Anticipatory Innovation

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Abstract

This article examines the role of innovation in society, arguing that a failure of foresight in the practical design and development of innovations has been a significant causal factor in the crisis of global un-sustainability. It questions flawed assumptions about the nature of ecological and social change processes, and the worldview most commonly associated with modernism. In a diagnose, the dimensions of this failure reveal a "disciplinary dissociation", or the failure of disciplines to integrate in order to facilitate a process of innovation with a forward view. Finally the article proposes an alternative approach to innovation which utilises greater foresight, is inclusive of multiple disciplines, and has a greater sensitivity to social and ecological processes. This process is referred to as "anticipatory innovation."

Introduction

We are living in an age of radical innovations. Science, technology and industry have given communities across the world unprecedented instrumental capabilities, and the miracles of technology and industry are trumpeted daily in the popular media. These instrumental capabilities have a shadow side, however, and the shadow side of this process is often ignored or obscured. The tremendous innovative capacities that have emerged in late industrial society, which have led to ever increasing instrumental power, have also contributed to the undermining of social and ecological systems. The development of the atomic bomb, most obviously, exemplifies the proliferation of a kind of innovation not uncommon in late industrial modernity. As the sociologist Ulrick Beck argues, along with the innovative capacities which empower us, we have also seen the emergence of a "world risk society"; a globalizing world of "manufactured uncertainties".[1]

While the direct consequences of our innovations often seem positive, much innovation research has systematically marginalised consideration of the "consequences of consequences" - the diffusion effects of innovation. An illustration of this principle can be perceived most succinctly through a reading of Everett Rogers' well known work *The Diffusion of Innovations. The Diffusion of Innovations* brings together various strands of innovation research, exploring the diffusion of innovation through a generalist perspective on the definition, process and nature of innovation. Included are examples of social innovation (new types of social organization, such as the modern democracy), technical innovations (computers and pesticides) and innovations of technique or method (for example, the boiling of water). It is a text for those who want to know *how* to

introduce innovations into a system, and it includes studies of issues such as rates of innovation adoption, the attributes of change agents within a system, the perceptions of adopters, and opinion leadership (how to influence the right people so that innovations are accepted).

The Diffusion of Innovations has functioned as a virtual bible for marketers, R&D experts, leadership gurus and the like throughout the late half of the 20th century. In this "mountain top" view of innovation research, however, it is stated that less than one per cent of innovation researchers were dedicated to studying the consequences of diffusion in social systems.[2] Existential questions which relate to why people would want to adopt certain innovations in the first place, and issues surrounding the consequences of the adoption of innovations are either subsumed by fixed assumptions (i.e. "this way is more modern/convenient") or left relatively unexplored.

With 99% of research listed in Rogers' work reflecting a largely instrumental approach to innovation, it is apparent that the capacity to effectively develop innovation with an eye to future needs and interests has been lacking, at least in mainstream society. *The Diffusion of Innovations* reflects a general focus on the development of short term instrumental capacity. The question for innovators seems to be "what can we do and how can we do it?" rather than "what effect will it have?"

Rogers himself has acknowledged this problem. In the last chapter of his book he calls for a shift from instrumental innovation research (which looks at the innovation process) to innovation research which also asks "what are the effects of adopting innovations?"[3] Part of the problem, he states, is the longitudinal nature of such research. It takes many years of tracking to analyse diffusion effects in a group. This is not the only problem. A sincere and effective look at the diffusion effects of innovation has often been hampered by the predominance of survey sampling, which is inadequate for the analysis of consequences. There is the difficulty of measuring the effects of innovations within different cultural groups, and within different value structures. Evaluation of the desirability of the innovation is also often seen to be higher among the change agents than the adopter groups, because change agents propagate and diffuse innovations, then attempt to assess its value. With assessor and inventor rolled into one, the independent nature of research into diffusion effects may be compromised.[4]

Innovators and Laggards

One of the aspects of the innovation cycle which is coming under increasing scrutiny is the pro–innovation bias. Rogers frames this bias as:

> *The implication in diffusion research that an innovation should be diffused and adopted by all members of a social system. That it should be diffused more rapidly, and that the innovation should be neither reinvented or rejected.*[5]

This "pro-innovation" bias reflects a belief in the superiority of scientific knowledge and its universal advantages, and through its proponents we also tend to see a prevalence in the use of categories such as "modern" and "traditional". The "brave new world" style innovator will tend to make value judgements about communities based on their level of technological advancement. Within this description we see a standard - deviation bell curve which places "innovators" first, "early adopters" second, the "early and late" majority in the middle and "laggards" last. Thus we may easily infer the absolute value of the swift adoption of innovation.

In a section of the book entitled "Steel Axes for Stone Age Aborigines", Rogers cites a case study on the consequences of introducing innovations into a social system - in this case steel axes in aboriginal populations. The Yir Yont were a tribe whose whole social system revolved around the stone axe, which was the central tool of their culture. Axes were traded in seasonal fiestas with other tribes, and while axes were principally used by women children in day-to-day life, they actually belonged to older men and were a symbol of masculinity and authority in the culture.

The introduction of steel axes by missionaries radically altered Yir Yont culture. The mis-

sionaries granted the axes to all and sundry, and young men, most typically, were the most enthusiastic adopters. This precipitated a massive breakdown in the traditional status – relations in Yir Yont culture. Older men were now forced to borrow steel axes from their social inferiors (even prostituting wives and daughters for the use of someone else's steel axe) and the seasonal fiestas between tribes lost their principal motive.[6]

Rogers himself also belatedly acknowledged the problems inherent in this perspective:

> *Change agents give little attention to consequences. They often assume that the adoption of a given innovation will produce only beneficial results for adopters. This assumption is the pro innovation bias. Change agents should recognise their responsibility for the consequences of the innovations that they introduce. They should be able to predict the advantages and disadvantages of an innovation before introducing it to their clients, but this is seldom done.*[7]

He relates an interesting story about his own efforts, when he was undertaking field work with farmers in the early 1950s. Researching the adoption of pesticides during his PhD preparation, he interviewed one Iowa farmer who was refusing to adopt certain pesticides, which were then being introduced in the farming industry. These included weed sprays, cattle and hog feeds, chemical fertilizers and rodenticide. Basing his "innovation scale" on expert, "best practise" advice from Iowa State University, Rogers ranked the farmer last as a "laggard", because the farmer in question was then refusing to adopt certain new chemical compounds.

Ironically, forty years later IPM (integrated pest management) began to emerge as a farming innovation, part of the organic farming movement which was in direct opposition to the use of chemical agents. Many of the chemicals which were used in the 1950s, had since been banned due to their carcinogenic effects. High chemical usage in farming practises were also subject to decreasing returns (see fig. 1). The cost of using chemicals had increased as more and more chemical intervention was used with less and less efficacy. IPM had come to be considered a cost effective and safe alternative to the use of chemicals, despite the fact that it required more complex farm management. The farmer in question was now considered an "early adopter."[8]

What was revealed in this longitudinal analysis of innovation, and in numerous other studies documented, was the limitations of an instrumental view of the world in understanding the underlying complexities of adaptive life systems.

As we can see from figure 1, the complexity (and adaptive quality of variables within the system) had not been properly accounted for.

