A New Theory of Innovation?[1]

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ABSTRACT   *Some problems in our understanding of innovation can be addressed by thinking of innovation as a social process. This can be done by using the idea of technology as applied social science. To explore this idea, an approach called 'technography' is introduced. Sources of resistance to innovation are considered and the question whether new technologies will make us more innovative is posed.*

Keywords: applied social science, innovation, linear thinking, social process, technography.

Introduction

My congratulations to 3M on their choice of this year's Innovation Lecturer! It is typically courageous of 3M that they invite an academic, and a social scientist to boot, to deliver this year's lecture. Courageous, inventive, innovative but risky. As we know, however, most innovations fail! We shall see just how risky as the evening proceeds.

It is a pleasure to be associated with 3M as acknowledged pioneers in building a tradition of innovation. More than this, 3M are especially influential in promoting debates between industry, government and academia. For me, the special attraction of this is that this commitment precisely addresses perhaps the major intellectual problem of our time. In an increasingly fragmented society how do we best communicate across organisational and institutional boundaries? As I shall be suggesting, the key to understanding innovation is to place it in the context of this wider problem of communication between and across institutional and organisational networks.

This paper is organised as follows. I first consider where we have got to in our understanding of innovation. I outline some problems which I then suggest can be addressed by thinking of innovation as a social process. In order to explain the particular sense I have in mind of innovation as a social process, I elaborate the idea of technology as applied social science.[2] In order to explore this idea of tech-nology as applied social science, I introduce and discuss one of the key approaches used in my research: that of 'technography'. I then go on to consider sources of resistance to innovation, before finally asking whether new technologies will make us more innovative.

Where Have We Got to?

So what is the story so far with innovation? Where have we got to and what do we now

know? The rationale for the importance of innovation is fairly well known. The advanced economies are increasingly under pressure. There is now increased global competition for a wide range of goods and services. As part of this we see shorter and shorter product life cycles. In order to address these pressures, companies have deployed a wide range of measures which include merging, downsizing, cutting costs and re-engineering. However, there are reasons to believe that we have now taken these kinds of measures to their limit. One can cut costs and downsize only so far. Given the continued accelerating pace of competition companies are forced to innovate. The inescapable conclusion is 'Quick, think of something!' Oddly, given the spirit and force of this rationale, at least in the manufacturing sector, the proportion of a firm's turnover being spent by industry on innovation is actually decreasing.

In addressing the problem of innovation, the importance of the human, social, organisational and management dimensions is now widely recognised. Indeed, there is much high-quality social science research on the subject. Innovation has rightly excited much research interest. But it is perhaps worth noting some outstanding problems. Although we can find a wide variety of definitions of innovation, one of the most popular is that innovation is the successful exploitation (or implementation) of new ideas. This seems fair enough, but it concerns me that this definition might tempt us to overemphasise the distinction between the genesis of an idea and its exploitation. Rather like the old philosophical distinction between the contexts of discovery and of justification, this separation can be misleading. It suggests that the genesis of ideas (discovery) is somehow exempt from the influence of the social networks that are so important for exploitation. I am much happier with the view that whether or not something counts as an idea, and whether or not that idea counts as new, necessarily depends on the social networks involved. Somehow, somewhere, someone has to be convinced that it is a 'new idea'.

A further concern is the way in which 'innovation' sometimes acquires the status of a universal panacea. Everyone seems to agree that innovation is Good For You. The danger is that we reach a situation where, like other Good Things, innovation becomes like motherhood and apple pie. Because nobody any longer denies the desirability of innovation, are we in danger of losing sight of just which kinds of innovation are good for whom?

Is innovation *always* Good For You? We recently carried out a study of university–industry links, focusing in particular on small and medium sized enterprises (SMEs) in the manufacturing sector.[3] As we all know, SMEs are regarded as the engine of growth in the economy. We wanted to know how they went about identifying and acquiring exploitable university innovations. Overwhelmingly, we found that SMEs shunned the notion of innovation. From their point of view talk about innovation was simply not 'real world talk'. They made clear to us their views that 'those DTI people don't live in the real world'. And we were chastised as 'you university types coming down here and talking about innovation'. By contrast, the Department of Trade and Industry (DTI) refrain was 'What are we going to do about SMEs? Why don't they innovate? Why won't they listen to us?'.

