology transfer. Technical knowledge consists, for the most part, of 'know how' and 'know why'. It is very important. However, powering up a computer, launching a GIS and completing a classroom exercise is not a skill, but a technique. Skills are developed by constant application and observation of techniques. They involve the embodied knowledge or *praxis* that is the hallmark of a skilled artisan. It hardly matters whether you are learning to build a dry-stone wall, play a musical instrument or create new knowledge – it takes about seven years dedicated practice to develop a non-trivial skill.

It is hardly surprising, then, that early-stage researchers often quit after their first baptism of fire. They have been given a lot of technical knowledge and then thrown into a situation that demands praxis. Even very gifted people begin to doubt their abilities in these circumstances and this makes them neurotic. When they quit the problem of over-delegation is aggravated.

So we are locked into a vicious spiral in which every contractor needs a personal exit strategy. Many develop a mental picture of the epistemic communities to which they owe primary allegiance. They usually have family commitments too. Though the products of research may be bought and sold, these unacknowledged stakeholders exert a strong influence on the research process. Regulators must work round these conflicts, but managers work with them. The trick is to foster a blame-free environment that encourages people to experiment with new ideas, to take risks and learn from mistakes. One must also understand and facilitate personal exit strategies. Contracts fail if goodwill and confidence collapse. It is wise to know whether people want to find a new adventure or more stability and help them achieve this before they burn out in their current post.

Regulatory bodies sometimes contain people who are also required to manage. Those who combine both roles well have substantial experience as contractors and

remember which role they are playing at a given time. Failure to insulate the team from the concerns of regulators, or to understand the executive process, is very disruptive. It is like hiring contractors to paint a house blue and stopping them half way to ask whether pink would be more popular with the neighbours, or if they would prefer to throw the brushes away and put paint on with a pointed stick.

However, there are limits beyond which even the most enlightened regulator cannot go. Policy-relevant research has ethical implications that must be monitored. It is expensive and often funded by agencies that are constitutionally obliged to audit quality and value for money. A balance must be struck that reconciles the needs of managers to the demand for proper scrutiny and audit. However, many institutions are simply too sick to find that balance. As a Mode-2 researcher, you need to be able to spot those institutions and avoid them.

Spotting a sick institution

For a few years in the mid ’70s I worked as a quality controller checking and rejecting sub-standard product. One morning, over a hard-boiled egg and a cup of instant, my line manager told me about ‘quality assurance’. The idea, he said, was to prevent goods of inferior quality ever being produced. If you get it right first time, every time, you don’t need quality control at all. I nearly choked on my egg. Our factory was going bust very slowly. Staff could be laid off at a moment’s notice and re-hired for a few days next month, some were almost murderously angry, health and safety standards were abysmal and here was this man talking about investing in quality. Had he dared mention this idea on the factory floor, he would probably have been lynched.

What my friend was talking about was *quality regulation*. It is a method that can be applied to any business. It can even be applied to a university or a Mode-2 research project. The regulator negotiates protocols or norms that describe the *process* by which the (extrovert) quality of a good or service can be assured. There is always a stakeholder community. If the work is publicly funded, for example, the funding agency is a stakeholder. If the work has pure academic value, academic peers are also stakeholders and their wishes must be considered. If the work is applied, there may be residents, pressure groups and NGOs to consider too. The regulator serves those stakeholder interests by negotiating ways of doing the job that meet their needs.

The focus of regulation is probably the clearest indicator of institutional health we can have. This is so in purely commercial settings and in publicly funded research. If the focus of regulation is on minimizing costs and maximizing profits, or on meeting statutory obligations and building an ‘audit trail’, the institution is sick and you should look elsewhere for work. If, however, the focus of regulation is on quality – if regulators see themselves as facilitators rather than as blockers, the institution is probably in good shape. If morale among your prospective colleagues is also high, that’s the clincher. You have found a really good place to work.

Sick institutions often run on poor information and you can spot them quite easily. Regulators often preside over a community of ill-informed bean-counters and box-tickers who do not know what the rules are. You will encounter a folk culture of myths and fairy tales about industrial-relations law, health and safety, statutory regulation and so on. A lot of this comes from newspaper stories and gossip.

