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Directions for environmental innovation – time, space and enterprise pp. 20 - 26

Bronwen Rees interviews Elizabeth Garnsey

"To make the paradigm changes necessary to combat the environmental dangers we face requires a sense of urgency and change of mindset similar to that generated in wartime."

Elizabeth Garnsey is Reader in Innovation Studies at Cambridge Universities, working on emerging technologies, industries and organisations. Bronwen Rees interviews her about the relationship between these issues and sustainability.

Q: Could you tell me something about your involvement in issues of sustainability?
Since I have been working for industries and technologies, there has been a natural progression into technologies and organisations that are environmentally friendly. Students are very keen to do research in these areas. Some years ago I started proposing topics to students for research on new companies launching sustainable technologies and obtained research council funding for doctoral research – building on work on emerging technologies in other sectors. One can't understand environmental innovation without a foundation in how and why radical innovation has taken place in other relevant sectors like ICT, advanced materials and biotechnology.

It was clear that from research into innovation that if we want really paradigm-shifting innovations, then these are most likely to come from new companies. Existing companies have baggage they have to maintain. This has been the basis for their success and so there is a limit as to how much they can change. They lack the incentive for radical change except under specific conditions: when such innovation extends their prior markets, builds on their prior skills or is a basis for new combinations of competencies – some of which they already have. The classic example of incumbent innovation is the float glass process from Pilkington, started in 1959, but this kind of innovation from an

established incumbent is unusual. It is because the required conditions are seldom found or exploited in established companies that most radical innovations, from microprocessors, through to internet technologies have come from new entrants. From their past record and what we know about corporate inertia, we should look to new companies as the source of radical technologies for the environment. There are many exciting ones around. Take 'Carbon8' – a Greenwich University spin-out based on decades of work at Imperial College. At a recent eco-enterprise event, they did a demo with a plastic drinks bottle containing sludge from landfill. They pumped in CO2 under pressure and under our eyes a chemical reaction took place which turned the sludge into a composite of clean pebbles. Carbon8 Systems has developed a rapid, cost-effective treatment for contaminated soil and waste – a controlled and accelerated version of the naturally occurring carbonation process. The technology can utilise waste CO2 emissions from local sources, capturing significant volumes of CO2. When carbonation is used in the recovery and recycling of waste, an end product with value is created. (http://www.c8s.co.uk/Our.html). According to Carbon8, CO2 is a resource that we should use as trees do, to make useful things. Many eco-enterprises are university spin-outs – the outcome of scientists offering new solutions from applying their knowledge.

These small companies are exciting but also vulnerable. They have to develop new technologies in the face of entrenched substitutes and impatient capital. And few new companies start out with sufficient capital to fund extensive R&D, so many of these experiments don't work out. They are not wasted though, because what was learned in knowledge-intensive activity is recycled and used again in new ways. What makes entrepreneurial innovation work is that it is dispersed across the economy. There are waves of activity, most of which don't succeed, but a few of them result in a breakthrough. Big companies cannot work in this way, since they cannot afford to 'waste' resources on projects that don't make money.

But at the same time, new companies have multiple obstacles to overcome in order to succeed, and while there is a lot of talk about new technologies solving environmental problems, when we look closely at new eco-enterprises, we find that they are struggling, even promising ones that are well regarded enough to launch on London's Alternative Investment Market (AIM). Unlike IT or bio-technology companies, they are faced with entrenched substitutes and powerful customer companies who don't have the incentive to innovate.

One of the ironies is that we have seen these small companies struggling for funding because the financial sector has been very cautious about lending to them. Yet in the same period, the financial sector has been involved in sub-prime investment – hardly less risky than investing in knowledge-based companies which can build on and recycle their knowledge to achieve eventual success.

Meanwhile much greater government subsidies have for decades been poured into activities like sugar beet production. There is no knock-on benefit from such subsidies which only depress the price of sugar for third world sugar producers and ruin our landscape. If the same amount were spent on knowledge this would not ultimately be wasted: knowledge finds new routes and combinations. It is not usually the first generation of firms based on new applications of knowledge that becomes profitable, but often second or third generation firms building cumulatively on knowledge developed in their firms of origin that increase the odds that there will be a commercial success. In the environmental arena these efforts will eventuate in technologies that could potentially economise resources and reduce the carbon footprint. Patient capital and well-conceived support, such as was given to the US computer industry by the US military during the cold war, could greatly speed up the process.

Q: So it is difficult to predict which ventures will hit the jackpot?

A new company takes part in a complex dynamic system and these are inherently unpredictable, because of all the feedback effects. Causes become effects, and effects become further causes, and so further effects – it's not a linear process. You can't tell what the long-term impact will be. The way we apply the Newtonian paradigm to the human sciences needs to be rethought. The environment forces us to recognise feedbacks, interactions and unpredictabilities; and that the law of unintended consequences operates. To understand this dynamic we need to explore across technology, business and environmental sciences.

We need a new intellectual paradigm to understand what is going on. There is increasing pressure on young researchers to do predictive 'scientific work' in the social sciences. But science has moved on to recognise that many features in the natural world cannot be predicted. The goal of science has become understanding, not prediction as such, as Ilya Prigogine explained. There are not necessarily one-to-one relationships between cause and effect. That is a challenge to linear thinking.

Q: It seems that we would need a new way of thinking about the relationship between firms and the environment. Is this possible?

We need to move beyond a focus on crude measures of growth – in every arena – as the criteria for success. Value creation is a multi-faceted process. The new environmental companies are like other enterprises in their potential to create far greater social and environmental value than returns they generate for their investors. Innovating companies need to attract partners and co-producers, to help

them create value; they may have to create a whole new value chain where there are no suppliers yet. Even when new companies create value they may not succeed in capturing value for themselves and their investors. But all creative processes need to capture some of the value they create if they are to keep going. And they need to deliver to their partners to retain support. Along the way, value may be created for the community, the local area or the planet.

