The Knowledge Economy as the Second Age of Craft

What follows is an extract from: Gristock, J (2001) A study of a System of Innovation as a System of Mediation: Organisational Virtuality in the UK Newspaper Industry. Doctoral Thesis, University of Sussex, Sections 2.6-2.8 (see https://independent.academia.edu/JGristock) gristock@me.com

———

2.6 Technologies, space, time and communities.

Technologies are often understood as objects or artefacts which are the result of 'applied science'. Even Castells writes, 'By technology I understand, in straight line with Harvey Brooks and Daniel Bell, "the use of scientific knowledge to specific ways of doing things in a reproducible manner"' (Castells 1996:30). But other authors, for example, Vincenti (1990) and Rosenberg (1994), acknowledge the limitations of scientific knowledge[1] in the development of new technologies:

While scientific theory sometimes guides the experimentation process, the precise design of an experiment and the mapping of its results into a new product or process are activities that cannot be deduced from theory. . . Science, at best, is of only limited assistance in determining the specificities of such designs (Rosenberg 1994: 2).

Yet perceptions of technology are not simply influenced by disciplinary considerations. When Marvin (1988: 3) argues that '"new technologies" is a historically relative term', it is accurate to say that the word, 'new' adds very little to this sentence: our perceptions of which artefacts do, or do not qualify as 'technologies' change over time, between places and communities. For example, Vandiver (1988: 96) notes that thermal shock was being used in the heat treatment of figurines in 25,000 BC, that containers were being made from fibre-reinforced composite materials in around 7000 BC, and that Egyptians were making non-clay ceramics

[1] 'Making something that works economically, reliably and safely is a rather different thing in purpose and consequences from running a scientific laboratory experiment. Such differences explain why engineering can never be simply applied science' (Vincenti 1995: 308).

such as faience[2] in 4000 BC. Such early materials technologies could hardly be described as the result of 'applied science'. What then, does this say about scientific[3] definitions of technology? She notes:

We rarely read technical papers older than a decade, and often tend to think in twentieth century ideals of uni-lineal progress from the scientific or industrial revolutions of the 17th or 18th centuries. We tend to forget the complex and diverse technologies that are thousands of years old which are examples of problem solving by analogical reasoning (Vandiver 1988: 99-100).

Our perceptions of the artefacts and systems that qualify as 'technologies' therefore change over time. But if communications in the virtual organisation, which is said to be 'enabled' by information and communication technologies, use both old and new technologies, then there is a danger that the role of the older communications media will be overlooked, as the emerging 'high-tech' systems call into question the older media's very status as technologies.

However, scientific and temporal considerations are not the only factors affecting the activities that a particular group of people regard to qualify as involving 'technology'. For example, today, some UK engineers will happily describe the Neolithic ceramics as ancient technologies[4], yet many would balk at the idea of categorising weaving tools in this way[5]. Weaving[6], being currently regarded as 'women's work', is not so easily regarded as technological[7]. As Gordon writes,

---

[2] Vandiver (1988: 101) writes, 'the innovation involved combining a powder processing technology with experimental pyrotechnology such that liquid phase sintering of quartz with a soda-lime-copper-silicate occurred'.

[3] The Royal Society was formed as 'The Royal Society of London for the Promotion of Natural Knowledge in 1662 (Bronowski and Mazlish 1960: 183).

[4] UK materials engineers, for example, set up the Historical Metallurgical Society in 1962 (Historical Metallurgical Society 2001).

[5] Gordon, as an engineer, may be an honourable exception. For example, in his discussion of sails and the 'bias cut' dresses of the 1920s, he writes, 'In many respects, the problems of persuading cloth to conform to a desired three-dimensional shape are not very different in sailmaking and dressmaking. However, tailors and dressmakers seem to have been more intelligent about the matter than sailmakers' (Gordon 1978: 255).

[6] For example, under the heading, 'Technology from Ancient Greece: Women Weaving', Ford describes an illustration of women using a loom on a Boetian vase by saying, 'This small illustration, dating from 430 BC, is one of a range of early portrayals of technology' (Ford 1992: 15).

[7] For instance, the current coding system of the UK's Universities and Colleges Admissions Service (UCAS) categorises weaving and under 'design' (Code W) rather than 'technology' (Code J), although weaving techniques are used in composites technology. See UCAS (2000).

The engineer had to get his effects by means of wheels, springs, connecting rods and pistons sliding in cylinders. Although these rather clumsy devices were originally imposed on him by the limitations of his materials, the engineer has come to look on this kind of approach to technology as the only proper and respectable one (Gordon 1978: 22-23).