An instrumental scientific perspective framed the process as such:

But the actual process that occurred looked like this:

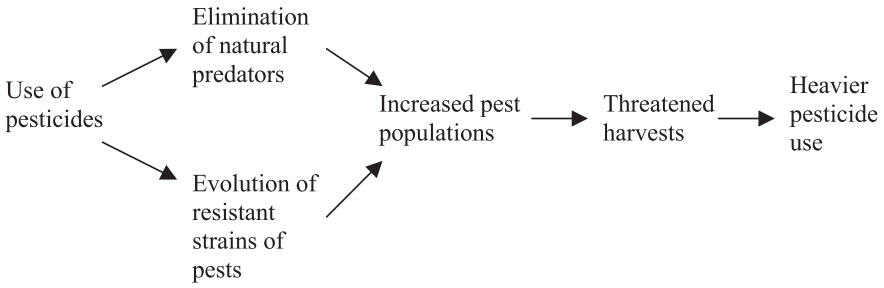

Figure 1: Rogers 1995: 427

The consequences of consequences had not been taken into consideration. It is these consequences of consequences that are often part of the dilemma facing societies and ecologies in the diffusion of innovation. While it is primarily direct consequences that are intended (consequences which are often marketed or created as value propositions), an "invisible web of interrelationships among the elements in a culture mean that a change in one part of a system often initiates a chain reaction of indirect consequences, stemming from the direct consequences of innovation."[9]

A litany of such innovations have played a role in the crisis of un-sustainability. A few examples help illustrate this:

- CloroFluroCarbons (CFCs) were developed as propellants in spray bottles. They are also used in domestic and commercial refrigeration units. These substances came to be considered partly responsible for the disintegration of the ozone layer.[10]
- Nuclear power, at one time heralded as the bringer of limitless and free energy, has been implicated in numerous contaminations. It is now considered impractically expensive and dangerous. Nuclear waste, which is also extremely difficult to store, maintains toxicity for hundreds of thousands of years.[11]
- Synthetic pesticides, the production of which boomed after WW2 as an offshoot of biological warfare research, have found their way into ecological systems. They have been traced in locations as varied as bird eggs and human breast milk. The effects that such toxic agents might have on living systems, as well as the level of threat they pose, is not yet clear.[12]
- Depleted Uranium, a heavy metal used in warfare for its bunker and tank penetrating qualities, has been shown to have long term detrimental effects on humans. The radioactive poisoning associated with DU residue causes horrific deformation in children and even adults. Over 100, 000 Gulf War veterans are said to suffer from "gulf war syndrome", a syndrome which has, in part, been attributed to DU exposure. The superfund money which would be needed to clean up each one of the thousands of contaminated sites in [the middle east] would run into millions of US dollars.[13]
- The combustion engine has been one of the great successes of the 20th century, increasing capacity in the areas of building, transport and manufacturing. Unfortunately the burning of fossil fuels (and particularly hydrocarbons) has been implicated as a major cause of global warming.
- The international monetary system developed through the Bretton Woods accords following WW2 aimed to optimise modernization and economic development. This monetary system has also been instrumental in undermining the currency values of third world countries over the long term, exacerbating third world debt and in some cases making debt unpayable.[14]

In our world risk society of "manufactured uncertainties" we now need to radically rethink innovation. We should not continue to introduce radical uncertainty into complex socio - ecological systems, without regard to the often counter-intuitive effects which may be produced. The well known American historian, Lewis Mumford, expressed the issue this way:

> *In the old game of truth or consequence, the consequences turn out to be as important as the truth, and must be warily examined and re-examined with every extension of truth into new areas. For this lack of wariness today, not only do millions of human beings live in the shadow of a total catastrophe, but the air they breathe, the water they drink, and the food they eat are all being poisoned by other misapplications of scientific knowledge.*[15]

Brave New Worldviews

"Modernism" is the term which is generally used to describe the period following industrialisation. As Jaques Ellul has pointed out though, a series of technical innovations as varied as the computer and telecommunications revolution, the leap into space, automation, the combustion engine, military advancement (tanks,

hydrogen bombs, guns), international monetary systems and the expansion of electric power could be more accurately described as several mini revolutions (making large - scale terms such as "modernism" over simplistic).[16] "Modernism" itself has been most commonly typified by an energetic worldview; a belief in a world of possibilities. The confidence of that era was not entirely unfounded, either; polio, as well as other diseases, are today a significantly smaller problem (at least in the first world) than they were at the turn of the 18th century. This confidence can be seen as reaching its peak in the historic moon landing. The mentality "if we can put a man on the moon we can do anything"' reflects the beliefs of an era where potential did indeed seem limitless.