Q: Is this reflected in our business education?

Business schools believe they will attain academic credibility by creating social science specialities within them. Academic publications tend to be disciplinary – this journal [*Interconnections*] is one attempt at breaking down those silos. Many intellectual breakthroughs of the past century have been at the interface between disciplines through cross-fertilisation of methods and concepts. Genuinely new thinking requires powerful ideas with generic applications. Much of the entrepreneurship literature is attempting to gain respectability by importing concepts from mainstream economics, but applied to enterprises these produce formal approaches that are narrow in scope. They lack that union of evidence with powerful explanatory concepts that have intellectual relevance across disciplines. Evolutionary theory and systems thinking have swept the physical sciences providing new interdisciplinary and non-linear perspectives that can be applied at the interfaces of social and environmental studies. Our thinking can be informed by ideas of feedback, emergence and self-organisation. Books on complexity tend to be theoretical and mathematical and not relate to evidence, but that is changing. In our new book (*Co-evolution*) we try and bring ideas about evolving systems to bear on real empirical data, and to show that you can carry out empirical research about people and the environment based on these ideas. Evolutionary and systems theories have powerful conceptual tools to aid our understanding but their modernist versions need updating.

Q: I understand that in addition to you work on emergent industries, you have been involved in researching into what could help reduce the carbon footprint. Can you tell me more about this?

We are all becoming more aware of our carbon footprint, but the environmental crisis challenges our everyday expectations including those about clock time and overcoming distance. If we were serious about minimising energy use, we would make our work and leisure hours coincide as much as possible with natural daylight, as they did before the industrial revolution. But as long as clock time governs our activities, with most people coming home from work around 5-6pm it does not make sense to put the clock back in winter. It moves daylight from the evening when everyone is up, to the

morning when a third of people are asleep – even in the dead of winter. No energy experts had done the sums to estimate the energy impact of Britain being on GMT in winter. I put this forward as a potential project for students and since 2005 a series of students have taken on tasks in this big modelling exercise. We have had over 200,000 data points to analyse, looking at the impact of changes in light status – as clock time changes – and at half-hourly energy consumption over a period of 6 years. Using National Grid data on electricity use, our pilot study suggests that 2% more electricity may be expended when the clocks are put back as compared with staying on GMT plus one hour, as in the summer. We really wanted to challenge energy professionals to look at the neglected evidence and get the government to think about the issue.

People don't change their hours of work much summer and winter – being ruled by official clock time means we are out of sync with the sun, our source of free light. Ideally we should be out and about when the sun is out. In Scandinavia they start school later in winter when it gets darker. No matter what the official clock says, we could organise local activities when it is light, rather than keeping the same working hours as the hours of daylight shift. That would take quite a change in mindset – it is still cool to be up late and burn the night away, it's a feature of modernism. This is just one example of how the environment challenges us. Institutional innovations like clock time are among the most difficult to undertake because no one owns the problem nor its solution. It also suggests the need for local solutions in the face of inertia at the national level.

Another area that needs opening up is bringing people together from a distance. Video conferencing is now largely a business sector technology, but improved technology could have much wider use. I am not talking here about web cameras on the PC that distort peoples' faces – that does not create a real sense of co-presence and may be one of those inferior substitutes that delay real improvements in a technology. If video-conferencing technologies were optimised and integrated, with greatly improved sound and vision, we could really sit down around the table with friends and family on a life sized screen across from us. There's a lot of work to be done to make this idea a reality, but it is quite feasible already and would actually be less costly than many transport innovations that are already under way, like silent aircraft.

Q: So in fact, in these areas, we are talking not so much about creating and innovating, but rather about a shift in consciousness?

The real problem is mindset. I'm sure that all contributors to this issue will say the same thing. Not just our technologies but our minds are stuck within a high carbon paradigm. To shrink distance, the

technologies are already available; it's a matter of changing mindsets so that people see the point of taking them further.

As for the introduction of other new technologies by new companies, that is much harder, as they need major sources of investment and are not going to generate high returns soon. In the short term in the current investment horizon, the stock market and venture capital paradigms are not going to be enough to support the innovation that has to take place. During the twentieth century world wars, many important technologies emerged under pressure, notably radar and antibiotics. IT made rapid advances in its early years because of the Cold War – the Pentagon invested billions in IT for military ends. IT entrepreneurs were later able to make money out of technologies that had received military development funding. Companies like Oracle and Google were started on the back of US military development funding. Innovative projects like the Internet were brought to readiness through defence funds that aimed to avert the dangers of over-centralized communication systems. Over-centralised systems of energy remain in place however. And environmental ventures that might provide the technologies and ideas for new distributed energy systems today have to raise private sector funds, and are expected to make money in the short term for their private investors despite facing entrenched competition. Shell recently pulled out of renewables altogether, abandoning specific undertakings in offshore wind energy, because under the current fiscal regime it can make many times greater profit in oil and gas than it can from joining the drive towards renewable energy. It requires a massive reallocation of resources to shift the economy from damaging activities to more environmentally beneficial ones. But this is not ultimately an economic matter, nor one that will be solved politically within current electoral horizons. Why do we see no signs of intelligent life in the universe despite having sensors that can detect signals 100 million light years into space? Is it because there is a small space of time between the stage where life forms can manipulate the electro-magnetic spectrum, and the point at which they poison their planet? The environment as an issue will become more central in our lives when it becomes part of a new awareness, spiritual enlightenment perhaps, around our responsibilities towards the future of this small planet.

Reference

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