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Technological changes in the workplace, such as microelecronics, genetic engineering, robotics and artificial intelligence, promise to transform not just occupational structure but all of western society. Two sociological theories have emerged that most influence current notions of how technology alters the organization of work: sociology of automation and deskilling theory. However these perspectives fail to capture adequately the multiple, subtle ramifications of technical change, and tended to view technology as either a physical or a social object. A fuller understanding of technological change would consider both the physical form of a given technology, its relationship to workplace organization, and its capacity to alter the balance of power between individuals or groups in the workplace.

SOCIOLOGY OF AUTOMATION AND DESKILLING THEORY

Concern over automation motivated industrial sociologists to systematically investigate technology's implications for work. Early studies focusing on automobile plants reinforced fears that automation would "empty labor of meaning and thereby spawn an ever more alienated workforce. However, once researchers began to investigate other industries, the scenario quickly muddied."[35] The effects of automation varied by industry and type of technology. In fact, under certain conditions, automation might even reverse the alienation characteristic of mechanically paced production.

A theory of industrial evolution emerged from this school of thought which proposed that technology evolved through three stages: craft, machine, and automated production, tracing a U shaped trajectory with respect to alienation. Workers become more alienated as industry moved from craft to machine-based (and paced) work. Automation first increased alienation levels, but, as it became more sophisticated, alienation could actually decline. This placed the burden of explanation solely on the technology itself, a form of technical determinism in which technology would eventually eliminate the very problems it caused.

The critical distinction of deskilling theory is its claim that technology is essentially a social phenomenon; specifically, that automation is a means of wresting control from labor by removing skill and autonomy from the worker and investing it in machines and engineered produciton processes. This implies that the development and implementation of technology has an intentional aspect, that it is a matter of managerial motives rather than technological imperatives. However, deskilling theorists do not tend to explore the implications of this fully,

turning to a kind of social determism with claims that the need to control labor is central to manageerial culture.

These two theories operate with different assumptions and offer divergent visions of the future. Each tradition avoids testing the limits of its claims and instead promulgates a one-sided account of technological change. However, evidence from outside each tradition suggests that technologies rarely enhance or degrade work unambiguously. Because deskilling theory and sociology of automation are ultimately deterministic, neither offers a framework sufficiently flexible to account for multidirectional change in the web of occupational roles.

TECHNOLOGY AS A SOCIAL OBJECT OF ORGANIZATION

Three uses of the term "technology" have prevailed in social science -- apparatus, technique, and organization. "When technology and organization are allowed to share the same semantic domain, it often becomes difficult to decide where technology stops and organization begins."[46] Individuals would tend to describe technology in terms of specific machines or techniques, but technologies are also embedded in a social space and web of meaning.

Technology can serve a symbolic as well as an instrumental purpose. New technology may be adopted to signal that the organization is at the cutting edge or that it is at the same level of technical proficiency as other organizations in its field. Technologies are also molded into social objects as different organizations develop their individual interpretive and behavioral templates. Technologies are usually introduced into settings with a history of customary behaviors and relationships which tend to reshape the new technology to be compatible with familiar practices. Where no pre-existing work culture exists to influence the meaning of the technology, technical change appears to proceed more smoothly. New technologies may open new arenas of negotiation, engendering opportunities for social change.

Neither a purely materialistic nor a purely cultural theory of technology is adequate for mapping the implications of technology for the workplace. A more viable sociology of technology will require a hybrid paradigm which might be called "interpretive materialism." Such an approach would direct investigators to start with the particulars of the local context in which a technology is used before attempting to unravel the multiple and often conflicting implications of technology on the organization of work.

THE DYNAMICS OF POWER

The focus on skill in most discussions of technology and work may be too narrow and divert attention from social action. In fact, most sociologists of technology do not intend to address issues of skill per se, but rather are interested in how technologies alter systems of power and control. Power can be investigated at many level of analysis, including individuals, groups, occupations, or organizations, and can encompass concepts of dependency, centrality, prestige and hierarchy as well as the autonomy and control which are considered by automaion and deskilling theories.

In order to understand whether a new technology will empower or degrade, it may be studied in the following three contexts -- taken separately or in combination:

1) *The attributes of the technology*. Some technologies produce codes, systems of signs whose meaning requires interpretation, either as an element of intentional design (medical imaging equipment, radar) or as a byproduct (sounds that convey informaiton about the functioning of a machine). The ability to interpret codes may represent a source of power and influence for those who operate or maintain the technology. Finally, technologies may circumvent codes by translating naturally occurring codes into codes that can be read by a machine; therefore, the technology would degrade occupations associated with the old code while empowering occupations associated with the new.

Another technical attribute constraining a technology's capacity to empower or degrade its users is how and how much the signals it produces become inputs for its further functioning. Complex and open systems of feedback should empower, while closed systems -- those designed to operate without human mediation or interaction -- should degrade occupations associated with their use.

Any technology can be described relative to its departure from an earlier technical order. By reducing human discretion and increasing rationality, incremental innovations deskill specific occupational groups. Radical innovations should empower some occupations while degrading or eliminating others. Occupations spawned by radical innovations experience a temporary advantage until further incremental innovations work to degrade or eliminate them.

2) *The organizational and occupational milieu.* Technologies rarely alter power distributions directly, but are instead conditioned by the setting in which they are used. Technologies are more likely to degrade occupations when they are accompanied by reorganizations that rationalize work structure, especially in larger firms. They should degrade work less when they are introduced incrementally rather than radically, and when they are deployed by organizations that emphasize ideological rather than rational control, for if one can control the premises behind the action, there is less need to control the action itself. Moreover, technologies less frequently deskill members of occupations that have chosen to professionalize rather than unionize, because professionalization builds power by monopolizing expertise and knowledge, while unions have usually ceded to management the right to introduce technology as it sees fit.

3) *The larger socioeconomic environment*. Finally, the larger socio-economic environment constrains an organization's or occupation's actions with respect to technology. Organizations are unlikely to employ technologies that degrade work unless the strategy makes economic sense, and that depends in part on conditions in the product market. Labor markets, in turn, affect the occupation's ability to resist degradation; and idiosyncratic conditions of specific industries also influence whether technology will degrade or empower workers.