49

INFORMATION AND COMMUNICATION TECHNOLOGIES AND WORKPLACE LEARNING: THE CONTESTED TERRAIN OF LEGISLATION, POLICIES, PROGRAMS AND PRACTICE

Peter H. Sawchuk
Ontario Institute for Studies in Education/University of Toronto

> Governments everywhere try to formulate productivity-enhancing policies ... [E]conomists have found that technological change is a principal source of economic growth and rising per capita income. Students of business identify it as basic cause of the growth of the corporation. Its effects on employment, the distribution of income and regional differences in growth are carefully scrutinized. (Thomson, 1993, p. 1)

At the turn of the new millennium, national expenditures on Information and Communication Technology (ICT) have approached double digits as a percentage of GDP within the USA, Japan and the European Union countries breaking the 7.5 percent mark. In the USA alone, these expenditures represent over 1.5 trillion dollars per year. Despite this, OECD policy analysts (1999) and an enormous array of others (e.g., Reich, 1991; Thomson, 1993; Castells, 1996; Archibugi & Lundvall, 2001) suggest this isn't enough. For them, it is clear that economic success is dependent on further development of ICT: investment in it, its application, and its diffusion. However, what are we to make of this policy orthodoxy? How is 'technology' itself understood in this context? What are the presumptions made about the relationship between ICT development, implementation, learning and use?

A corollary of this orthodoxy is of course that the invention of new technologies have defined the path of economic progress. However, economic history teaches us that the claims of links between technology, productivity and the emergence of past and future phases in the economy are far from straightforward. The key technologies of modernity, those that are said to have defined the first, second and third industrial revolutions (steam, electricity, and ICT respectively), have in fact seen fascinating, contentious and complex pathways

International Handbook of Educational Policy, 000–000
Nina Bascia, Alister Cumming, Amanda Datnow, Kenneth Leithwood and David Livingstone (eds.)

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

toward application in the workplace (e.g., Von Tunzelmann, 1978; Devine, 1983; Gospel, 1991; Thomson, 1993; Lipsey, Bekar, & Carlaw, 1998). Indeed, the major 'General Purpose Technologies' (GPT's) including electricity (e.g., Hughes, 1983), ICT (e.g., Noble, 1979, 1984), and in particular steam (e.g., Devine, 1983) have been shown to be the subject of political and economic struggle. In fact, in this chapter I argue that the details of the emergence, diffusion and transfer of GPT's provide important clues as to the actual nature of technology as a phenomenon that run counter to conventional wisdom. I begin by asking, is technology a 'thing' or is it a social process? Lazonick (1993) suggests the latter in his discussion of the meaning of 'technological transfer':

> Insofar as the utilization of technology requires complementary human inputs with specific cognitive capabilities and behavioural responses, the transferred technology will have to be developed in the new national environment before it can be utilized there. As a result, when 'transferred' technology is ultimately developed so that it can be productively utilized in a new national environment, it is in effect a new technology (Lazonick, 1993, p. 194).

Lazonick's perspective is in fact aligned with a broad and interactional view of technology represented in the concept that Fleck refers to as 'configurations' (1993). Technology, understood as 'configuration', is defined as a complex mix of standardized and locally customized elements that are always highly specific to specific historical, national, regional or organizational settings. Building on this we can say that those who have been most insightful in considering the nature of technology have defined the term quite broadly to reflect this broad complex. Technology is not this or that tool, artifact or machine, nor is it a 'GPT' such as steam, electricity or ICT. Rather, it is 'the way we do things around here' (Franklin, 1990); the 'organization of resources' (Hacker, 1991; Mumford, 1964); or, 'society made durable' (Latour, 2000). The suggestion here is that any genuinely useful approach to the issue of ICT, work and learning must, then, expand its perspective on technology in order to make it 'social'.

In the context of ICT defined as a social process, it becomes clear that traditional policy research on work and technological innovation has arrived at something of a cross-road: how, in times in which the combination of ICT and knowledge work appear to be pivotal (e.g., Castells, 1996; Reich, 1991), can such policy research credibly proceed without a robust theory of ICT as a broad, interactive phenomenon encapsulating design, implementation, practice and, perhaps most importantly of all, learning?

The most practical outcome of the realization that technologies are really 'social processes' rather than 'devices' is that we are forced to conclude that ICT-based policy cannot be understood in isolation from either industrial relations and training policy on the one hand, or analyses of actual labour and learning processes on the other. However, even this important step in our thinking is not enough. The question remains 'What kind of social phenomenon

are we talking about?' I have mentioned already that steam, electricity and ICT all emerged from, and in fact can be defined through, the push and pull of economic and political struggle. As Feenberg (1991) has said, 'technology is a scene of struggle … a parliament of things'. Historically, as now, the intersection of work, learning and technological change has occasioned conflict: from the Luddite revolts of early 19th century to the countless industrial conflicts caused by the imposition of technological change and, more recently, the transformation of occupations including printers (e.g., Zimbalist, 1979; Wallace & Kalleberg, 1982; Cockburn, 1985; Smith, 1988), engineering (e.g., Jones, 1988), textile work (e.g., Lazonick, 1979), postal work (e.g., Louli & Bickerton, 1995), and computer programming (e.g., Kraft, 1977). Wallace and Kalleberg (1982), working from the US context, summarize:

> We have argued that while technology is the proximate cause of this transformation, the underlying and fundamental sources for these changes are found in historically developed social relations of production … The stated goal of automation in printing, as in other industries, is the rationalization of the labor process: the streamlining of production and elimination of costly sources of human error … However, efficiency is not a value-neutral goal in capitalist economies (pp. 321–322).

Thus, it is the core point of departure in this chapter that our conceptions of ICT, and, in turn, the intersection of ICT, work and learning, must be 'de-reified' if we're to move beyond mere appearances toward substantial, critical analysis. ICT as an isolated device, tool or machine is an abstraction; in reality however, it is an elaborate, historical process. It is fundamentally both a social and highly conflictual phenomenon.

In this chapter I explore a selection of policies and practice at the intersection of ICT, work and learning. I use a broad definition of policy that encompasses formal legislation, regulation and programs at various international, national, as well as regional, sectoral and organizational levels. Defined in this way, policy involves the efforts of national governments and inter-governmental bodies as well as sectoral bodies, firms, research institutes and labour unions. My discussions of practice in this chapter deal with the processes of technological design and implementation as well as the full range of work activity involved in the development of skill and knowledge necessary to diffuse, transfer and actually put to use ICT at the point of production.