The problem of the relation between universities and SMEs is often posed in linear terms. It is imagined there is a (rational) path of connection between university and SME, but the linear connection is impeded or blocked (Figure 1). The disarmingly simple solution is to identify and remove the blockage.

By contrast, the picture suggested by our work with SMEs is of a worldview

Figure 1. A linear model of technology transfer.

organised around a cluster of specific local relationships (Figure 2). This SME-centric universe comprises close connections with suppliers and customers, more or less well developed knowledge of competitors, and lesser interactions with Training and Enterprise Councils (TECs), consultants, trade associations, colleges and schools, exhibitions and shows. Note that university graduates are just on the edge of the universe, barely within the light, while universities and government are on the metaphorical equivalent of the dark side of the moon.

The cosmological metaphor positions SMEs at the centre of their own worlds. They see themselves as neither 'isolated' nor 'cut off' from universities, nor do they think in terms of the path to universities being blocked. They are instead focused upon a specific, specialised set of needs. Their primary orientation is to markets rather than to the production of new ideas. Many of them point out that their key products, upon which their profitability depends, are far from the current cutting edge of research. Obviously, I am caricaturing to make the point. It would be wrong in particular to suggest that all members of the DTI (let alone all SMEs) hold a singular view. Nonetheless it is clear that we have two very different ways of viewing the problem.

The example highlights the inappropriateness of imposing linear thinking. Of course, as many of my colleagues remind me, the linear model is much derided in the academic literature. All of its key assumptions—that the two communities are distinctly separate, that there is a unidirectional flow between one and the other, that the flow comprises the
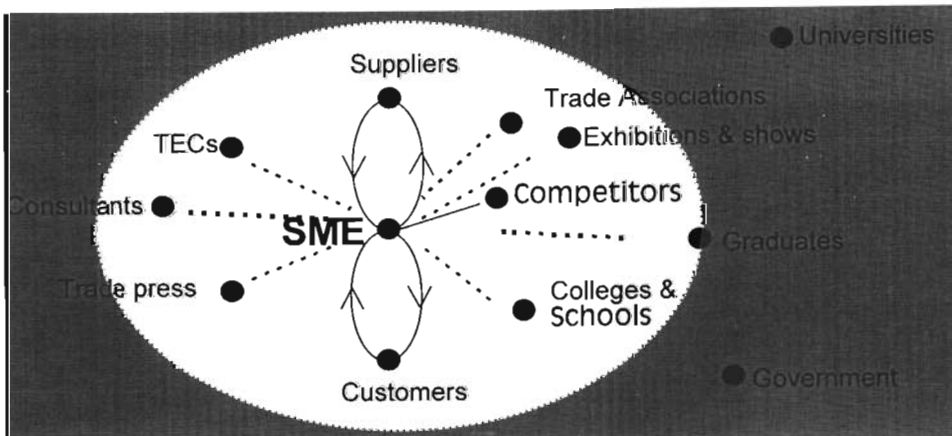

Figure 1. A linear model of technology transfer.

Innovation as a Social Process

An alternative way forward begins with the central maxim of social science that society comprises overlapping networks of social arrangements or social relations. By 'social relations' I mean nothing more sophisticated than sets of identities, expectations, beliefs, values and language. We are each a member of several such networks of social relations. Innovation is a social process that entails a change in a network of social relations. Innovation is thus about changes in some or all of an existing set of identities, expectations, beliefs and language.

Technology is Applied Social Science

Some networks of social relations are more robust than others. Some endure over time, some fade away, some are easily dismantled, some are unstable. One particularly notable class of networks is designed to have particular effects on other parts of society. These networks we call technology. This, I suggest, is one useful sense of the slogan 'Technology is applied social science'. Technology embodies key assumptions, for example, about the identity and nature of users, their abilities in dealing with the technology, what they want and expect and how they will react to a new product. These assumptions inform the design process and become built into the new machine during the process of design, development, marketing and implementation. During this process views and assumptions about users become fixed and set within the emerging technology. The technology comes to embody an assembly of ideas about social arrangements. Technology, we might say, is this network of congealed social relations.

