The role of labour in choosing and implementing information-based technologies

N.A. Ashford
Center for Technology, Policy and Industrial Development, Massachusetts Institute of Technology, USA

Introduction

Information-based technologies (IT) in both manufacturing and office settings promise to revolutionize the nature of work, the relationship between employers and workers, and the competitive position of firms and nations. This "second industrial revolution" has already begun, and it is particularly timely to ask why and how labour should play a role in choosing and implementing information-based technologies in the impending transformation of the industrial state.

The necessity for labour's involvement includes the following:

1. Labour's resistance to the introduction and utilization of IT could lessen its potential impact.
2. IT, more than other kinds of new technology, requires intelligent use by and interaction with its users, i.e., workers, to be effective.
3. IT has the potential to improve the hazardous and stressful nature of work, but this potential cannot be realized without labour's participation.
4. The effect of IT on job creation or loss, skilling or de-skilling, and wage-enhancement or depression, is of primary importance to workers and unions, and to national governments and trading blocks.
5. Because of the special nature of IT, prospects for industrial democracy and shared decision making may be advanced.

Labour's resistance to the introduction and utilization of IT could lessen its potential impact.
We see that the proportion of machine tools that are numerically controlled is less in the United States (40%) than in Japan (67%) or in Germany (49%) (1). While the reasons for these differences may not be entirely clear, they demonstrate under-utilized potential that could have its origin partly in labour attitudes and willingness to accept new IT in manufacturing, and partly in organizational attitudes and management styles.

Resistance (the functional opposite of employee participation discussed below) may occur for several reasons: "[Workers] resist change when the need is not well understood, it is imposed from above, [it is] perceived as threatening, [it] seems to have risks that are greater than the potential benefits, and [it] interferes with other established priorities" (2). People tend to reject solutions they did not create; when they actively participate in the decision-making process they develop a sense of ownership of the change they helped develop (2, 3).

Although IT has the potential for benefiting both society and workers, workers have experienced problems with its introduction and application. Employee resistance due to fear of job or wage loss as a result of technological change in general is an often-justified reality (4). Labour believes that management's enthusiasm for lean production, re-engineering, and agile manufacturing is based on an opportunity for management to cut back hands-on labour to an absolute minimum, if it cannot be eliminated altogether (3). Resistance is also related to the anticipated de-skilling of jobs or decreases in the level of control and responsibility.

On the other hand, in 10 years of work on the computerization of information work, Bikson and Eveland report little research support for the view that labour resists technological change in IT (4). In contrast, in a study of the implementation of office IT, Bikson and Eveland report that resistance is more likely to be found in the organization than among the employees. Organizations are sometimes reluctant to recognize changes in employees' skills, tastes, or standards with changes in job titles, job descriptions, or wages (4). Firms are also sometimes organizationally suboptimal in their capacity to undertake technological change (5).

IT, especially, requires intelligent use by and interaction with its users (the workers) to be effective.
The savings achieved by using computer-based systems can be multiplied when these systems are combined with changes in work organization. One commentator observes: "[t]echnology is fundamentally an organisational and human endeavor linking what is theoretically possible to what happens in the laboratory, in the design shop, in the operating room, in the office, or on the plant floor. Recognition of this factor, however, is relatively recent. Historically, engineers have assumed that implementing technology means that people will adapt and learn to use the new equipment (2)...Employee involvement...becomes more important [in the implementation process] as the technology advances more quickly and facilitates user feedback (2)."

Much has been written about lean management to increase flexibility in production. However, shifts in participatory management by workers are thought to be a more significant factor in successful technological change (2). Bikson and Eveland report that participative decision making in all aspects of the implementation process, including working with systems designers, is a strong predictor of successful transition to new computer-based tools (4).

They discuss the special characteristics of IT that make this so:

> Unlike computer technologies that are heavily bound up with specific pieces of equipment...information technology is generally characterized by a high degree of flexibility, modularity, and adaptability. These very properties, however, make it difficult to test and predict successful implementation (4)...An information tool that performs well in one setting may not perform equally well in another setting because of greater work load in the real world, less predictable user demands, a more heterogeneous base of installed hardware and software into which the new tool must be integrated, and other context-specific factors...The environment for new computer-based information tools has proved to be too rich, variable, and uncontrolled for the technology to be deployed uniformly. This has posed difficult challenges for behavioral scientists attempting to predict what individuals, work groups, and organisations will do (4)...Implementation...is inherently a process of mutual adaptation of the technology to its [contextual and human] environment (4).