The examples I draw on respect this broad, integrative approach to policy and practice. National and international policy and programs are examined with reference to USA, Canada, the European Union, as well as Sweden and Norway. I then look at important types of policy and practice at the level of the firm with a focus first on 'Technology Agreements' and second, on research concerning the practice of ICT innovation and use in the labour process, with an emphasis on what is known in the sociology of work field as the 'de-skilling/en-skilling' debates. I begin, however, with a brief discussion of the central ideological

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

approaches to technological thought: an indispensable resource for assessing the meanings, the biases and the trajectories of recent policies and practice at the intersection of ICT, work and learning.

Historical and Philosophical Contexts of ICT, Work and Learning

In North America, according to Theodore Roszak (1994), the word 'computer' entered the public vocabulary in the 1950's at a time when the most advanced models were still room-sized beasts that burned enough electricity to present a serious cooling problem. Building on the principle of ICT, work and learning as a conflictual social phenomenon as explained above, we can note that computerization was not simply been 'discovered' in the conventional sense of the term. Rather, its was brought into being by specific historical and political economic processes of politics, policy and practice. Noble (1984) provides the definitive analysis in these terms by noting how contemporary computerization emerged through a series of concerted and contested activities through which companies like General Electric, Westinghouse, RCA, AT&T and IBM, relying upon private control over public funds vis-a-vis what could be called the 'university-industrial-military' complex of the post World War II era in America, led the development of specific forms of technology: Numerical Control, Computerized Numerical Control (CNC) and automated robotics. Importantly, Noble makes it clear that, in fact, alternatives to CNC could have been developed that were just as efficient, and that strategic choices by dominant groups revolved around issues of power and control over the organization of production. Just as the Luddites of 19th century Britain were in favour of technologies that supplemented rather than displaced human skills (Sale, 1995), the key alternative with regard to CNC technology was 'Record/Playback' (R/P) technology; a system that was actively ignored largely because, as Noble (1984, p. 190) puts it, "to the software engineer, this places far too many cards in the hands of the lowly machinist".

While this historical background is important, if we are to understand the current intersection of ICT, work and learning as a contested social phenomenon, it is equally important to have a basic understanding of the competing ideologies or philosophical approaches that inform the policy and practice of ICT development and use. Williams and Edge (1996, p. 2) reminds us, "these debates are not merely 'academic': they relate to policy claims and objectives". Extending the analysis of Feenberg (1991), we can categorize the different approaches into four basic categories: instrumental/technocratic; substantive; constructivist; and, what Feenberg refers to as a 'critical theory' of technology.

Instrumentalist or technocratic approaches tend to be the source of either the positive or neutral characterizations of ICT's in the workplace. This is the dominant approach amongst government, business and mainstream policy sciences. Here the transfer of technology is inhibited only by cost; what works in one context can be expected to work equally well, more or less, in another; and, "the only rational stance is an unreserved commitment to its employment" (Feenberg, 1991, p. 6). Influential original formulations of this approach as it

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

involves work can be found in the work of Dahrendorf (1959), Kerr (1962) and Bell (1973) who wrote at length on the issues of technology and industrial progression. More often than not under this approach, technology comes to take on a kind of autonomous, creative and deterministic role (and thus it makes sense that Time Magazine, in 1982, could award 'person of the year' to the computer). This autonomous casting, in turn, gives rise to exaggerated tales of the emergence of 'knowledge workers' (Bell, 1973; further popularized in Naisbitt, 1982) and 'symbolic analysts' (Reich, 1991).

A competitor to technocratic thought is the *substantive approach*, represented best in the writings of Jacques Ellul (1964) or Martin Heidegger (1977). This approach presumes a technology necessarily crystallizes and expresses a type of destructive, alienating, environmentally degrading, instrumental rationality. Like the technocratic approach the substantive approach is determinists. It attributes an autonomous force to technology, with an emphasis on its role in our 'cultural systems', and orients the world as an 'object of control'. An intensely dark trajectory is pre-figured from the substantive approach (e.g., as Heidegger said, 'Only God can save us now'); a return to simplicity or primitivism, according to this approach, offers the only viable alternative.

Standing in many ways separate from either of these first two perspectives is the *constructivist approach*, exemplified (though quite differently) by the likes of Latour (2000), Callon (1992), and Suchman (1987). Taken as a whole, we can say that these works emphasize how technology is rooted in human interaction and the local activation or use of mediating objects or artifacts. The meaning and effects of technology are determined in their use by actors and not necessarily in any straight-forward, *a priori* way by designers. Among all the approaches to ICT, it is the constructivist approach that most clearly articulates how users implement and appropriate ICT; sometimes in keeping with the intentions of the designers (and those who have contracted them), sometimes not. Others (see contributors to Rip, Misa, & Schot, 1995; Suchman, 2002) have echoed the importance of this approach for technological development, emphasizing reciprocal relations between moments of design, implementation, and use in such a way as to open up new ground in conventional understandings of 'choice' within the course of technological development. There is at the heart of this approach a sensibility that suggests that the ways and contexts in which users interact with devices is definitive of the technology as a whole.

Finally there is the *critical approach*. Its roots are largely, although not exclusively, in the Frankfurt School of critical social theory (e.g., Feenberg, 1991). I say not exclusively because a variety of other work, such as that of Lewis Mumford (e.g., 1964), have relevant connections to this approach as well. In general, the critical approach rejects the presumptions of both the technocratic and the substantive perspectives, charting a course, as Feenberg says, between the poles of resignation and utopian visions of efficiency. With its emphasis on power relations, to some degree the critical and constructivist approach can overlap as when authors such as Latour (2000) and Callon (1992) recognize the inherent political dimensions of technological development (e.g., 'Technologies

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

are politics pursued by other means' – Latour). Nevertheless, central to the critical approach may be what Feenberg calls the 'democratic advance'; that is, the democratic participation of citizens in the establishment of both the goals and means of technological development, implementation and diffusion. Echoing this concern in terms of policy analysis, Gärtner and Wagner (1996) have noted, drawing on case studies in Europe, the difficulties faced by design efforts situated within 'fragmented political cultures'. Likewise, Mumford's (1964) pan-historic discussions stress what he calls 'authoritarian and democratic technics', the former being 'system-centred,' immensely powerful and yet inherently unstable due to its centralization of control. Indeed, he goes on to say that to cope with increasingly powerful technologies of the modern era, "if democracy did not exist, we would have to invent it" (p. 21).