Importantly, the notion of technology as congealed social relations goes beyond the idea that the technical and the social must be considered together. This new way of thinking about technology also insists on the relevance of the human and the social. But instead of thinking in terms of the connection or balance between the technical and social elements, it conceptualises technology as comprising an amalgam of social relations.

Often these social relations—for example, unarticulated preconceptions about users—are difficult to discern in the final product. In order to tease out the congealed social relations embodied within technology, we adopt a perspective that we call 'technography'. By analogy with 'ethnography', this is an anthropological form of study. By way of prolonged immersion in the tribe, we record the details of the tribe's practices and beliefs. This requires sustained empirical study in technical settings. Again by analogy with ethnography, we retain some scepticism about what the natives tell us: about their beliefs, language, practices, myths, hero stories and so on. At the same time, we develop and maintain a dialogue with the subjects of our study. Unlike much traditional ethnography, the process and results of technography are as much aimed at participants in the setting as they are at colleagues 'back in civilisation'. It is thus important to note that this is a method for study in, not just of, technical settings.

An important result to emerge from this perspective is the notion of configuring the user. For example, one technographic study I undertook required me to take the role of project manager in a personal computer (PC) development company. I spent 18 months working with the natives on the development of a new range of PCs for the education market. It became clear that the whole process of development could be understood as a process of configuring the user: a series of activities, events and decisions which amounted to a process of identifying, defining, enabling and constraining putative users of the new PC. For example, different groups within the company held often quite

different views about the user. There ensued lively debates about who knew users best and hence which design features were most appropriate. The development process included a series of well-orchestrated meetings with key user representatives, where I observed with fascination the ways in which users routinely made suggestions to the company for the development of products to which the company had already previously committed. It was clear that the producers of the new technology were not so much meeting users' needs as teaching users what to want.

One outcome of this project can be described in terms of the certainty trough, a notion mentioned in passing by my colleague at Edinburgh, Donald Mackenzie. His study suggested that the reception of attempts to measure the accuracy of nuclear missiles can be represented by an inverted U curve.[4] The y axis denotes uncertainty while the x axis indicates social distance from the site of production (Figure 3). In line with the adage that absence makes the heart grow fonder, we find that those situated some distance from the site of production exhibit greater certainty than those doing the measuring. These, in the terms I have been using, are the configured users. In the case of missile accuracy measurement the configured users were the US military, the generals with a vested interest in believing the figures more strongly than the scientists themselves. At a further remove along the x axis are those entirely alienated from the whole institution, with much higher uncertainty.

The beauty of the certainty trough is that it is extendable to a range of technologies. For example, it nicely describes the range of views about the merits of PC versus Macintosh computer standards. Macintosh devotees, firmly situated within the trough, are configured users whose confidence in Macintosh products is greater than those actually designing and producing them. Yet further away from the site of Macintosh production, we find the disaffected adherents to the PC standard. They manifest an uncertainty bordering on disdain. Incidentally, the steepness of the slope on the left-hand side of the curve accounts for the cognitive wear and tear on the technographer as he or she makes the fieldwork transition back and forth, in and out of the company, up and down the slope. My own experience was that on days in the company I would sometimes wonder how on earth the new machine would ever work: the hard disk access times were way off specification, the case manufacturers had gone into receivership and a leading hardware engineer had been taken off the project to help with another product. By contrast, during days back at Brunel I remember telling my academic colleagues what a wonderful new computer it was. There was even an occasion when I found myself handing out brochures about the new machine.

Configured users are those sitting firmly within the certainty trough. It is obviously the aim of any innovation to create a trough as wide and deep as possible. Robust innovations have just this characteristic. Less robust innovations have a shallower trough (Figure 4). Failed innovations correspond to the entire absence of a trough, a lack of configured users with uncertainty at levels higher even than the insider producers. Those exhibiting great uncertainty to the right-hand side of the graph are the yet-to-be-configured users. They need tempting down into the trough. In all this we see the paramount importance of controlling the boundary between the company and its outsiders, establishing control of access, promoting what counts as an ideal user, and so on.