Do not imagine you can ignore this nonsense, even if the regulator is sympathetic. The regulator and administrator are usually playing the old interrogator’s game of ‘good cop, bad cop’. The administrator, of course, is the bad cop punishing you with

paperwork and blocking every innovation. The regulator (good cop) sympathizes, but rules are rules and the administrator is the expert here … If the administrator tells the regulator that the business you bring in operates at a loss or the reforms you advocate are unlawful, the regulator has to accept that. Surely, you understand? The regulator's hands are tied. Perhaps if you …

Do not waste time explaining that the 'unprofitable business' helps sustain market share and should be funded from externalities, or that the administrator is ill-informed and vicious. Everybody knows that. The good cop and the bad cop are working together, after all.

Escaping from sick institutions is good, but avoiding capture better. If you are offered work by an institution that has weak regulators, strong administrators and ineffective quality assurance procedures, make sure you get a really good deal and check your own exit strategy before you sign anything.

Innovation and research

Suppose you have found a really healthy institution – one that regulates quality effectively, is well-informed and open. Your next question should be: is this place innovation-friendly? You answer that question by looking at the balance between innovation and regulation. A healthy institution always has a policy in respect of policy *regulation*, but regulation is normative and actually fixes procedures in a way that makes it difficult to innovate. Indeed, most institutions, even academic institutions, *do not innovate*.

A lot of excellent research, both in Mode 1 and Mode 2, is normative. Researchers gather and synthesize information and make it available to stakeholders. I know this to be so, because I have done quite a lot of it. Innovative research is uncommon and, in my view, should be uncommon. Innovative research is like prospecting for new mineral deposits, normative research exploits the ones we have already found. If we over-resource innovation, conceptual models change so fast that we never get to exploit the knowledge we have created. Balance is the key. We (governments and stakeholders) undervalue normative research at our peril.

An institution with a good quality regulation strategy can be managed very cheaply. You need a few strategic thinkers to scout for new opportunities. The norms on which quality is regulated must be monitored and revised occasionally, but continual innovation is disruptive. If you know what an institution is supposed to do, then regulate it well, delegate what little management is required to a safe pair of hands and let it run. Almost every Mode-1 institution I have worked with and a great many Mode-2 institutions seldom innovate. Indeed, the reason some European universities have been around since the mediaeval period is that they are well-regulated and stable. They have been able to accommodate changing patterns of demand simply by making minor adjustments to their quality regulation strategy.

In an innovative institution, however, getting it right first time every time can be a disaster. You need an effective *quality management* strategy that allows people to make mistakes creatively and learn from them. Although a quality regulator need not be an innovator, a quality manager must have a track record in innovation. Innovative institutions are critically dependent on highly mobile actors – innovators who are constantly at risk of getting tired and going stale. Those who are smart and lucky maintain their energy by moving from one job to another. Those who are less smart or unlucky burn out in post. Consequently, an innovative institution is inherently unsustainable.

Over the last few decades the move to a centralized command economy for knowledge services and the growing fear of litigation and 'bad press' throughout society have shifted the balance between quality regulation and quality management in a way that undermines any attempt to promote a safe, blame-free environment. Consequently, public bodies, including government departments, are increasingly risk-averse. They encourage administrators to prescribe methods in great detail and devise record-keeping procedures that can be used to defend themselves from litigation or sanction. This makes it very hard to innovate in publicly funded institutions.

Indeed, your greatest enemy as an innovator is fear of the unknown. This is true both in Mode-1 institutions (universities) and in Mode 2 and is as disruptive for tenured teachers as for research contractors. It is often aggravated by poor morale among administrators and clerical staff, who may become obstructive – blocking initiatives and creating arcane regulations that protect their own jobs by making it impossible for anyone to act on initiative. They will fight you all the way.

You can only buck this trend while you have a strong regulator who is willing to support you in these battles and your stamina holds up. In the long run, the bean-counters and box-tickers will grind you both down so you must get out before your regulator is replaced or starts playing good cop, bad cop. Once you have got things moving, start thinking about your own exit strategy. Ten to fifteen years is about right. This gives you time to make a difference and a chance of getting out in good enough shape to start another adventure.

Managing a Mode-2 team in a Mode-1 context

If you are not sure you want to run an innovative group, or have no clear idea about what threats or opportunities you wish to address, if you think it might be fun to be Indiana Jones but have no experience of innovative research, please do not follow the advice in this section. It will go wrong; you will hate it. As principal investigator, you will have to deal with the regulator directly and this is difficult. It is much easier to innovate if you are not the boss and have no direct contact with the regulator. Find yourself a job in management and let someone else take the heat. If in doubt, stay out!