I suggest that these four basic approaches to technological thought will be useful as a type of philosophical compass for analysing policy and practice. In other words, they orient us to the more general directions and purposes that, all too often, remain hidden beneath the surface of legislation, policy, programs and practice that express them.

ICT and Workplace Learning Legislation, Policy and Programs

If we commit to understanding the intersection of ICT, work and learning as a broad, conflictual social phenomenon, then, as I suggested from the outset, we must look at a variety of types of policies that relate to ICT training. We must also regard work-based learning – whether it is organized as a training program or undertaken informally in everyday participation within the labour process – as a phenomenon that sits atop, gives meaning to, reacts upon and affects legislation, policy and programs regarding ICT.

Research and development (R&D) is central to the efforts of core capitalist countries (Archibugi & Lundvall, 2001) though there is considerable variation internationally (e.g., see Mani, 2002 for how developed and developing countries compare). In terms of recognition within formal policy of the linkages between technological development and the broader regulation of industrial relations, we see that Northern European governments are most advanced with other European governments such as France and Germany (as well as Japan) moderately so, and the governments of countries such as the UK, USA, Southern Europe, Australia and Canada least likely to recognize, in the form of regulatory policy, these linkages. Clearly, the most 'interventionist' responses of government are to be found in countries like Norway and Sweden where issues of ICT R&D application as well as industrial relations more broadly speaking are shaped by general policy commitments toward 'co-determination'. However, in general, the power of national or international governmental bodies to influence the introduction and application of ICT in actual work processes and workplaces through regulation is quite limited. In the USA, for example, while Carnoy, Pollack and Wong (1993) have noted that labour relations structures, policies and practices are coming to the center of the debate over the design and adapotion of new

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

technologies, the most common model of employer/employee negotiation on ICT adoption is adversarial, antagonistic as well as fragmented.

It is relevant to briefly note, however, that a parallel system of coordinated private-sector policy and (corporate-based) governance has blossomed. There have been, for example, a growing number of international agreements between large corporations in terms of various forms of ICT development and application. According to Archibugi and Coco (2000), between the periods of 1981–86 and 1993–98 international, firm-to-firm technological development agreements have doubled. In particular, strategic technology partnerships (R&D) between Europe and the USA have rocketed in the last 10 years. These partnerships sometimes involve collaborations with public research institutions and universities who play an important role in the international dissemination of knowledge and ICT development, but, conspicuously absent, is the involvement of either unions or the public at large. While this layer of ICT, work and learning policy is important, a solid grasp of the range of governmental legislation, policy and programs in the area remains most relevant for our discussion here. To review these, I rely on several selected examples involving different countries as well as different political levels of enactment.

An examination of the US system of training, ICT development and implementation – often and increasingly set as an ideal in the policy world in terms of leading edge practices of ICT innovation – on closer look reveals a fragmented, chaotic and, in light of the trade-offs it produces for the population as a whole (Audretsch & Thurik, 2001), possibly ineffective overall mix of federal, state and regional efforts. Audretsch and Thurik (2001) suggest this goes hand-in-hand with economic growth associated with the entrepreneurial (versus the managed) economy as policies become most effective at the regional rather than the national level. However, at the more localized level of the firm and sector, the USA system of industrial relations places decisions on technological change and work organization firmly under the 'management rights clause' of any collective agreement (Kelley, 1990). This context includes a corporate culture hostile to unions and comparatively high levels of involvement in 'inter-firm' technological development agreements, both of which decrease the likelihood of genuine 'co-determination' in the USA. In slightly broader terms, vocational and work-based training policy in the USA has also been recognized to be a patch-work of state and federal programs, beginning in 1962 with the Manpower Development Training Act, to the Comprehensive Employment and Training Act of 1973, through to the Job Training Partnership Act (1983) and the School-to-Work Opportunities Act (1994–2001) (see Grubb, 1996). Likewise, host of authors have lamented the general lack of industrial policy in the USA historically, which is also reflected in the arena of ICT R&D policy as well (see contributors to *Industrial Policy: Investing in America*, Volume 5, Number 1). At the same time however, Herman (2001) has documented some important examples of multi-lateral partnership agreements over ICT implementation and training in the USA that would appear to hold a good deal of promise for the future. Based on 14 case studies of 'high-road' partnerships between employers, government

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

as well as unions and local communities, Herman concludes that, in the USA, ICT/work/learning policy that is most successful tends to be found at the sectoral rather than the state or federal level which tends to support the types of claims economists such as Audretsch and Thurik (2001), cited earlier, make around the effects of globalization.

As something of an alternative to the type of de-centralized, largely corporate-controlled policy models seen in the USA, in Canada there has been more innovative experimentation with governmental policy. 'Sector Skills Councils' in Canada offer a unique model not seen elsewhere in the world. At the federal level, these councils have their roots in the Industrial Adjustment Services established in 1963, and saw a height of 22 councils in the mid-1990's (17 with union participation) following establishment of the Sectoral Partnership Initiative by the federal government earlier in the decade. Related initiatives also emerged at the provincial level in Canada. In general, the Skills Council built on pioneering examples such as the Canadian Steel Trade and Employment Congress (Sharpe, 1997). Both federally and provincially, sectoral skills councils had their origins in the inability of the private sector to develop workable options for high levels of training and adjustment on their own.

An important example at the provincial level was established in Canada's most industrialized province (Ontario). It represented a mixed governmental/firm/corporate model that, as in the USA, seemed most effective at the sectoral level. The 'Technology Adjustment Research Programme' (TARP) was first envisioned by the Premier's Council of Ontario in the late 1980's, and was later funded by Ontario Federation of Labour and the provincial government's Ministry of Economic Development and Trade (Schenk & Anderson, 1995). It involved the participation of 16 specific unions. Connected to this program, the government established sectoral strategic initiatives in areas including aerospace, steel, biotechnology, plastics, automotive parts. 'Sectoral Skills Councils' emerged, a variety of sectoral initiatives were established, and a variety of innovative, multi-lateral research efforts were undertaken. However, the results were mixed in terms of outcomes at the level of the workplace, ICT implementation and learning. With the withdrawal of the government, only remnants remain today. Without both broader legislative support as well as ongoing resources for developing this multi-lateral model (inclusive of a genuinely multi-lateral industrial policy), even the best efforts were hampered. Frequently, those at the center of policy implementation and program research lamented a lack of a broader 'European' approach (and funds to match).