Despite the confidence which has been inspired by "progress", there have been many noteworthy minds critiquing "progress" along the way. Carl F. Stover, writing as early as 1964, summed up the situation thus:

> *A source of great authority over nature, the modern scientific - technology promises to be both the hope of man's future and the instrument of his enslavement or destruction. If we are to avoid the disasters it lays open to us and take advantages of the opportunities it presents us, we...must understand what modern technology is, what it means, and what must be done if it is to serve man well.*[17]

A "source of great authority over nature", innovation (and particularly technological innovation) was viewed as both the great hope, and potential threat. Both views can be seen as having validity. The belief that innovation, and particularly technological innovation, however, represents a panacea for all the problems of the world has since been revealed as a simplification. We live in an inherently complex world, a world of subtle and adaptive life systems, market forces, sociologies and political systems. Instrumental ability is always limited by context and circumstance. Despite our best intentions, we often fail to acknowledge the challenges of a complex world.

During the Seminar on Technology and Social Change, held by Columbia University in 1962, Eli Ginzberg and colleagues assessed some of the inherent tendencies of the innovation of his time. Over the course of the seminar, themes had begun to emerge. One of these was a tendency for technological innovation to be focused on certain objectives.

Industrial nations, it was pointed out, seemed to be focused on innovation as a key to increasing economic growth through heightened industrial productivity.[18] Much of such "increased industrial productivity" had defuturing (i.e. future degrading) potential, through both the consumption of resources and manufacturing processes. There was also "concern expressed about the fact that such a disproportionate number of scientists and engineers are engaged in military and space research and development activities which are relatively contained and do not easily spill over into civilian life."[19]

As we can see from these observations, increased industrial productivity, military and space research tend to reflect the short term goals of governments. They are often used to advance some of the comparatively limited, and even destructive tendencies of nations, just as technological innovations which are driven by market forces represent the short term profit goals of companies.

In a complex and multi - layered world, the question of where the funding and support for innovation is coming from becomes extremely important. Technology will not always "spill over into civilian life" in positive ways (i.e. be used for the utilitarian common good) and we don't always get the technologies we need, at the price we want, when we need them. Much funding, inevitably, comes from the corporate sector. The corporate sector may produce tetanus vaccines, or fish fingers soaked in saturated fat (the fat helps the product to reheat well, and makes the cheaper - than - fish "breading" taste better, making the product cheaper to produce). Such products are not marketed purely for philanthropic reasons. They are marketed because they are commercially viable.

Due to contributing factors such as those mentioned above, we often see the innovation of technologies which are an expression of the negative aspects of human societies; whether it be the greed of oil and fast food companies

(whose combustion engines and fish fingers represent products with damaging social effects), the tendency of nations to innovate new methods of human destruction, or simply the development of monetary systems which devalue the currency of third world nations, impoverishing entire population and even nations.

The Dissociation of Modernism

Ken Wilber blames certain destructive tendencies in society, in part, on the development of modernism. Wilber has attributed to modernist and post-modernist movements alike the creation of what he refers to as a "flatland". Wilber believes that the three main *human value* spheres of art, morals and science were differentiated through modernity, allowing for the development of modern democracies, human rights, rigorous science, new forms of artistic expression and philosophy.

The unrivalled success of science and its technical - empirical mode of enquiry, however, colonised the other value spheres. The success of science was also more easily measurable; it is easier to know that a big building is truly "there", for example, than it is to assess the presence of authentic communication, happiness or insight. This colonisation, in effect, marginalized inquiry into art and morals, the psychological and inter - subjective respectively. Wilber terms this "the disaster of modernity".[20] He argues that post - modernists have successfully critiqued the shortcomings of modernism, but have failed to re-conceptualised a new "paradigm" without falling into the same "flatland".