However, if you *are* an experienced innovator and have reached the point in your career where you are *certain* you want to do this, this is what to do. Hire competent innovators to run project teams, delegate managerial responsibility (and accountability) to them and insulate them as far as possible from regulators. Relax quality assurance standards and create an environment in which all personnel are encouraged to make mistakes creatively and accept new challenges when ready to do so. Do not move too fast – especially if your team is embedded in a larger Mode-1 institution like a university. Quality regulation and staff retention are always important – you are trying to find a new balance between regulation and management, not engineering anarchy.

Really good innovators are those who have learned to make high-quality mistakes, so quality management must itself be innovative – it must create a safe environment within which people can make mistakes, bounce ideas off each other, move from task to task and borrow ideas. In an innovative institution, there are only three types of people who may not have a personal exit strategy: they are the Director, (in the early stages of development, when continuity is essential), the administrator and academic dead wood. As the manager of an innovative team, your task is to get rid of the dead wood either by encouraging it into growth or cutting it off.

You must expect strong resistance from your parent institution and may reasonably demand robust support from your regulator. Not only will you make enemies when you start threatening that dead wood, you will frighten the life out of the administrators who will tell you all sorts of bogey-tales about the dire consequences of changing procedures. Please be realistic about your chances of success. Is there a lot of dead wood about? Is your parent institution risk-averse? Is it over-regulated? If so, don't go there!

If you decide to try, make sure the Mode-1 institution you have chosen understands the risks. Ask your regulator about *its* exit strategy. What does the regulator want your team to look like in ten or twenty years? If possible, negotiate a succession policy that will facilitate this and keep it under continual review.

Regulating Mode 2 in a Mode-1 context

As the regulator, you can only afford to hire an innovator if the Mode-2 team is embedded in an institutional setting that is healthy enough and stable enough to absorb intellectual diversity. If this is not the case – if you are a stand-alone research centre or embedded in a risk-averse university, start with an innovative phase to get things set up and gradually shift to normative work. With luck the manager will have a personal exit strategy and you can negotiate a succession policy that will facilitate this. Develop a strategic plan that gradually strengthens regulation, weakens management and replaces your innovators with 'safer' personnel by natural wastage. Last, but by no means least, help your manager to develop a personal exit strategy and get out in good order before (s)he dies of frustration.

You must be honest with your manager and demand the highest standards of integrity from administrators. If you start playing good cop, bad cop, you have failed as a regulator. If you have a really good manager (s)he will bail out, and take all your innovators away. Your colleagues may cluck sympathetically and turn a blind eye to your failure, but everyone knows how the Mode 1 / Mode 2 split works. Mode-2 researchers owe their colleagues a much greater debt of loyalty than they do to you, especially if, by your actions, you have shown yourself incapable of accommodating them. You may moan, you may accuse them of asset stripping and disloyalty, but no-one will care. If contractors are any good at their job, they will treat you with contempt. If they lack confidence, they may stay, but morale will collapse, costs will spiral and the institution as a whole will sicken and you will look stupid.

Defensive auditing procedures and draconian central regulation will reduce managerial wriggle room, increase costs, destroy morale, delay completion, frustrate innovation and aggravate problems of staff retention, particularly among experienced staff and those with marketable skills. This will create a problem of over-delegation. Tasks requiring time, professional experience and judgment will devolve to students and early-stage researchers because there are too few experienced researchers in the system. You will be bounced into a Fire-Fighting mode that further damages morale and increases costs.

For the price of one old hack you can hire two or three Early Stage Researchers, but don't be tempted to do it. Any problem that cannot be solved by an Early Stage Researcher in three to five years will be beyond you. Quality standards will slip and so will your revenues both from research and from research-led teaching. Young researchers will be given responsibility for 'mission-critical' tasks at a stage in their career when they should be making mistakes and learning their craft. Those that survive usually try to get jobs as teachers, but their research and managerial skills are

often stunted in this unsafe, over-regulated environment. They are too busy filling out forms and fooling around with administration to learn their trade effectively and that, too, will drag you down the league tables.

As a regulator, you can destroy your institutional credibility by taking your senior colleagues beyond their innovative 'comfort zones' and then trying to tame juniors by regulating your way out of difficulty. If you are serious about innovation, you must weaken regulation, forget all that stuff about getting 'it' right first time every time, and allow those below you to manage quality. If you are not serious about innovation, concentrate on normative work.