One of the most comprehensive sets of studies of ICT, work and learning was conducted in western Europe in the early 1990's. This research was entitled "Participation in Technological Change" and was undertaken by the European Foundation for the Improvement of Living and Working Conditions. Based on 64 case studies and a large ($n = 7{,}326$) survey, the study showed technological change dependent on national industrial relation regimes as well as, in broader terms, "historical and cultural factors" associated with particular nations and sectors (Carnoy, Pollack, & Wong, 1993). In keeping with our prior discussion,

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

two key factors for success were unionization and skill level of workers. The European Union (EU) represents the key example of how inter-national policy and programs are created and carried out, and provides important information on the current status of the intersection of ICT, work and learning in advanced capitalism. In general terms, this model of policy development contrasts starkly with the de-centralized model in the USA. The EU's policies on technology and training revolved around the principle that the circulation of knowledge is as important as a common currency; even more starkly put, "that economic growth, employment and welfare in the old continent are strictly associated to its capability to generate and diffuse new technologies" (Archibugi & Coco, 2000, p. 1).

Perhaps as important as the centralized organization of ICT, work and learning policy, however, is the willingness and ability of the EU to carry out combined R&D, training and implementation research programs that link corporations, research institutions and governmental resources. The most relevant example in this regard is the European Commission's Information Technology program entitled 'European Strategic Programme of Research on Information Technology' (ESPRIT, 1994–1998) (see Cressey & Di Martino, 1991). ESPRIT represents an international attempt, at the policy/programmatic level, to organize R&D, ICT based innovation as well as work and learning outcomes to respond to the needs of the workplace. The ESPRIT outcomes, however, have remained ambiguous from a critical approach perspective, partially due to the phenomenon that Gärtner and Wagner (1996) describe as narrow forms of 'agenda setting'; that is,

> What is politically and ethically legitimate and desirable cannot be simply solved by establishing participatory structures. The kind of close partnership between designers and users at which, e.g. situated design, aspires is not a sufficient answer to the core question of what makes a 'good system'. Our case analysis points at the importance of understanding agenda setting. Each arena has its own set of legitimate agenda, from questions of user interface design to quality of working life and privacy issues. (p. 203)

The ESPRIT program and associated European Commission policies on which it is built is largely democratic, but at the same time its agenda is largely predefined along technocratic lines. At the point of learning and ICT use, for example, its' motive is tied, mostly to serving markets, and relatively narrow interests of profitability rather than issues of quality of working life, sustainability, equity and so forth (Gärtner & Wagner, 1996).

In Northern Europe, however, there is a different tradition at the intersection between ICT, work and learning. Again, Gärtner and Wagner's (1996) work is instructive. Their work looked closely at the role of formal national legislative frameworks, such as the Norwegian Work Environment Act (NWEA), which detail the relations between the various industrial partners and the norms of work, technological development and ICT use. The NWEA defines participation in work-related areas using ICT systems and suggests a much deeper form of participation in policy formation.

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

Specifically, the 1970's was a water-shed decade for progressive policy and legislation around ICT design, implementation, work and learning in Northern Europe. In 1977, the Norwegians put the NWEA into place giving workers formal participation in 'company assemblies' and the right to appoint specific trade union representatives in the area of technological change. Co-determination procedures were established and a system of penalties was set in place. Likewise, in the late 1970's, Sweden enacted a series of 'work democracy' regulations, including establishing a legal framework for 'Labor Representatives' on company boards, disclosure acts, and other items under the 'Work Environment Act' (1978). This set of acts, described by some as the most important reform in Swedish society since the universal right to vote, also included the 'Joint Regulation Act' of 1977 which guaranteed co-determination around issues of design and use of new technology specifically. While management did retain certain rights of ownership, articles in these acts stipulated that employers must negotiate with local unions before making any major changes to work processes; that the workers can initiate such negotiations as well; and that all parties had the rights to relevant documentation (financial and technical). Significantly, in Sweden these legislative and policy frameworks were complemented by specific ICT development research programs, namely DEMOS and UTOPIA (see Ehn, 1988) which had as their central goal to investigate how technical design could, in fact, respond to this radical new legislative environment. Also, complementing these legislative frameworks were innovative experiments in user-based design: Scandinavia's UTOPIA program (Bjerknes, Ehn, & Kyng, 1987) as well as the Effective Technical and Human Implementation of Computer-based Systems (ETHICS – Beirne & Ramsay, 1992), made the network of policies, programs and legislation particular thick with ideas and potential. The conclusions from this exciting period in Northern Europe were that local participants must be deeply involved in the process, but also that participatory design was necessary but not sufficient for genuinely progressive socio-economic outcomes surrounding technology design, implementation, learning and use (Gärtner & Wagner, 1996). They discovered that often trade unions were not prepared to adequately take advantage of their new powers and responsibilities; notably, that they did not have the resources or the organizational structure to produce levels of expertise comparable to business.

Across these international examples of legislation and policy, we see that technocratic ideologies tend to prevail in the USA. These ideologies appear slightly less powerful in Canada and the Europe where experiments in the democratization of industrial and technological development policy (at sectoral and EU level respectively) have seen the light of day. Technocratic ideologies are least powerful in the Nordic countries where 'co-determination' opens up the apparently autonomous force of technological development to the scrutiny of workers and citizen's to a much greater extent. As one might expect, this break in technocratic hegemony allows additional experimentation with constructivist approaches to ICT which have traditionally been most developed in

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

the Nordic countries as well (e.g., the 'Collective Resource Approach'; see Bansler, 1989).

Linkages Between Policy and Practice

I have explored the historical and philosophical context of ICT and reviewed key legislative, policy and programmatic initiatives. However, I have also emphasized that policy takes on its meaning within the cycle of social processes that includes practice and learning. With this in mind, in this section I want to review existing literature on workplace ICT, skill and learning to fill in an important gap in of our discussion thus far. In terms of the philosophical framework I established above, we now look toward issues of application and use, and thus more closely implicate the critical and constructivist approaches.

We can begin by noting that one of the ways that policy and practice intersect in the workplace is through what are known as 'Technology Agreements'. These agreements, often though not exclusively seen in unionized firms, establish a form of co-determination relationship in regards to ICT adoption, learning and use. In some ways, these agreements mirror, on a smaller scale, the kinds of national legislative frameworks seen in Norway and Sweden. However, these agreements have appeared in a much wider range of countries.