Sources of Resistance to Innovation

This way of thinking can also help us understand some important sources of resistance
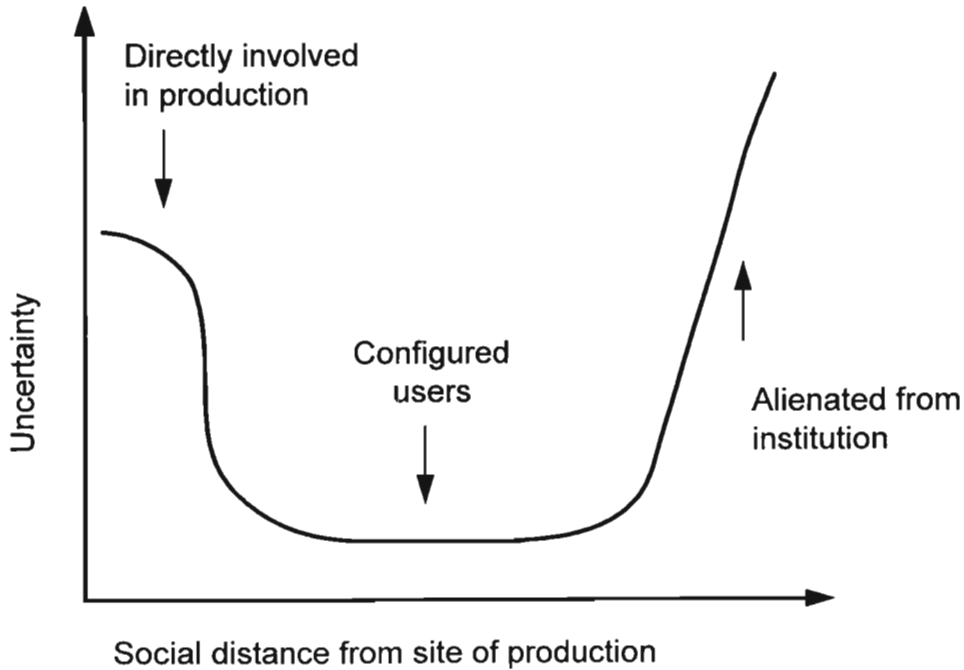
Figure 3. The certainty trough.

to innovation. On the basis of what I have said so far, we know that resistance to innovation is best understood as resistance to change in established social networks. First then let us look at some of the social glue that keeps these networks together and intact. Through language and action, members of social networks routinely remind each other of their membership and of what counts as appropriate behaviour. Folk tales, stories, anecdotes and jokes deploy categories that display the basis for network membership. In particular, jokes are powerful reminders of who is in and who is out of the network. With respect to technological innovations, jokes are the basis for adequate, member-like behaviour towards the new technology. Incompetence jokes are especially vivid examples.

> A novice fax user kept trying to 'send' a document. He complained that it simply wouldn't go. However many times he put it into the machine it just kept re-emerging from the other side of the fax machine.

> A novice CD ROM user complained to her computer supplier that her coffee cup would not fit properly into the plastic cup holder. What cup holder? The one which protruded from the new computer whenever she pressed the little button on the front console.

> A customer of a large computer company was having problems making a particular programme work. The company's Technical Support section asked him to return the floppy disk to them for inspection, but were somewhat taken aback when it arrived with a compliments slip stapled through it.