Wilber also believes that post-modernist critics fail to acknowledge what he refers to as the "dignity of modernity", or the unparalleled success of modernity. Wilber's integral theory aims to integrate *value spheres*, without falling into the trap of a solipsism, which denies anything outside of the socially constructed, or of an empirical "flatland", which denies anything outside of the material, observable and structural.

This also reflects the concept by pioneering ecological economist Herman Daly, that the ultimate ends we strive for as communities revolve around qualities, not quantities, which he distinguished through the "Daly triangle".[21] These qualities may be typified by such things as community, well - being, quality of life, happiness, harmony, fulfilment, self - respect, self - realisation, identity, flow, resonance, transcendence and enlightenment. Donella Meadows later extended this toward developing a framework for progress indicators.[22] Together they show how immaterial qualities are often sidelined in favour of means, which are more easily measurable. The objectives of nations, to increase production, can soon become a recipe for a material abundance which lacks moral or spiritual direction. While means are important, Daly emphasises that these should be a platform for human self - realisation. Without this insight, sustainability is framed naïvely, maintaining meaningless consumerist life-styles.

Another aspect of this dissociation, which runs parallel to Wilber's critique of modernity, is the specialization process that has evolved throughout academia. The disciplinary advancements characteristic of western-style education, which saw the differentiation of manifold new fields, has also led to disciplinary dissociation. Explanatory power wielded in each field has expanded through this process of disciplinary development, but a failure to integrate these domains of knowledge and their practical applications has led to an inability to integrate ways of knowing; a pathology of blinded development. We are no longer "warrior–poets", we are more likely specialists. Capitalists make money, and ethicists make ethics. Our roles, and our academic disciplines, are not only limiting, they express a profound ignorance for the rest of what counts as knowledge.

Anticipatory Innovation - Deep Designing Sustainability

Whether we feel that we personally have chosen "modernism" or not, there is no doubt that the world we have created, is the one which we must deal with. We may choose to idealise the past, but such an approach is unlikely to prove useful in facing the challenges

of the future. Jacques Ellul, writing in 1962, commented that:

> *One may well regret that some value or other of the past, some social or moral form, has disappeared; but, when one attacks the problem of the technical society, one can scarcely make the serious claim to be able to revive the past, a procedure which, in any case, scarcely seems to have been, globally speaking, much of an improvement over the human situation of today. All we know with certainty is that it was different, that the human being confronted other dangers, errors, difficulties and temptations. Our duty is to occupy ourselves with the dangers, errors, difficulties and temptations of modern man in the modern world...There is no possibility of turning back, of annulling, or even of arresting technical progress...It is our duty to find our place in our present situation and in no other.*[23]

In order to find our place in the future, we must engage with our strengths, and one of the strengths of our species is the capacity for foresight. Humans, as distinct from other species, are capable of the abstract conceptualisation of change processes and of the influence of future conditions.[24] Communities can even increase or develop their "foresight potential" (if we are to see "foresight potential", rather than as a fixed capacity, as a capacity which may also be engendered or developed through learning processes). According to Slaughter, foresight needs to be an embedded capacity society - wide.[25] Through the development of foresight capabilities, human systems can overcome the challenge of internal rigidity.

If we wish to innovate in ways which have positive impacts on society and the natural world, we must develop innovations which have futuring (future enhancing) rather than de - futuring (future degrading) potentials.[26] We must have innovation with anticipation – a forward view. Innovation must be sensible, realistic and positive in its engagement with sensitive, complex and adaptive life - systems.

It has been argued that social change is typified by "tetra–evolution", meaning that changes in social structure correspond to ideological and worldview shifts.[27] This means that changes in our social structures also need to be accompanied by psychological and behavioral changes, new perspectives, worldviews and narratives. The emergence of anticipatory innovation can be seen in this light, as the tetra - emergence of cultures and worldviews of sustainability and sensitivity, greater foresight in individuals, and the emergence of arts and sciences toward a radical re-design of the organisation of ourselves in our world.