Although not quite as prevalent as when they were first introduced in the 1970's and 1980's, the basic Technology Agreement remains an important form of workplace-based policy concerning ICT and learning. According to Evans (1983; see also Small & Yasin, 2000), writing in the early days of their emergence, these agreements typically include two basic components: first, 'procedural' elements which include broad statements on the need for new technologies, but also, more importantly, statements on timely disclosure of information by employers inclusive of the likely affects of the changes and possible options. This category often includes procedures for the development of joint union/management committees and change monitoring practices; the establishment of worker 'technology representatives'; arrangements for union and management to draw on outside experts/consultants, etc. Occasionally, unions establish 'veto' powers if clear violation of procedures are evident. A second component to Technology Agreements involves what are called 'substantive' elements – including specific statements on how things such as job security, re-training and adjustment, methods of sharing economic benefits, health and safety, and surveillance issues are to be handled. Small and Yasin (2000) have noted the varied affects that Technology Agreements have on practice in the workplace, and they note the importance of related industrial relations infra-structure in a firm (i.e., unionization). Though many factors impact on the overall success of Technology Agreements, evidence suggests they tend to lead to better firm performance, a broader and more productive labour process, and a collective learning feedback loop which leads to better choice and implementation surrounding new technologies (Small & Yasin, 2000).

However, the preceding discussion of workplace-based Technology

Agreements does not entirely exhaust our description of the 'cycle' of social processes that define policy and practice. To complete the picture, we must look carefully at discussions of ICT and workplace skill and learning specifically, and for this we turn to adult education, industrial relations and sociology of work scholarship. However, generally speaking (and with a variety of notable exceptions), it has been unusual to see work-based learning talked about as an interactive, social practice. That is, most often learning was discussed as a sort of passive 'by-product' of work: a skill, a credential, an increase (*n.b.* rarely as a decrease) in productivity, and so forth.

Nevertheless, skill/knowledge development in the workplace has regularly been associated with both the introduction of new technologies, often in conjunction with the different historical phases of the labour process (e.g., 'craft production', 'Taylorism', 'Fordism', 'neo-Fordism', 'flexible specialization', etc.). Approaches to work, learning and policy (e.g., Reich, 1991; Archibugi and Lundvall, 2001) associated with the technocratic approach, for example, largely presume that ICT requires advanced skills. However, among those that have looked closely at skill and learning practice associated with workplace technological change, many have questioned this assumption (e.g., Hyman, 1991; Gee, Hull, & Lankshear, 1996). Poster (2002), for example, suggests that levels of learning may be reduced in some ways by the introduction ICT, and that, in any case, accurate assessments of performance and skill change remain elusive. Important empirical analyses in North America (e.g., Berg, 1970; Livingstone, 1999; Sawchuk, 2003) seem to support Poster's claim, with some suggesting there may in fact be a "surplus" in computer literacy given the inadequacy of actual opportunities that workers have to actually apply their skills at work. For example, referring to computer literacy in the Canadian context, Lowe (2000) notes this specifically, stating that typically "job structures deprive workers of opportunities to use their education and talents" (p. 170). Comparative North American research (Livingstone, 1999, p. 50) shows that, despite calls from the corporate and government sectors to increase computer literacy, "empirical evidence certainly suggests that there are now more people with basic computer literacy than there are jobs which need it". By all estimates, North American workplaces are not alone in this paradoxical situation of, on the one hand, the relatively wide-spread availability of ICT, and, on the other, apparent barriers to effective diffusion, implementation, learning and use.

Kelley (1990) provides a useful review of literature on the work-based skills use issues (as well as empirical analysis of her own) which focuses on technology and work practices at the level of the firm. She concludes that translating a firm's adoption of ICT into increased skill and learning is dependent on a host of organizational as well as broader industrial relations policy and practice issues. According to Kelley, the 'least complex' firms are most effective; that is, open participation of workers in all facets of production, including management operations, appears to be vital. In some sense, the conditions that Kelley describes represent the spirit of 'co-determination' legislation, policy and programs discussed earlier. Nevertheless, how any organization achieves this type of open

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

participation remains an open question. Small firms seem to offer hope for translating ICT adoption into effective learning and production outcomes, but typically lack the levels of capital for significant ICT investment. Large firms have the capital but may not have the ability to generate accountable, shared decision-making across all levels of the organization; unionized firms offer an infrastructure for shared decision-making, but, given that in most countries workers must actively fight to obtain union representation, these firms can be host to bitter management/labour relations. It is worth noting here, however, in terms of unions and learning, that for some time it has been a demonstrated fact that the forms of representation offered through unions often provide the best chance for achieving effective work/learning outcomes (e.g., Doeringer & Piore, 1971; Mishel & Voos, 1992; Livingstone & Sawchuk, 2003).

Another way of understanding questions surrounding learning, technology and work can be seen in research related to what is known as the 'de-skilling/en-skilling'? debate. This 'debate' was initiated in the work of Harry Braverman (1974; see Penn & Scattergood, 1985) and his ground-breaking research based on an elaboration of Marxist theory through a critique of Frederick Taylor's 'Scientific Management' (i.e., Taylorism). Along with Braverman himself, other advocates of the 'de-skilling thesis' (e.g., Glenn & Feldberg, 1979; Zimbalist, 1979; Noble, 1979; Shaiken, Herzenberg, & Kuhn, 1986) note that the goal of the labour process under capitalism is to generate managerial control for maximization of efficiency and profitability.

> The focus on the labour process points also to the irremediable necessity of a coercive system of control and surveillance, leading to a critical perspective towards the role of 'management'. Of crucial importance, such a focus also helps deflate the ideology of 'technology' as a neutral, autonomous and irresistible force … (Hyman, 1982, p. 93)

In Taylorist, Fordist and neo-Fordist models of production the de-skilling argument points toward the stark division of mental and manual labour and the breaking up of complex tasks into smaller more discrete ones often with the aid of new technologies. As Hyman (1982) suggests, there is often a significant growth in worker surveillance as well (see also Sewell & Wilkinson, 1992). The classic assembly line, and the myriad of similar work design principles we see today across manufacturing as well as many service sector workplaces, attempts to generate profit and managerial control by breaking up knowledge/skill forms 'owned' (for lack of a better word) by individual workers or groups of workers, thus converting these skills into a feature of the work system itself (owned by owners; and under the control of managers).