Incompetence jokes of this kind are boundary devices. They portray and celebrate the difference between insiders and outsiders to a network of social relations. They tell about the incompetence of novices compared with experts; of the ignorance of customers as compared with the knowledge of members of the Technical Support section. The appeal of the jokes is compelling. Even if we don't quite understand the technical substance of
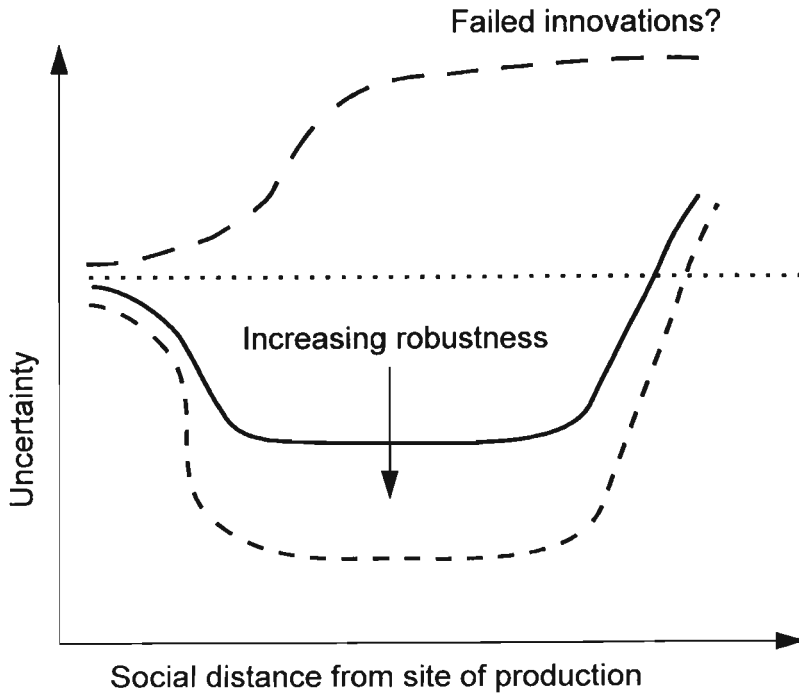
Failed innovations?

Figure 4. The certainty trough—variations.

the tale, our recognition that there is a constituency of person to be laughed at encourages us to laugh along nonetheless. The distinctions articulated by these jokes can also provide a source of identity for self-proclaimed sceptics: 'You'd never catch me near one of them new fangled computers.' These then are moral tales of social distribution. They tell us who is in and who is out. Technology is a network of congealed social relations. These jokes signal the richness of the resources available for reasserting this congealment and hence for resistance to change in the network.

In their more elaborated form these tales appear as urban legends. This is a form of story familiar to you all. For example:

The Killer in the Back Seat

As the woman walked to her car in a parking lot, she noticed a man following her. She jumped in her car and tore off, only to notice to her dismay that the man was following her in his car.

The woman drove through downtown Phoenix trying to elude him, passing stores, houses and bars. When that failed, she drove across town to the home of her brother-in-law, a policeman.

Horn honking, she pulled up and her brother-in-law came running out. She explained a man was following her and 'There he is, right there!'

The policeman ran up to the man's car and demanded to know what he was doing. 'Take it easy. All I wanted to do was tell her about the guy in her back seat', the man said.

And indeed, there was a man huddled in the woman's back seat. [Sometimes the story has 'a man huddled in the back seat clutching a knife'.]

This true incident of several years ago ...[5]

Although analytic treatment of the urban legend genre remains largely undeveloped, it is clear that the urban legend focuses upon something that is peculiarly modern, and which can be experienced as strange, foreign or new. As Noel Williams put it,

> many of the phenomena ... which form the hub of the storyline are innovative and mysterious for many people. Just as for earlier cultures, the woods beyond the village and the flint arrowhead were mysterious, hence potentially dangerous and fearsome, so microwave ovens, foreign coats, hitchikers, superglue can be seen as potentially threatening because unfamiliar.[6]

Of particular interest is the fact that the general form of certain legends remains the same over long periods of time, even though the specific substantive focus might alter. 'Details are forgotten, tales are told in outline only, elaboration or improvement may occur, generalisation or specialisation of detail may occur, cultural or temporal replacement occurs, anachronism is written out.'[7] In other words, although the focus (substance), the particular aspect of modernity at the centre of the story, might change, the form (structure) of the tale remains more constant. The current substantive focus is an index of current concerns and anxieties.

If we look at urban legends in detail we see that they often possess a fourfold structure which organises the telling of the tale (Figure 5). In the case of 'The Killer in The Back Seat', a boundary violation occurs in virtue of the (revealed) presence of the man in the back seat of the car. The violated boundary is that of the car, the bounded space of the car providing a powerful metaphor for the bodily space of the woman driver. Here the delayed realisation is forceful because the feared boundary transgression—that the man following may potentially violate (the space/boundary/body of) the women driver—turns out both to be misplaced and to be less horrific than is actually the case. The horror of the eventual realisation is premised on erroneous optimism. The threatening figure is not just near, in the following car. The real threat has already invaded the woman's space.