Rapid technological improvement requires a flexible and fluid organizational structure that goes beyond lean management and worker participation in the narrow sense. In addition to having the ability to sense and respond to consumer needs and market opportunities in a timely manner through the adoption of flexible production technologies and approaches, the "learning enterprise" must ensure flexibility in the manner in which workers use technologies, in the interactions between management and labour, and in the management of the firm in general. This kind of flexibility requires appropriate changes in both work organization and in enterprise-wide organizational innovation (5).

IT has the potential to improve the hazardous and stressful nature of work, but this potential cannot be realized without labour's participation.

The implementation of IT technology provides an opportunity for emancipation from tedious, repetitive manual work, but it also creates the possibility of increased stress stemming from machine-paced work and electronic monitoring, as well as repetitive strain injury and other ergonomic problems in both manufacturing and word processing. Moreover, while computerized production can eliminate some hazards of manual manipulation, reliance on automated warnings in controlled operating systems that remove the worker-operators from dangerous operations also present opportunities for unanticipated human responses, as for example in the false reliance on disabled safety systems at Bhopal or the failure to believe information indicating the melt-down at Three Mile Island. The participation of labour in the choice, design, and implementation of these technologies is essential to ensuring their beneficial/optimal use and to minimizing their adverse effects for labour, the firm, and the society.

The effect of IT on job creation or loss, skilling or de-skilling, and wage-enhancement or depression, is of primary importance to workers and unions, and to national governments and trading blocks.

New ways of acquiring, analyzing, and presenting information have already started to

create new jobs and products. However, the introduction of IT has also eliminated jobs. (One study by MIT examining nation-wide data from 1979 to 1989 found that for every 1% increase in IT investment, the average firm dropped 0.13% of its employment within one or two years (6). Displaced workers will probably not assume the new positions created by technological change. Often the skills required in the new jobs are different from the old skills replaced by automation. The latter are usually semi-skilled production jobs in manufacturing, while the former are usually in the unorganized (non-unionized) and poorly-paid part of the service sector[1]. In addition, there is a shift to part-time work and temporary contracted-out work, at the expense of full-time jobs. In the United States, while there is some evidence for an increase in skills required in many manufacturing jobs (of those that remain), one recent study concludes that while half of clerical jobs were up-skilled, the other half were down-skilled, and this was related to the introduction of new technology (8).

The concern for employment in general has been discussed in the recent white paper from the European Commission entitled *Growth, Competitiveness, and Employment* (9) in which the response of the American labour market to the changing global economic order, resulting in a steady erosion of real wages and a shift to lower-skilled jobs over the last 15 years, is contrasted with the European experience of maintaining wage rates at the expense of increasing unemployment. The European Commission rejects the American solution, instead favouring the creation of higher-paying and skill-enhanced jobs. However, without labour's direct influence, and/or government intervention on behalf of labour, this may not be realized. In addition, innovative organizational systems may be required (5). Since a significant proportion of new jobs are expected to be generated by IT, this presents a special challenge and opportunity. The work of the future may need not only to be designed with a human-centered focus and radical organizational changes, but the trend away from labour-intensiveness that has characterized American, European, and Japanese economic development may also need to be slowed or even reversed.

Because of the special nature of IT, prospects for industrial democracy and shared decision making may be advanced.

Bernard writes "[i]f new technology is to be designed as a tool of liberation, worker participation must be integrated throughout the design, development, and implementation

[1] A recent report from the U.S. Council of Economic Advisors (7) presents as somewhat unexpected picture of the U.S. economy for the period February 1994 to February 1996. One might have expected growth in part-time, low-skill jobs. However, exceeding employment growth for any of its G-7 partners, two-thirds of the net growth in (mostly) full-time employment was due to the creation of jobs in a part of the service sector paying above-median wages, namely in the relatively high-paid managerial and professional specialty occupations "sales supervisors and proprietors", "electricians", "managers of marketing and advertising", and "electrical and electronic engineers". At the same time, the percent of workers holding multiple jobs (6%) and the aggregate wage level stayed about the same, and the older, white-collar workers were considerably more at risk of displacement in 1991–1992 than in the previous recession. Blue-collar and less-educated workers remained more likely to be displaced than others. Without more detail than was available as of this writing, one can only muse that the information-based economy is gearing up in the service sector.

of that technology. We cannot be a society of obedient, powerless employees at work, and free, powerful consumers after hours" (10). Because IT requires the cooperation of labour to be successful, it could serve the general goals of increasing industrial democracy through shared decision making. Whether it will significantly further those goals within the narrow context of IT, or whether there will be spill-over effects into other manufacturing technologies, remains to be seen.