While this classic form of de-skilling still occurs widely, the introduction of new forms of advanced ICT has re-defined the de-skilling process for a small number of occupational groups (see Burris, 1999; Rothman, 2000). The classic separation of mental and manual has evolved into something more complex (though it is difficult to argue that it is fundamentally distinct). Within some

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

firms and amongst certain occupational groups, we now see a more nuanced form of mental/manual skill division associated with the struggle over macro-design (or, 'agenda setting') and creative micro- or local-design and use of ICT. Hosts of workers are now being asked to use the tools provided for them in creative and responsive ways but in processes which are set within pre-established boundaries beyond their control. It bears mentioning that this is entirely within the range of commentators such as Marx (e.g., 1973) who, more than a century ago, noted that the capitalist labour process does not necessarily seek to eliminate the mental capacities of labour but rather seeks to appropriate and control these capacities. The so-called 'en-skilling' thesis advocates are quick to seize upon these complexities, pointing to niches in the economy (often involving small firms) where the stark divisions of mental/manual labour are less often seen. Friedmann (1961), Blauner (1964) and Bell (1973) are, in a sense, the forefathers of the 'en-skilling thesis', collectively suggesting that unskilled jobs will simply be 'automated away', while Reich (1991) and Castells (1996) and a host of technocratic analysts can be viewed as more contemporary advocates.

Between these two camps are writers such as Kelley (1990), Piore and Sabel (1984), Sorge and Streeck (1988), Form, Kaufman, Parcel and Wallace (1988) and others who emphasize a range of organizational, institutional and market factors that shape the de-skilling/en-skilling learning outcomes of the introduction of new technology, and by extension ICT policy. Burris (1999), however, sums things up nicely by noting that a commonly held corollary of technocratic restructuring is,

> 'skill restructuring' (Cockburn, 1983), 'skill disruption' (Hodson, 1988) and new types of alienation, stress and occupational hazards (see Hirschhorn, 1984). Both de-skilling and re-skilling occur, and the balance between the two depends upon both the design of the technology and the way in which it is implemented (Burris, 1999, pp. 40–41)

Still, de-skilling/en-skilling debates, invaluable as they are, can't help but gloss over the actual learning processes that spring from the organization of work, industrial relations and ICT development policies. The 'how' of ICT skill and knowledge development remains obscure, and thus an important role is left to workplace learning scholars who analyze the learning process (as opposed to the learning outcomes) specifically. In terms of comparative international analyses, Lam (2002) provides a good example of how institutions, legislation and policy in different countries (i.e., Japan, UK, USA and Denmark) actually supports/inhibits ICT innovation and learning. At the center of this analysis is the concept of 'tacit knowledge', rooted in the relations of discretionary communities of practice (established among either organizations or a specific occupational group). In the USA, anthropologist Charles Darrah (1994, 1996) has extensively described workers' learning processes, and specifically analyzed these processes in advanced ICT settings (Darrah, 1999). A host of detailed empirical studies of exactly how ICT and learning practice relate are available in Luff,

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

Hindmarsh and Heath (2000; see also selected contributors to Engeström and Middleton, 1992). Each of these studies shows that ICT is not merely 'adopted' by a workplace, but rather is activated and, in some sense, re-configured by users in the course of (learning) practice.

A particularly relevant piece of work in this area is found in Livingstone and Sawchuk (2003). This collection of case studies provides an important complement to the sociology of work and de-skilling/en-skilling debates based on comparative examination of workplaces across five sectors (auto assembly, garment, light manufacturing, chemical and public service) in the Canadian economy. Drawing on in depth 'learning life-history' interviews, what these case studies demonstrate, among other things, is how ICT use and learning at work is shaped by the industrial relations climate and the dynamics of a specific sector, as well as the struggle by workers for greater participation in the labour process. Moreover, the analysis makes it clear that issues of race, gender, and age as well as occupational type are also significant indicators of skill and knowledge development. Related work on computer literacy development among manufacturing workers in Canada (Sawchuk, 2003) delves even more deeply into the types of linkages (cultural, economic, and political) between ICT and learning. It shows how learning is rooted in collective, informal groupings of workers and operates interactively across workplace, home and community spheres. This learning is carried out in order to cooperate with the needs of industry and labour markets as well as in order to satisfy needs that may diverge from the interests of business. Overall, in both Livingstone and Sawchuk (2003) and Sawchuk (2003), we see computer literacy skills among workers that far outstrip the actual needs of their workplaces. Thus, as we saw in the previous sections, important assumptions informing mainstream, technocratic approaches to policy surrounding ICT, work and learning are questioned.

Conclusions and Future Directions

Comparative, international analyses of legislation, policy and programs provide an important basis for understanding ICT-based learning practices in the workplace. In terms of integrative research studies of policy and practice involving ICT, work and learning, I have suggested a broad, multi-leveled approach. Such an approach requires robust theories of learning and cognition such as those discussed in Latour (2000), Engeström and Middleton (1992), Luff, Hindmarsh and Heath (2000) and Billet (2001) to name only a few. It also requires critical scholarship on adult education (e.g., Foley, 1998), philosophy (e.g., Feenberg, 1991) and histories of technology (e.g., Noble, 1984) and of ICT development (e.g., Ehn, 1988; Asaro, 1996).

In reviewing the most relevant examples of legislation, policy, programs and analyses of learning and skill development, we are, to my mind, aided by a general understanding of the ideological approaches to technological thought which I took time to summarize early on. How do specific policies relate to either technocratic or critical approaches to technology? At several points above

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

I've left some indications. What role, for example, do the substantive critiques of Heidegger or Ellul play in attenuating the messages offered by the likes of Negroponte (1995), Castells (1996) or Reich (1991)? What can the constructivist approach of Suchman, Latour or Callon add to the de-skilling/en-skilling debates surrounding ICT, work and learning, and how might policy benefit from such research? After reading this chapter, a variety of answers to these and other questions should begin to emerge, but perhaps more importantly one should be in a better position to understand, evaluate and perhaps even affect the current landscape and trajectory of ICT, work and learning policy and practice. Clearly, technocratic approaches continue to (and perhaps increasingly) hold sway in the policy efforts across most countries, though this is not absolute as recent attempts in the USA discussed above (see Herman, 2001) indicate. Substantive approaches appear to offer few work-able paths forward for policy as it relates to our present conditions, and thus tend to be excluded from mainstream debate. Under appreciated and with a great deal of potential for positive economic and social outcomes are the constructivist and critical approaches, though they remain a minority in policy circles. However, just as clearly as technocratic approaches continue to hold sway in these circles, so it is that democratization of technological design, policy, work and learning processes, potentially drawing on both critical and constructivist approaches, offer the most relevant and progressive means to move forward into a future with increasingly powerful technological forces at play.