Sustainable innovations need to make unsustainable innovations obsolete. The creative/destructive potentials within our species will not simply disappear, but we can become more aware of our futuring and de-futuring potentials, and become more responsible through this process. New innovations with sustainability (in its myriad forms) in mind will need to challenge older innovations which are less sustainable. Through a process of expanded perception and consciousness, creativity and design, inquiry and social legitimation, we can begin to institutionalise a process of anticipatory innovation.

Appendix - Examples of Anticipatory Innovation

1. *Transdisciplinary design* – the development of new fields that straddle disciplines, integrating perspective so as to see the overall picture more powerfully. This is the ideational prerequisite for anticipatory innovation, and future studies has generally embodied such broad concerns. The layered futures studies approach of Inayatullah (which integrates exploration of social change, cultural worldviews, narratives, myth and metaphors in a process of creativity and re-conceptualisation) is one example of such integration.[28] Slaughter's incorporation of Wilber's meta-perspective to develop an epistemologically informed futures studies is another example,[29] as is the emerging complex adaptive systems research of Gunderson and Hollings.
2. *Single products / service innovation* - Innovations of particular products or services (aimed at greater efficiency and

addressing ecological and social issues) have proliferated of late. The entrepreneurial design and proliferation of just one product can have profound effects, and these can have even greater impact through a wider diffusion process. One example is the company Desert Ecosystems, which has produced microbial bacterial cubes which break down the composition of urine in toilets, eliminating odor and stains and allowing for a 98% reduction in water used through flushing.[30] Another example of a particular product / service innovation with the future in mind is the development of ethical investment funds and bodies.

3. *Infrastructural design* - At a larger scale of development is the design of infrastructural systems, which by implication are more technically complex and politically sensitive to change, but which are at the core of un-sustainability. An example in Australia is EnviroMission, which has developed a way of producing electricity from a solar thermal power station. The 200MW power station generates energy by trapping air heated by the sun, and can power 200,000 homes.[31] Another example is the Dutch Sustainable Technology Development program, which has created a way of "calculating the necessary scale of de-materialisation" to achieve real sustainability in the Dutch economy. By back-casting from a sustainable economy, they have clarified the degree and dimensions of change in efficiency and waste management necessary to achieve authentic sustainability.[32]
4. *Political-economic design* - This refers to the radical re-conceptualisation of political economy to serve the interests of communities and future generations, instead of just short term corporate-state interests. The emerging field of ecological economics reflects this new focus, as do community based cooperative economic systems. Writers such as Kenneth Boulding and Herman Daly pioneered the reconceptualisation of economics[33], which others such as Paul Hawkin, Amory and Hunter Lovin have further popularised advances in resource productivity, biomimicry, the shift to a service and flow economy and the development of a "natural capitalism".[34]
5. *Sub-political design* – Following Ulrick Beck's concept of "sub-politics", sub-political design can be referred to as the development by emergent global civil society of international and transnational systems and processes aimed at addressing global challenges, such as security, poverty, environment, and development. These are the most complex types of problems and have the longest time scales of change, in respects with macro-historical dimensions. A recent example of this are the changes called for at the World Social Forum, where ecological political and economic thinkers such as Vandana Shiva, Arundhati Roy, Samir Amin, Joseph Stiglitz and George Monbiot argue for a new system of local-global governance as a design solution to the long term and multifaceted problems associated with economic globalisation. As Beck writes:

...with regard to all issues which are central to society, dissenting voices, alternative experts, an inter-disciplinary variety and, not least, alternatives to be developed systematically must always be combined. The public sphere in cooperation with a kind of "public science" would act as a secondary body charged with "discursive checking" of scientific laboratory results in the crossfire of opinions. Their particular responsibility would comprise all issues that concern the broad outlines and dangers of scientific civilization and are chronically excluded in standard science. The public would have the role of an "open upper chamber". It would be charged to apply the standard "How do we wish to live?" to scientific plans, results and hazards.[35]

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Note

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