Quality management

The first rule of quality management is to push managerial responsibility down the institutional hierarchy and regulate just enough to protect inexperienced staff from costly and embarrassing failures. Once a student has stopped making novice mistakes, you help him/her build up a portfolio of successful projects. As (s)he completes these 'test pieces' you must find out what level of risk (s)he is comfortable with and let him/her push the margins a little.

Your aim is to provide a form of delayed reinforcement. If they fail, you help them understand why the failure occurred and encourage them to try something new. If they succeed, you send very clear messages that they have succeeded and allow them time to consolidate the work at that level. Many will reach the edge of their innovative 'comfort zones' quite early and should then be found work that matches their appetite for risk and stimulation. You should never knowingly drive staff beyond these comfort zones.

Stress in the workplace arises whenever people or institutions deny the constraints under which they operate. This is so in a struggling business trying to deny the evidence of its own failure and in a research team that constantly pushes people beyond the limits of their own abilities. That stress actually reduces ability by eroding confidence. It locks personnel into a vicious cycle of failure and retreat that leads to isolation, obfuscation and spurious claims of originality. Let people find their own level and hold it so they experience the fulfilment of succeeding close to the boundaries of their current ability.

Once they have settled at that level, a significant proportion will come back and ask for more responsibility. If the risk of failure is acceptable, they should be given it. When people start to grow in this way, holding them back is counter-productive. An innovator whose natural desire to take risks cannot be accommodated in the current institutional setting will inevitably start looking for a more risk-tolerant employer. Let them go. Indeed, it is an error to imagine that the most valuable personnel are the most risk-tolerant.

To innovate one must communicate – the idea must strike an answering chord in a substantial part of the population. Relatively small conceptual adjustments often pay good dividends and institutions below a certain critical mass should concentrate on retaining moderate risk takers. Ideas are cheap and one seriously scary innovator can easily create enough epistemic diversity to occupy a team of twenty or thirty normative researchers. If a colleague's risk tolerance or desire for a change destabilizes the team as a whole, help them develop an exit strategy that will move them to a more congenial environment. If they are any good they will be channelling business back to you within five years. If they are accident-prone, someone else will be paying for damage limitation.

There are circumstances where a risk-taker should also be a team leader, but often he or she is more comfortable and valuable in a consultative or managerial role while the team leader manages relations with the regulator. Indeed, in small projects where stakeholder communities face serious threats, a risk-tolerant project leader can be a disaster, while the same person in a supporting role can pay huge dividends. The exceptions to this rule are when you are trying to create an innovative team from scratch or reform one that has gone stale. Then it may pay to create a project with a start date, an end date and a deliverable (a viable research team) and put a risk-taker in to act as pathfinder. If you do this, develop a succession policy that will calm things down once the job has been done, and help the risk-taker move on to a new adventure.

Sustained innovation

You cannot educate Mode-2 researchers in an institution that cannot facilitate Mode-2 research. Innovation is part of Mode 2 – only part, but an indispensable part. So your training facility needs just enough regulation to meet statutory and ethical standards and avoid mission-critical mistakes. Any more than that and quality of the educational service you provide will fall as, indeed, will the quality of the research you undertake. One might imagine, then, that the easiest way to educate Mode-2 researchers would be to privatize the task and let market forces drive the failures out of business. However, in my experience this does not work. Many effective innovators go out of business anyway, while the universities, for all their faults, have been financially viable for centuries.

As I have already explained, really active innovators need a large team around them to absorb and exploit the conceptual diversity they create. Most institutions have a critical mass below which they cannot do this. Innovators are highly mobile and perfectly happy to walk away from an institution that tries to curb their enthusiasm. If your team is too small you can easily lose all your key personnel in a few months. Even the ‘golden handcuffs’ strategy (paying an innovator enough to keep him/her with you for ever) can be counter-productive because innovators get bored and go stale. The ‘infant mortality’ among science parks and semi-commercial research centres is alarmingly high for this reason. You need quite a crowd of innovators to keep things going for more than a few years.

Furthermore, a substantial proportion of the Mode-2 budget comes from public funding and those who spend that money must be regulated. Simply shifting money from universities to private businesses will move the problem of over-regulation from one set of institutions to another but will not solve it. We need to liberalize, not privatize. Put bluntly, if policy makers can shift the balance between regulation and management to favour innovation in the private sector, there is nothing to stop them doing so for the universities. If they cannot do it for the universities, they probably cannot do it at all.