References

Archibugi, D., & Coco, A. (2000). *The globalisation of technology and the European innovation system*. Rome: Italian National Research Council.

Archibugi, D., & Lundvall, B. (Eds.) (2001). *The globalising learning economy*. Oxford: Oxford University Press.

Asaro, P. (1996). Transforming society by transforming technology: The science and politics of participatory design. *CMS Conference Stream: Information Technology and Critical Theory*. Urbana, IL: University of Illinois at Urbana-Champaign.

Audretsch, D., & Thurik, A. R. (2001). *What's New about the New Economy? Sources of growth in the managed and entrepreneurial economies*. (ISSN 01-1). Institute for Developmental Strategies, Indiana University, USA.

Bansler, J. (1989). Systems development in Scandinavia: Three theoretical schools. *Office: Technology and People*, *4*(2), 117–133.

Beirne, M., & Ramsay, H. (Ed.) (1992). Information technology and workplace democracy. London: Routledge & Kegan Paul.

Bell, D. (1973). *The coming of the post-industrial society*. New York: Basic Books.

Berg, I. (1970). *Education and jobs: The great training robbery*. New York: Praeger.

Billett, S. (2001). Co-Participation: Affordance and engagement at work. *New Directions For Adult And Continuing Education*, *92*, 63–72.

Bjerknes, G., Ehn, P., & Kyng M. (Eds.) (1987). Computers and democracy: A Scandinavian challenge, Aldershot, UK: Avebury.

Blauner, R. (1964). *Alienation and freedom: The factory worker and his industry*. Chicago: University of Chicago Press.

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

Braverman, H. (1974). *Labor and monopoly capitalism: The degradation of work in the twentieth century*. New York: Monthly Review Press.
Burris, B. (1999). Braverman, Taylorism and Technocracy. In M. Wardell, T. Steiger & P. Meiksins (Eds.), *Rethinking the labor process*. New York: SUNY.
Callon, M. (1992). The dynamics of techno-economic networks. In R. Carnoy, S. Pollack & P. L. Wong (Eds.) (1993). *Labour Institutions and Technological Change: A Framework for Analysis and a Review of the Literature* (pp. 72–102). Stanford University/International Labour Organization.
Castells, M. (1996). *The Rise of the Network Society*, Vol. 1. Oxford: Blackwell.
Cockburn, C. (1985). Machinery of dominance: Men, women and technical know-how. London: Pluto.
Cressey, P., & Di Martino, V. (1991). Agreement and innovation: The international dimension of technological change. New York: Prentice Hall.
Dahrendorf, R. (1959). *Class and class conflict in an industrial society*. London: Routledge & Kegan Paul.
Darrah, C. (1994). Skill Requirements at work: Rhetoric versus reality. *Work and Occupations*, *21*(1), 64–84.
Darrah, C. (1996). *Learning and work: An exploration in industrial ethnography*. New York: Garland Publishing.
Darrah, C. (1999). *Learning Tools Within a Context: History and Scope*. Washington, DC: U.S. Department of Education, National Institute on Postsecondary Education, Libraries, and Lifelong Learning (PLLI) of the U.S. Department of Education.
Devine, W. (1983). From shafts to wires: Historical perspective on electrification. *Journal of Economic History*, *43*, 347–372.
Doeringer, P. B., & Piore, M. (1971). *Internal labor markets and manpower analysis*. Lexington, MA: D.C. Heath.
Ehn, P. (1988). *Work-oriented design of computer artifacts*. Arbetslivscentrum: Stockholm.
Ellul, J. (1964). *The technological society*. New York: Vintage Books.
Engeström, Y., & Middleton, D. (1992). *Cognition and communication at work*. New York: Cambridge University Press.
Evans, J. (1983). Negotiating Technological Change. In H. J. Otway & M. Pletu (Eds.), *New Office Technology: Human and Organizational Aspects* (pp. 152–168). London: Francis Pinter.
Feenberg, A. (1991). *Critical theory of technology*. New York: Oxford University Press.
Fleck, J. (1993). Configurations: Crystallizing contingency. *International Journal of Human Factors in Manufacturing*, *3*(1), 15–36.
Foley, G. (1998). *Learning in social action: A contribution to understanding informal education*. London: Zed Books.
Form, W., Kaufman, R., Parcel, T., & Wallace, M. (1988). The impact of technology on work organization and work outcomes. In G. Farkas & P. England (Eds.), *Industries, firms and jobs: Sociology and economic approaches* (pp. 303–328). New York: Plenum.
Franklin, U. (1990). *The real world of technology*. Toronto: CBC Enterprises.
Friedmann, G. (1961). *The anatomy of work*. Glencoe, IL: Free Press.
Gärtner, J., & Wagner, I. (1996). Mapping actors and agendas: Political frameworks of systems design and participation. *Human-Computer Interaction*, *11*, 187–214.
Gee, J., Hull G., & Lankshear, C. (1996). *The new work order: Behind the language of the new capitalism*. Boulder, CO: Westview.
Glenn, E., & Feldberg, R. (1979). Proletarianizing clerical work: Technology and organizational control in the office. In A. Zimbalist (Ed.), *Case Studies on the Labor Process* (pp. 51–72). New York: Monthly Review Press.
Gospel, H. (Ed.) (1991). *Industrial training and technological innovation: A comparative and Historical Perspective*. London: Routledge & Kegan Paul.
Grubb, N. (1996). *Learning to work: The case for reintegrating job training and education*. New York: Russell Sage Foundation.
Hacker, S. (1991). Doing it the hard way: Investigations of gender and technology. Winchester, MA: Unwin Hyman.