Opportunities for labour to affect the choice and implementation of IT

As a general rule, the earlier in the process influence and demands are placed on the design and development of a particular system, the easier it is to change that system. As already discussed, the dimensions of technological change go beyond materials and equipment to include the methods of production, the organization of work, and the structuring of employment in the enterprise. Additional far-reaching organizational changes in the enterprise may also be necessary (5).

Technological revolutions tend to occur in three stages: the introduction of new tools and machinery within the old system of work organization, the convergence of the new tools and equipment into a new method of work organization and division of labour, and the consolidation of the new work organization (10). At this point in the information revolution, we are only beginning to develop new methods of work organization.

The traditional mode of involving workers in decisions affecting the commercial enterprise has been in an industrial relations system where negotiations related to concerns over wages and conditions of employment take the technologies of production as given and determined by management. Collective bargaining or worker demands for changes in working conditions thus usually focus on *existing* production systems. If management does attempt to adopt new technologies, labour has been more successful at bargaining about mitigating the *effects* of those new technologies than on influencing the *choice* of technologies in the first place. However, labour is increasingly recognizing that in order to make significant improvements in working conditions and jobs, they have to be able to influence management at the time of *decisions* regarding the adoption of, not after implementation of new technologies. This is termed "technology bargaining" (11). Those decisions need to be made in the context of the potential changes in materials and equipment (what some call "hard-tech" changes [12]), in production methods and work organization ("soft-tech" changes [12]), and in job content and creation. In order to maximize labour's participatory role in the design, development, and implementation of both safer technology (13) and IT, workers, or at least their unions, need to develop a certain degree of "technological literacy" similar to the literacy they have achieved in job health and safety hazards which has enabled them to bargain effectively about the need to avoid unnecessary risks. However, this technological literacy must enhance the ability of labour to identify technological options for, or alternatives to, materials, production processes, and the organization of work. Especially important is the *integration* of labour's demands for improved health and safety, job creation and design, and work tasks and organization.

Among the many ways in which labour can influence the choice and implementation of both safer technology and IT are collective bargaining, participation in joint management-labour efforts at the enterprise level, influencing health and safety regulation, and joining in efforts with environmental and consumer groups to influence the direction of technological change. Also important is a central role for labour in the formulation and implementation of industrial policy. This would require (a) labour participation in governmental and international industrial policy making (see below) and (b) the establishment of research and policy analysis capability in labour organizations.

The role of government

Both national governments and international trading blocks can play an important part in creating a general climate conducive for both the economically-optimal adoption, implementation, and international trade of IT technologies, and for ensuring maximized positive effects on employment, job content, and wages. Options deserving of serious consideration include (12, 13):

1. An industrial policy that incorporates concerns for the impact of technological change on employment, job content, wages, purchasing power, worker health and safety, and environment (14). This would require that labour organizations, environmental groups, and consumer groups, in addition to industrial trade associations and specific industries, participate in the formulation of industrial policy, including but not limited to appropriate regulation of the "information superhighway". This is needed both at the national level and in context of the World Trade Organisation's (WTO) implementation of the General Agreement on Tariffs and Trade (GATT) (15).

2. The mandating of joint management-labour "technology change committees" to consider technology options, with the power to recommend or implement changes in workplace technology and organization. These committees would have within their purview not only the hardware of technology, but also the software of workplace re-organisation and worker participation.

3. Inclusion in labour law of the issues of technological change, job design, and workplace re-organization as mandatory subjects of bargaining (11), as well as "re-opener clauses" allowing re-negotiation of labour agreements if there are significant changes in the number of workers employed or in the nature of work. These proposed measures require a sharing of decisions that were formerly relegated solely to management prerogatives.

4. Extension of labour law to more adequately cover small workplaces, teleworkers, and domestic, part-time, and contract workers through sectoral and/or regional bargaining by labour unions.

5. Mandatory training in all workplaces with the introduction of new technology significantly changing the nature of the job.

6. More far-reaching labour adjustment policies, such as opportunities for job training and education, including paid educational leave necessitated by technological changes.