The guiding principle is very simple. If you want innovation, managers must be allowed to manage. This can only happen if regulators allow managerial responsibility to be pushed far enough down the institutional hierarchy to allow this to happen and, for that, they have to relinquish control. Of course, they cannot cede their task of regulation, so they must negotiate a minimal set of deliverables for the work and hold managers accountable for the lawful, timely, efficient presentation of those deliverables.

Provided the rules of the contract, ethical and statutory obligations are met, regulators have no right to interfere in the management process. Indeed, any agency

that disrupts the research process may reasonably be held responsible for failure to meet the terms of the contract arising through that action. Consequently, regulators and external stakeholders should not intervene in any legitimate managerial decision unless they are prepared to accept liability for that action under the contract. This is widely understood both by regulators and (especially) by managers.

The role of individual players cannot be over-emphasized in Mode 2. If you want people to succeed in a risky business, you need teachers and mentors who can encourage people to take risks and have the experience to distinguish acceptable from unacceptable levels of risk and mount an effective rescue strategy when things go wrong. It also helps if mentors really enjoy watching other people succeed. This is why I assert that the only people able to manage innovation are those who have a proven track record as innovators. Those who have had personal experience are less tempted to upstage innovative novices or abandon them when things go wrong.

The downside of the quality-management approach, however, is that the risk of failure must be real. There can be no accountability in an educational system that is too weak to weed out failures. Sadly, one of the effects of over-regulation in the knowledge sector is that it has become increasingly difficult to tell a student or university employee they have not got what it takes. Indeed, one of the ironies of the Mode 1 / Mode 2 split is that in Mode 2, excellent researchers have a career expectancy of less than ten years while, in Mode 1, incompetent researchers are almost impossible to sack and often get promoted into a sinecure just to keep them out of mischief. The institutions that train researchers should be broad enough to accommodate innovative and normative approaches, but sufficiently committed to quality to weed failures out.

Why researchers fail

In the early 1980s I was working as the Operations Manager of a small airline. We had started with one nine-seater aeroplane and two pilots and built up to a small outfit with thirty or more aircrew. The company was gradually moving from an innovative into a normative phase and I was thinking about a career in research. I was discussing my exit strategy with a colleague who told me there were two types of pilot. There were those who wanted to fly supersonic, and those who became deeply interested in Tiger Moths. The question I should ask myself, he suggested, was: “do I really want to fly supersonic?”

He believed that most well-adjusted people have an intuitive sense of their own strengths and weaknesses and match their aspirations to them unconsciously. If you want to do something enough to devote a few years to practice and trial, the chances are you have the ability and will succeed. My colleague gave me good advice and I have passed it on to others since. Often it works out rather well, but sometimes it goes badly wrong. It works particularly well in civil aviation.

Civil aviation is an unusual sector. The relationship between management and regulation is well understood and regulation (rightly) plays the dominant role. Anyone involved in ground or air operations who starts creating new procedures can jeopardize public safety and place the whole enterprise at risk. For this reason professional accreditation and testing are very demanding and the industry weeds out those who cannot or will not accommodate procedural norms. Although an undergraduate student can win distinction by averaging 75% in examinations, a pilot who scores this badly will fail.

In a research setting, however, there is no 'correct' procedure. Although most academics do not innovate, the freedom to do so has been written into our contracts since the seventeenth century. Consequently, academics sometimes encounter students who want to 'fly supersonic' but lack the technical and temperamental discipline to do so. In Mode 2 we have an ethical obligation to identify and exclude the accident-prone and incompetent. This has nothing to do with hegemony and elitism, but with economics and ethics. Incompetent innovators are expensive to employ and often work under such extreme stress they can destroy their own lives and those of the people around them – especially vulnerable stakeholders.