When considering the nature of technology, then, it is important to look beyond our ideas of the communities which are traditionally seen as engaging with it. It is also important to look back further than the 17th or 18th centuries, as our notion of what a technology is changed considerably during this period. And it is also worth considering: is it possible that this change in our understanding of technology has influenced our understanding of ourselves?

2.7 Technologies and skill

The starting point of this journey into the nature of technology is an entomological one: the observation that the word, 'technology' comes from the Greek *tekhne,* meaning 'skill' (Heidegger 1977). Over time, the association with 'skill' has been overshadowed by the perspective of the technology-as-artefact. For example Marvin (1988: 4/5), laments the misapprehension that the social influence of media technologies 'logically and historically begins with the instrument'.[8] Similarly, Blackman writes that studies of much older technologies suffer from the same limitations:

There is a tendency to disembed ceramics from their cultural context and view them as individual objects. These objects are studied, grouped based on technological similarity.... and conclusions presented based on this comparison... .but to understand technological changes in ceramic production, it must be viewed within the context of the culture in which it was embedded (Blackman 1988: 103/4).

Indeed, our concept of technology has moved so far away from its Greek root (skill), that some authors are cautioning policymakers against policies which see universities as a source of 'technology rather than talent' (Florida 1999, SPRU 2000). That the word, 'talent' should be chosen by those wishing to redress the balance is especially curious, given that this criticism comes in the context of intense pressure on academics for the commercialisation of science. After all, the word, 'talent' comes from the name of a coin[9]. 'Talent' came to mean, 'skill' only

---

[8] For example, considerations of 'the instrument' alone cannot explain why Trevor Baylis' invention, the clockwork radio, made the radio a 'new medium' for many rural communities in Africa in the late 1990s.

[9] From Assyria, Greece, Rome and elsewhere (Brewer's 1996: 1051).

when Matthew (25: 14-33) retold a parable which used the investment of this currency as a metaphor for the development of God-given abilities. But if techne denotes a skilful 'mode of knowing' (Krell 1978: 180) or 'art' (Jones 1981: 62) the new emphasis on 'talent not technology' suggests, not the emergence of a new relationship, but rather, the rediscovery of an old, familiar flame in the 'white heat' of technology.

The Collins English Dictionary (1994: 1583) defines *technology* as: (1) the application of practical sciences to industry or commerce, (2) the methods, theory and practices governing such application: a highly developed technology, or (3) the total knowledge and skills available to any human society for industry, art, science, etc. Other common definitions belie a shift of focus: from skill to artefact; and from a wide to a narrower set of goals or objectives. The nature of this change is well illustrated in the writings of Thomas Carlyle (1795-1881) who regards technologies as involving the artful adaptation of means to ends (see Gross 1992: 136). In *Signs of the Times,* Carlyle describes how the advent of machinery and the socio-political environment of the eighteenth and nineteenth centuries changed the nature of this adaptation, and the ends to which it was commonly put:

Were we required to characterise this age of ours by any single epiphet, we should be tempted to call it, not an Heroical, Devotional, Philosophical, or Moral Age, but, above all others, the Mechanical Age. It is the Age of Machinery, in every outward and inward sense of that word; the age which, with its whole undivided might, forwards, teaches and practises the great art of adapting means to ends. Nothing is now done directly, or by hand; all is by rule and calculated contrivance. . . . Our old modes of exertion are all discredited, and thrown aside. On every hand, the living artisan is driven from his workshop, to make room for a speedier, inanimate one. The shuttle drops from the fingers of the weaver, and falls into iron fingers that ply it faster (Gross 1992: 136).

What Carlyle is describing is not the introduction of a technology, but the invasion of a new technology in the social, economic and political spaces occupied by older ones (the weaver's shuttle, etc.). Comparing Carlyle's view of the upheaval of the time with today's commonplace definitions of technology, one cannot help but see both similarities and differences, not least in comparison to Davidow and Malone's (1992) assertion that The Virtual Corporation will cast all others aside.

If technologies across history use skills to adapt means to achieve ends, then before The Mechanical Age, those means were highly skilful (associated with many different forms of knowledge) and the ends were many and varied, (warmth, music, art, etc.). As these dictionary definitions[10] (OED 1989), illustrate, today's technologies, in contrast, are commonly seen as the results of applying only certain types of knowledge (science) to achieve only particular types of ends (scientific advance or industrial goals, profit)[11]. Yet as Jones (1981: 51) points out, 'technology need not be a slave to necessity: machines can also be used for metaphysical or artistic purposes'.