Consider the following example:

The Packet of Biscuits

> An elderly woman, travelling by bus, had a layover during her journey. She purchased a package of Oreo cookies from a vending machine in the bus terminal and located a table. She placed her cookies on the table, sat down, and proceeded to read her newspaper.
>
> She was joined by a young man, who, to her surprise, opened the package of Oreo cookies and began to eat them. The woman, saying nothing, but giving him an icy stare, grabbed a cookie. The young man, with a funny look on his face, ate another cookie. The woman again glared and grabbed another cookie. The young man finished the third cookie and offered the last to the woman.
>
> Completely appalled, she grabbed the cookie and the young man left. Outraged, the woman threw down her paper only to find her unopened Oreos on the table in front of her.[8]

Here also are the themes of boundary violation, delayed realisation and eventual guilt (embarrassment). The boundary transgression appears as violation of property rights by the young man: he eats the biscuits that belong to another without negotiation or asking. The violation is particularly acute because it centres upon the ownership of substances that are permitted to enter the body. *Her* cookies are being consumed by *his* body! The inappropriateness of his intrusive behaviour is underscored by his appearance, facial gestures and so on. Yet he appears to experience no guilt about his transgression. The

- Boundary transgression, invasion, penetration
  ➡ contamination, pollution, illness
- Illicit boundary transgression
  ➡ guilt and/or embarrassment
- Delayed realisation, uncertainty, hidden intruder
  ➡ contamination/guilt arises when it
  is least expected
- Self-replication further spread/contamination
  can occur before condition is detected

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Figure 5. The anatomy of an urban legend.

delayed realisation is that contamination/intrusion has occurred in precisely the inverse way supposed by the elderly woman: it is she who turns out to be the transgressor.

Urban legends work as moral tales about the dire consequences of boundary transgression. In other words, they go one step beyond incompetence jokes. Not only do they display differences between members of different networks of social relations, they also suggest the negative consequences of violating established boundaries. They have the added twist that the feared violation is actually less horrendous than another violation that has already actually occurred.

Perhaps one of the most celebrated applications of urban legends to technology is the case of stories about computer viruses. These contain all the main elements of the classic urban legend structure. The use of alien software that infiltrates one's otherwise uncontaminated system. Where the software is of illicit or dubious origin, there is the basis for guilt. Should you have not bought a copy with a licence rather than copying the disk borrowed from a colleague? The ensuing virus-induced problems are the consequence of illicit boundary transgression, but the effects of the virus are initially hidden. By the time detection has occurred it is too late to stop the further spread of the virus. In a way that uncannily parallels descriptions of the spread of AIDS, these stories tell of the stark fate that awaits those who do not take precautions and who fail to heed the warning, 'You can't tell by looking.'

Unsurprisingly, computer virus stories are resonant with descriptions of boundaries, foreignness and contamination. An early example includes the passage:

> A malicious agent might order the host to kill every file within reach. Usually the self-destruct command is delayed for a period during which the virus replicates, allowing for wider dispersal. The most destructive agent so far ... turned up in a corporate network in California last year. It interfered with the scan control of two video monitors, setting one afire.

> This winter, universities in the eastern United States and in Israel encountered a couple of nasty viruses, one of which appears to have originated from Pakistan.

> After replicating for several generations, the Pakistani virus as it came to be known, destroyed every file it could reach. The number of students and faculty members affected is unknown, but may number in the hundreds.

Significantly, the narrative deploys graphic boundary imagery ('erect barriers around them'; 'originated from Pakistan'; 'in California') and includes contrasts between good and evil ('black programs'; 'malicious agent') and between dirt and cleanliness ('islands of clean data'). More up-to-date examples focus on the use of mobile phones:

> The setting is one of those increasingly rare trains with compartments and a corridor. The compartments have glass doors and partitions. An old lady is seen tapping on the window partition of a train compartment while a businessman inside the compartment is using his mobile phone. At first he ignores her and continues with his conversation. But she repeats the tapping on the window. This goes on for some time until he can no longer stand it. Very irritated, he eventually breaks off his conversation and slides open the compartment door. 'What do you want?' 'Ah,' says the lady, 'will you be much longer, as I have to phone my sister?'