Ironically, liberal labour adjustment policies, justified out of concern for equity to workers, could serve to weaken workers' and their union's resolve to fight for changes that would transform their jobs into better jobs and simultaneously promote the interest of the firm. Nonetheless, the adoption of many of the measures enumerated above would strengthen labour's hand in forging a partnership with management to accelerate the design, development, and implementation of both safer production technology and mutually-beneficial IT.

Conclusion

Information-based technologies are radically changing both the physical work environment and the relationships between management and labour. Those changes occur in both industrial/manufacturing workplaces and in offices. They involve shifts in the capital/labour mix, job content and skills, ergonomics, health and safety, stressors, and the social environment of work. IT can both improve and adversely affect the work environment and prospects for employment. IT can also change the distribution of wealth and power through its effects on jobs and purchasing power. Since a significant proportion of new jobs are expected to be generated by IT, this presents a special challenge and opportunity. The work of the future may need not only to be designed with a human-centered focus and radical organizational changes, but the trend away from labour-intensiveness that has characterized American, European, and Japanese economic development may also need to be slowed or even reversed. In any event, the role of labour in choosing and implementing IT will be important and indispensable.

References

1. Adler PS, quoting D.J. Collis in Capitalizing on new manufacturing technologies: current problems and emergent trends in U.S. industry. In: National Research Council, People and technology in the workplace, Washington, D.C.: National Academy of Engineering, Commission on Behavioral and Social Sciences and Education, 1991:59–88.
2. Laumann EO, Nadler G, O'Farrell B, quoting van de Ven in Designing for technological change: people in the process. In: National Research Council, People and technology in the workplace, Washington, D.C.: National Academy of Engineering, Commission on Behavioral and Social Sciences and Education, 1991:1–14.

3. Turner BJ. Chapter 2: Visualizing the transformation process. In: Making change happen: six cases of unions and companies transforming their workplaces, Kaminski M, Bertelli D, Moye M and Yudken J. Work&Technology Institute, Washington, D.C., 1996.
4. Bikson TA, Eveland JD. Integrating new tools into information work: technology transfer as a framework for understanding success. In: National Research Council, People and technology in the workplace, Washington, D.C.: National Academy of Engineering, Commission on Behavioral and Social Sciences and Education, 1991:229–52.
5. Coriat B. Organisational innovations: the missing link in European competitiveness. In: Andreasen LE, Coriat B, den Hertog F and Kaplinsky R, eds. Europe's next step: organisational, innovation, competition and employment, London, England: Frank Cass, 1995:332 p.
6. Aley J. High tech vs. jobs, Fortune, April 1994 as quoted in Anderson and Schenk (see reference 9 below).
7. Council of Economic Advisors. Job creation and employment opportunities: the United States labor market, 1993–1996, Washington, D.C.:April 23, 1996:11 p.
8. Cappelli P. Are skill requirements rising? Evidence from production and clerical jobs, Industrial and Labor Relations Review, 1993;46(3) as quoted in Anderson and Schenk, reference 9 below.
9. European Commission. White paper on growth, competitiveness and employment, Brussels-Luxembourg: ESSC-EC-EAEC, 1994.
10. Bernard E. Information technology: old problems, new tools, and new possibilities for a healthy workplace. In: Technological change in the workplace: health impacts for workers, M. Brown and J.Froines, eds, Los Angeles: UCLA Institute of Industrial Relations, Los Angeles, CA, 1993:9–22.
11. Ashford N, Ayers C. Changes and opportunities in the environment for technology bargaining, Notre Dame Law Review 1987;62 (5):810–58.
12. Anderson J, Schenk C. Introduction: technology on trial-lessons from the labour front-lines. In Schenk and Anderson, eds, Reshaping work: union responses to technological change, Toronto: Ontario Federation of Labour, Technology Adjustment Research Program, 1995.
13. Ashford NA. Promoting technological changes in the workplace: public and private initiatives. In: Technological change in the workplace: health impacts for workers, M. Brown and J. Froines (eds.), Los Angeles: UCLA Institute of Industrial Relations, Los Angeles, CA, 1993:23–36.
14. Ashford NA. Government strategies and policies for cleaner production, United Nations Environmental Program, Paris, 1994:32 p.
15. Ashford NA. International control of occupational and environmental health hazards. In: International occupational and environmental medicine, L.E. Fleming, J. Herzstein, and W.B. Bunn, OEM Press, Boston, 1996.