Once created, the machinery of the nineteenth century allowed actions to be completed and goods to be produced, involving manufacturing skills that were certainly of a different kind, and arguably relatively less complex than the skills involved in the pre-automation production process. As materials technologist, J.E. Gordon writes:

The millwright and the coachbuilder, the shipwright and the rigger, needed a very high degree of skill, though of course they had their blind spots and they made the sort of mistakes on might expect from men without a formal analytical training. On the whole, the introduction of steam and machinery resulted in the dilution of skills, and it also limited the range of materials in general use in 'advanced technology' to a few standardised, rigid substances such as steel and concrete (Gordon 1978: 22).

Yet technology cannot be understood by regarding it simply as the skilful manipulation of means to ends. Carrying echoes of the concept of the system of innovation, Kingery, an author who writes about materials and ceramics from a historical perspective writes:

This system of technology [design, manufacture, etc] is immersed in, interacts with, affects and is affected by larger cultural ambience; its complexity and the much greater complexity of the surrounding social, political, symbolic, and cultural sets of systems suggest that any reductionist 'scientific' approach will face difficulties' (Kingery 1988: 160).

This immersion of technologies in this 'cultural ambience' leads to another characteristic of technologies: their potential to reveal the truths and values of communities. Teschner (1998: 3) writes, 'we misunderstand technology by believing that it is something that we can bring

---

[10] The Oxford English Dictionary (1989) defines technology as (a) discourse or treatise on an art or arts; the scientific study of the practical or industrial arts, practical arts collectively; (b) a particular practical or industrial art, (c) the terminology of a particular art or subject; technical nomenclature, or rarely, (d) the systematic treatment (of grammar, etc).

[11] Hagstrom writes about scientific research thus: 'Recognition is given only to scientists who are seen to make original contributions to knowledge without contravening certain normative expectations. These expectations require, on the one hand, conformity to specific theories and techniques and, on the other hand, to certain more general values and goals of science' (Hagstrom 1965; 17).

under control rather than as a power that is capable of defining our values and beliefs'. Such a perspective may carry strong overtones of a technological determinism, a subject which will be returned to in the next section of this thesis. For now, it is enough to say that the 'partial truth' in technological determinism, that 'technology matters' (MacKenzie and Wajcman 1999: 1), and/or the culture of the mechanical age encouraged a change in our perspectives on the nature of production, and the kinds of processes and materials that were, and were not involved in it. As Gordon (1978: 22) writes: 'Once he has settled in his rut of metal wheels and girders [the engineer] takes a lot of shifting'.

This new way of thinking did not end with the technology-as-artefact. As Carlyle's 'old modes of exertion' (see Gross 1992: 136) were thrown aside, people also took on new ways of thinking about the role of technologies in life. For example, Charles Babbage, the inventor of the 'difference engine' wrote:

We have seen then, that the effect of the division of labour, both in mechanical and in mental operations, is, that it enables us to purchase and apply to each process precisely that quantity of skill and knowledge which is required for it: we avoid employing any part of the time a man who can get eight or ten shillings a day by his skill in tempering needles, in turning a wheel, which can be done for sixpence a day; and we equally avoid the loss arising from the appointment of an accomplished mathematician in performing the lowest processes of arithmetic (Babbage 1835: 201).

Babbage's paper, 'On the Economy of Machinery and Manufactures' was extremely popular, the first edition selling 3,000 copies in the first three months (Berg 1979: 41). In this paper, Babbage extends the idea of the division of labour to mental as well as manual operations, applying it to the division of what he considered to be mental operations of different kinds: 'We have already mentioned what may, perhaps, appear paradoxical to some of our readers, -that the division of labour can be applied with equal success to mental as to mechanical operations, and that it ensures in both the same economy of time'.

In contrast to the much more recent work of Gibbons et al. (1994) for example, which focuses on the importance of transdisciplinarity, the influential Babbage maintained that moving from one occupation to another should be discouraged due to lost time savings that could be gained from the division of labour: 'In any change of mental exertion; the attention bestowed on the new subject not being so perfect at first as it becomes after some exercise' (Babbage 1835 reproduced in Berg 1979: 46).