> On the train between London and Manchester, an ostentatious city type in pinstripes talks loudly and at length on his mobile phone, much to the irritation of the other passengers. This goes on for the greater part of the entire journey. Suddenly an elderly man collapses in one of the seats across the aisle. He has evidently been taken ill. Several passengers rush to his assistance while the city type continues to yak away on the phone, apparently unperturbed by what is happening in the carriage. The passengers realise they can use the phone to get help. But when they ask him he refuses to let them have use of the phone. He is too busy, he says, the call is very important. The passengers beseech him to be reasonable. He continues to refuse. Outraged, the passengers eventually seize the phone from him only to discover that it is a toy one.

> In similar vein, you have probably heard the story of Chilean police stopping motorists in Santiago for using cellular phones whilst driving. Of the 49 motorists stopped while driving, it turned out that one third were pretending to talk on fake phones!

As with all urban legends, one of the most interesting features of these stories is the speed with which they are repeated and spread. Perhaps the only things that spread (almost) as fast as cellular phone technology are the stories about it. I was told the Chilean story by four separate sources in the space of 48 hours. These stories index a profoundly entrenched source of resistance to innovation. They are built around a fascination with and concern for established boundaries. In the case of mobile phones, the concern focuses on new ideas about space. The narrative tells of new divisions of behaviour and of responsibility contingent upon the introduction of the new technology. They are moral tales about the consequences of disrupting accepted social boundaries.

Jokes and stories about technology are not to be dismissed lightly. They deploy a long-standing narrative form to depict features of the latest technology. They are functionally important for rehearsing and displaying concerns about changes in social behaviour (and about the moral implications) contingent upon new technology. As such, they are an index of cultural responses to new and potentially frightening social arrangements. This a common and recurrent reaction to new technology.

Will New Technologies Make Us More Innovative?

My argument thus far should make us pause before answering this question head-on. In

particular, we must beware the distractions of the claimed effects of new technology. (Do not succumb to the temptations of the latest software package in a major presentation!). My central point is that innovation means a change in social relations. Our question thus translates as: will new technologies bring about a change in social relations?

The sorts of perspective required in addressing this question are illustrated by a recent study of business teleworking.[9] The broad rationale for this technology, of course, is to take advantage of the ability to reduce the amount of time spent in travel and in face-to-face contact, and thereby increase overall efficiency. The study found that teleworkers did indeed make faster, more extensive and quicker contacts with a wider variety of potential customers. But having done so, they were able to capitalise on these new contacts only by arranging to meet them face to face. As a result, the teleworkers found themselves using more time travelling greater distances in order to capitalise on the contacts they had made electronically. Greater remote contact thus led to increased face-to-face contact! This is a good example of a failure of innovation in the sense I have been using it. The failure was that there was insufficient change in the network of social relations.

Conclusions

In conclusion I recommend the following principles to guide our reorientation to the question of innovation:

- Beware linear thinking.
- Encourage intellectual promiscuity. We need to promote more and greater interaction across the boundaries between government, industry and academia, preferably to the extent that we can comfortably disown the constraints of these categories. Intellectual promiscuity? As one of my favourite feminist colleagues says, there should be much more thinking around!
- Innovation is a social process, which means it is a process of changing networks of social relations.
- Technology is applied social science. Technology is a particular kind of network of social relations, purportedly more robust than some networks, often embodying social relations in material form.
- Be technographic. To reveal embodied social relations, we need to look closely at the process of development and implementation. We need to retain an analytic scepticism about what the natives tell us, but simultaneously commit to working closely with them.
- Sources of resistance to innovation, often deeply entrenched, are manifest in fears about changes in established networks of social relations.

It follows that successful innovations need to have the right social networks in place. It similarly follows that our efforts to understand and produce new insights into innovation also require us to have the right networks in place. So is there anything new in this 'new' theory of innovation? Adequately configured readers of this text will have to answer yes!

References and further reading

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