There are, in my experience, five common categories of incompetent innovator:

1. **Risk-insensitive**. One occasionally encounters a researcher who appears risk-tolerant, but is actually risk-insensitive, accident-prone or plain stupid. Competent risk-takers operate on the margins of their comfort zones, not in uncharted territory. Some people can learn risk-sensitivity and it is worthwhile trying to teach them. Some cannot.
2. **Desperate risk-takers** are often bounced into taking risks by boredom or lack of career opportunities. Many are middle-aged and trapped in dull jobs or unemployed. However, the problem is never one of age alone. It is certainly possible to teach a middle-aged or elderly person Mode-2 skills. I have seen students in their 60s and 70s do excellent work, but those who have not grown accustomed to risk before their 40th birthday seldom adjust well to Mode 2.
3. **Stone-steppers** are people who see innovation as a means to an end – as a stepping-stone they can use to get somewhere else. Stone-steppers cut corners on research and often make spurious claims of originality. Like true innovators, they have an exit strategy but they are often working so far beyond their comfort zones that their strategic ambition is to stop researching as soon as possible and get into academic politics. Many of them succeed, alas.
4. **Psychopaths** are incompetent, unethical opportunists who sometimes masquerade as innovators. Researchers who seem to get trapped in an endless cycle of crisis management and are always 'too busy' fighting fires and dealing with regulators or administrators to do any research of their own may be psychopaths. Psychopaths may have been associated with isolated successes, but never have a solid track-record in their own right.
5. **Information blockers** usually lack confidence in their own abilities and so make themselves indispensable by annexing administrative responsibilities. They often create a complicated web of interdependence that prevents anyone working without their cooperation. An information blocker can easily paralyse a research team. Information blockers often bombard colleagues with unwanted e-mails and yet always retain a critical piece of the jigsaw so you can do nothing without them.

You cannot allocate a person to one of these classes purely on working style. It is especially difficult to distinguish a very ambitious risk-taker from the risk-insensitive type; a desperate risk-taker from a genuine innovator trapped in a dead-end job; a stone-stepper from a jaded innovator; a psychopath from a courageous trouble-shooter or an information blocker from a knowledge gatekeeper. The only way to be sure is to look at their track-record.

Those who have been given tasks commensurate with their training and aspirations and yet who continue to fail, to bluff their way out of the mess they have created or to shift the blame onto others should be encouraged to look for another job. Regulators should be particularly wary of people who seem to fail in a consistent way. If they

continually make promises they cannot keep, fail to show initiative, get involved in angry clashes with vulnerable colleagues or pick up unnecessary administrative responsibilities, it is probably time for a change of scenery.

A regulator's guiding principle in this must be that everyone is allowed to make mistakes, but that no one should make the same mistake twice without discussing the risks with the regulator and seeking formal approval. If the regulator sanctions the risk, the buck stops with the regulator. If not, the person who takes the initiative must carry the can.

To the doctoral student

Your doctoral project is usually your first serious piece of research, not your life's work. Like all projects it has a start date, an end date and a deliverable. You have to find a lawful, timely, efficient creative way of producing that deliverable. Very few contractors last more than ten years, so think of this as a sabbatical from the real business of life, not as your life's work.

Projects have regulators. Yours is no exception and your relationship with the regulator is important. You must either get along or move along. The trick is to negotiate a division of labour with the regulator. Research never goes according to plan, but you *must* have a formal agreement to use as a basis for immediate action. As things progress, you will have to re-negotiate. Keep the process open and unemotional; there is usually room to compromise.

As a doctoral student, your regulator will probably be a small institution (typically a university department). Your regulator is responsible for the extrovert quality of your work. Your doctoral supervisor is the link that connects you to the regulator. The regulator represents the interests of outside stakeholders. It is responsible for quality assurance and accountable for all the project's resources. If you damage a stakeholder's interests, the buck stops with the regulator. Really large projects often co-opt stakeholders to sit in an advisory capacity. When they do this, however, those external stakeholders *do not get a vote* unless they accept a share of the regulator's financial and ethical liability.

Doctoral projects, of course, do not usually co-opt stakeholders – the budgets (and risks) are too small. Here the regulator is a group of experienced personnel who represent stakeholder interests. The regulator delegates managerial responsibility and accountability to *you*. It also delegates some regulatory duties to your supervisor and usually appoints one or more supplementary advisors to support you both. This is the core team of your project.

You are your project's manager – responsible for timely, lawful, efficient, creative action. That is your job and you should take it very seriously. In my experience no-one ever failed to win a doctorate through lack of ability. If you lacked the ability to get a doctorate, you would not have been made a project manager. However, very many gifted students screw up because they lack basic managerial skills or fail to take their managerial responsibilities seriously.