In the nineteenth century, then, as the status of old crafts declined, and the skills needed to operate machinery became relatively easy to acquire, this idea diffused into the growing mechanical-based communities, the idea that labour could be divided, not simply in terms of the individual labourers who had been multi-skilled craftspeople, but were then, for the first time, seen to require assignment to one particular task. With this division of labour was also born the idea that labour could be divided into 'mechanical and mental operations'. The principle of the division of labour discussed by Adam Smith (1776) was seen to hold true, not just for all operations, but for all labours. With the mechanical machine, Babbage's ideas on the economy of machinery, and the dismissal of craft, was therefore born the distinction between mental and manual labour, another division which was able to take hold and flourish in the social and political environment of the day.

For as long as technologies were seen to involve only scientific knowledge plus manual labour (with its relatively less complex operational skills), and as simply a means of creating wealth, this distinction between physical skill and mental knowledge has remained to be seen as a reasonable approximation. Only authors and practitioners who held a much wider view of the kinds of knowledge systems, communities, timeframes, materials and objectives that were involved with 'technology' argued against this new perspective on knowledge and labour[12] or created a new, separate ideology of craft, which turned not on the wheel of technology and *technik*, but on the skill and practice of 'technique'.

2.8 Information technologies, space, time and communities

Freeman writes that 'human societies have always had technology', but that 'the expression "technology" . . . only came into general use when the techniques of production reached a stage of complexity where these traditional methods[13] no longer sufficed' (Freeman 1974: 28). The writer does not wish to contradict this view. But just as Freeman argues that seeing little new in modern technology is a 'profound mistake', this thesis argues that the ability to use, adapt and respond to the technologies which are currently changing science and society relationships is becoming increasingly dependent on the capability to use knowledge which is seen to be 'scientific' and 'technological' together with knowledge which is not seen to be

[12] As discussed in Chapter 3, such a perspective is echoed in the works of Nonaka, Umemoto and Senoo (1996: 205) who describe Western epistemology as traditionally defining knowledge in a way that excludes physical skills or embodied knowledge and hence creates an artificial division between that which is necessary to 'do', and the 'doing'.

[13] Arts and crafts.

science or technology based. It is also related to the many different kinds of expertise, developed over time in particular places, timeframes and communities that are not easily seen to belong to 'science' or 'technology': knowledge that includes, and yet goes way beyond, the scientific and the technological. Such a perspective is in line with the Gibbons' idea of the different communities who contribute to 'Mode 2' research (Gibbons et al. 1994) and Wynne's perspective on the importance of 'knowledge in context' (Wynne 1991) and 'lay knowledgeability' (Wynne 1996). This thesis considers not just 'local context' (i.e., context related to geographical space) but the contexts of space, time and community.

In this thesis, it is argued that almost two centuries after Babbage created his 'difference engine', the developed world is returning to the skill-based economy that pre-dates the Age of Machinery. That the new world has much in common with the old is only just beginning to be recognised (see, for example, Rhodes 2000: 192; McCullough 1998). This is because although the 'knowledge economy' is seen to present a new economic environment, the locus of this change is seen not to lie with skills, capabilities and the creation of meanings, but with information (see, for example, Levinson 1998: 2 Castells 1996: 66-7). Secondly, in this new environment, we continue to cling to idea of the distinction between manual/mental labour, an artificial division which is not helpful, particularly for technologies which demand a high degree of skill to use and adapt in different contexts.[14]

If the old mechanical technologies were relatively simple to operate, today's information and communication technologies demand different kinds of skills, arguably more complex skills, which require constant learning and updating. They require many different kinds of expertise that include, and yet go way beyond, those considered to be scientific or technological. Whether we talk about domestication, or everyday lives (Silverstone and Haddon 1996, Silverstone and Hirsch 1992), the use of these technologies is increasingly and intimately related to the rising importance of skills and expertise.

This expertise is diverse not just with respect to its location within scholarly disciplines (see Gibbons et al. 1994, Castells 1996: 30) but also with respect to a much wider range of contexts, as the diversity of application and adaptation of the new technologies requires a wider range of skills and knowledge to use them: to adapt means to ends. The pendulum is swinging back to craft; skills in the use and adaptation of technologies in everyday life. Once

---

[14] This misunderstanding is also particularly relevant to the idea of the virtual organisation and tacit knowledge, an association which will be returned to in Chapter 3.

again, an individual's skills are the means to bring about ends, since the contexts are so varied, and ends include, but go beyond, the creation of profit. In the socio-techno-economic space where technologies meet everyday life, therefore, lies a sweet irony: that the demands of computer literacy and the importance of context-related skills and knowledge are heralding a second age of craft, at the very time that the management writers speak of 'the knowledge economy' as the decline of so-called 'manual' work.