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

Heidegger, M. (1977). *The question concerning technology*. New York: Harper and Row.
Herman, B. (2001). How high-road partnerships work. *Social Policy*, *31*(3), 11–19.
Hughes, T. (1983). *Networks of power*. Baltimore, MD: Johns Hopkins University Press.
Hyman, R. (1982). What ever happened to industrial sociology? In D. Dunkerley & G. Salaman (Eds.), *The international yearbook of organisation studies 1981*. London: Routledge and Kegan Paul.
Hyman, R. (1991). Plus ca charge? The theory of production and the production of theory. In A. Pollert (Ed.), *Farewell to flexibility?* (pp. 259–283). Oxford: Blackwell.
Jones, B. (1988). Work and flexible automation in Britain: A review of developments and possibilities. *Work, Employment and Society*, *2*(4), 451–486.
Kelley, M. R. (1990). New process technology, job design and work organization: A contingency mode. *American Sociological Review*, *55*, 191–208.
Kerr, C. et al. (1962). *Industrialism and Industrial Man*. London: Heinemann.
Kraft, P. (1977). *Programmers and Managers: The Routinisation of Computer Programming in the United States*. New York: Springer-Verlag.
Lam, A. (2002). Alternative societal models of learning and innovation in the knowledge economy. *International Social Science Journal*, March, 67–82.
Latour, B. (2000). Technology is society made durable. In K. Grint (Ed.), *Work and society: A reader* (pp. 41–53). Cambridge, UK: Polity.
Lazonick, W. (1979). Industrial relations and technical change: The case of the self-acting mule. *Cambridge Journal of Economics*, *3*, 231–262.
Lazonick, W. (1993). Learning and the dynamics of international competitive advantage. In R. Thomson (Ed.), *Learning and technological change* (pp. 172–197). New York: St. Martin's Press.
Lipsey, R. G., Bekar, C., & Carlaw, K. (1998). What requires explanation? In E. Helpman (Ed.), *General purpose technologies and economic growth*. Cambridge, MA: MIT Press.
Livingstone, D. W. (1999). *The education jobs gap*. Toronto: Garamond Press.
Livingstone, D. W., & Sawchuk, P. (2003). *Hidden knowledge: Organized labour in the information age*. Toronto: Garamond Press/Washington, DC: Rowman & Littlefield.
Louli, C., & Bickerton, G. (1995). Decades of Change, Decades of Struggle: Postal Workers and Technological Change. In C. Schenk & J. Anderson (Eds.), *Re-shaping work: union responses to technological change* (pp. 216–232). Toronto: Our Times Publishing.
Lowe, G. (2000). *The quality of work: A people-centred agenda*. New York: Oxford University Press.
Luff, P., Hindmarsh, J., & Heath, C. (2000). *Workplace studies: Recovering work practice and informing system design*. New York: Cambridge University Press.
Mani, S. (2002). *Government, innovation and technology policy: An international comparative analysis*. Cheltenham, UK: Edward Elgar.
Marx, K. (1973). *Grundrisse*. Baltimore: Penguin.
Mishel, L., & Voos, P. (Eds.) (1992). *Unions and economic competitiveness*. New York: M.E. Sharpe Inc.
Mumford, L. (1964). Authoritarian and Democratic Technics. *Technology and Culture*, *5*(1), 1–8.
Naisbitt, J. (1982). *Megatrends: Ten new directions transforming our lives*. New York: Warner.
Negroponte, N. (1995). *Being digital*. New York: Knopf.
Noble, D. (1979). Social Choice in Machine Design: The Case of Automatically Controlled Machine Tools. In A. Zimbalist (Ed.), *Case studies on the labour process* (pp. 18–50). New York: Monthly Review Press.
Noble, D. (1984). *The forces of production: A social history of industrial automation*. New York: Alfred A. Knopf Inc.
OECD (1999). *The knowledge-based economy: A set of facts and figures*. Paris: OECD.
Penn, R., & Scattergood, H. (1985). Deskilling or enskilling?: An empirical investigation of recent theories of the labour process. *British Journal of Sociology*, *36*(4), 611–630.
Piore, M., & Sabel C. (1984). The second industrial divide. New York: Basic Books.
Poster, M. (2002). Workers as cyborgs: Labor and networked computers. *Journal of Labor Research*, *23*(3), 339–354.
Reich, R. (1991). *The work of nations: Preparing ourselves for 21st* Century capitalism. New York: Knopf.

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424

Rip, A., Misa, T., & Schot, J. (Eds.) (1995). *Managing technology in society: The approach of constructive technology assessment*. London: Pinter.
Roszak, T. (1994). *The cult of information: A Neo-Luddite treatise on high tech, artificial intelligence and the true art of thinking*. Berkeley: University of California Press.
Rothman, H. K. (2000). What has work become? *Journal of Labor Research*, *21*(3), 379–392.
Sale, K. (1995). *Rebels against the future: The Luddites and their War on the industrial revolution – lessons for the computer age*. London: Addison Wesley.
Sawchuk, P. (2003). *Adult learning and technology in working-class life*. New York: Cambridge University Press.
Schenk, C., & Anderson, J. (Eds.) (1995). *Re-shaping work: Union responses to technological change*. Toronto: Our Times Publishing.
Sewell, G., & Wilkinson, B. (1992). Someone to Watch over me – Surveillance, Discipline and the Just-in-Time Labor Process. *Sociology*, *26*(2), 271–289.
Shaiken, H., Herzenberg, S., & Kuhn, S. (1986). The work process under more flexible production. *Industrial Relations*, *25*, 167–183.
Sharpe, A. (1997). *Sectoral skills councils in Canada: Future challenges*. Ottawa: Human Resources Development Canada.
Small, M., & Yasin, M. (2000). Human factors in the adoption and performance of advanced manufacturing technology in unionized firms. *Industrial Management & Data Systems*, *100*(8–9), 389–401.
Smith, P. (1988). The impact of trade unionism and the market in a regional newspaper. *Industrial Relations Journal*, *19*, 214–221.
Sorge, A., & Streeck, W. (1988). Industrial relation and technical change: The case for an extended perspective. In R. Hyman & W. Streeck (Eds.), *New technology and industrial relations* (pp. 19–47). Oxford: Blackwell.
Suchman, L. (1987). *Plans and situated action: The problem of human-computer communication*. New York: Cambridge University Press.
Suchman, L. (2002). Practice-based design of information systems: Notes from the hyperdeveloped world. *The Information Society*, *18*, 139–144.
Thomson, R. (Ed.) (1993). *Learning and technological change*. New York: St. Martin's Press.
Von Tunzelmann, G. N. (1982). *Steam power and British industrialization to 1860*. Oxford: Wallace and Kalleberg.
Wallace, M., & Kalleberg, A. (1982). Industrial transformation and the decline of craft: The decomposition of skill in the printing industry, 1931–1978. *American Sociological Review*, *47*, 307–324.
Williams, R., & Edge, D. (1996). The social shaping of technology. *Research Policy*, *25*, 856–899.
Zimbalist, A. (Ed.) (1979). *Case studies on the labor process*. New York: Monthly Review Press.

bascia0049 15-11-04 11:49:49 Rev. 10*PS
Page Express (Manchester) Limited – Denton, Manchester, UK – 0161 320 7424