In Mode 2, research is a job. You have to be able to do it when you have a headache or when your love-life is in ruins. You have to have enough in reserve to be able to do it again if you want to. This is important. If you produce a brilliant thesis, but are so traumatized you never want to research again, you have been operating beyond your comfort zones. You have failed to demonstrate your ability to join a post-doctoral programme and should not be awarded a doctorate. Even if you get away with it (many do) you will have failed. Don't burn out on your first project!

A helpful way of thinking about the relationship between regulation and management (due to Vickers 1965) is to imagine a driving game in which the player tries to keep a car on a simulated race-track. When speeds are low the player concentrates on staying close to the middle of the track and getting to the destination. As the road twists more erratically and the simulated car accelerates, the driver begins to lose control and is struggling to keep the car within the white lines on either side of the track.

The task of the regulator is to set thresholds (akin to those white lines) and monitor managerial performance in respect of them. If your actions seem likely to violate a threshold, your supervisor will warn you. If you actually violate a threshold (or ignore advice) (s)he will take action. You may even find yourself disqualified. Your task is to negotiate the twists and turns safely and get to your destination. You are free to innovate *as long as you respect those thresholds and stay in control*. Your supervisor monitors those thresholds and ensures that the risks are acceptable. If there are external stakeholders involved, you may be monitored quite closely. If it's pure research, you can expect a little more freedom.

Sometimes students find regulatory thresholds so restrictive they feel trapped by them. Often the root problem is poor technique. Keep trying. Performance improves with practice. However, sometimes there is a case to be made for de-regulation and you must negotiate, either with your supervisor or through the advisors appointed to support you. However, you should remember that when stakeholder interests are threatened, it is the regulator that takes the blame. Ultimately, it is for the regulator to decide what risk levels are acceptable. Managerial responsibility is delegated to you, subject to those constraints.

If you are unlucky (or accident-prone) the regulator may tighten the rules part way through the project and so reduce your ability to manage. This is rare in a doctoral project, but does occasionally happen. Regulation is usually tightened when a risk-averse regulator is running a risk-tolerant manager and gets stressed into punitive action. This is what happened when civil servants tried to regulate researchers, for example. It can also happen on a smaller scale when a community of Mode-1 academics finds itself regulating a hairy bunch of Mode-2 risk-takers.

If it happens to you, go and talk to your supervisor about risk. Try to negotiate a settlement directly and get something down on paper. Sometimes you need a new supervisor; sometimes you just need to listen carefully to the old one. Remember, the regulator is responsible for extrovert quality and stakeholder satisfaction, you are responsible for introvert quality.

Occasionally the manager panics and knowingly violates regulatory thresholds. This usually happens when (s)he has invested heavily in a project that is going badly and starts to cut corners. Cheating, plagiarism, spurious claims of novelty and a range of unethical research practices ranging from the slightly dubious to the downright criminal can often be traced back to the misery of a badly managed project and a few sleepless nights.

Do not act without first taking advice – even if your supervisor is playing good cop, bad cop. You can always find a third party to mediate – that's why you have an advisor, a student-counselling service and a grievance procedure. Use them. Their job is to help you renegotiate a balance between regulatory and managerial responsibilities. You will not be marked down as a failure if you use them, but you will fail if you deny the existence of a problem. I cannot emphasize this too strongly. Hardly any student fails through lack of ability, but many students fail because they 'know' what external stakeholders expect of them and will not accept regulation. It

really does not matter whether you are ‘right’ or ‘wrong’ about stakeholder needs; extrovert quality isn’t your problem because you are not the regulator.

Sometimes both catastrophes strike at the same time. The regulator is panicked into playing good cop, bad cop and the manager digs in for a fight. Good managers try to avoid these double-whammies and many will capitulate rather than fight – whatever the cost. Those who wade in tend to be hardened risk-takers of the type an American friend described as ‘academic gunslingers’. Often these gunfights are part of a rear-guard action (to cover the evacuation of a research team, say) but they are always desperate ventures. To find yourself in one is to have managed a failed project and screwed up your exit strategy. It is nothing to be proud of.

A doctoral student can ignore quite a lot of my advice and still muddle through, because nobody wants you to fail. However, the work will be much harder and much less fun. Innovation is a social process and those who are tortured by doubt and conflict are poorly equipped to participate. Successful innovators do *not* break rules; they negotiate a chance to change the rules and hold that consensus long enough to make a difference. That is your task.

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