CQWL

FITTING COMPUTER-AIDED TECHNOLOGY TO WORKPLACE REQUIREMENTS: AN EXAMPLE

(CQWL-WP-76-2)

CENTER FOR QUALITY OF WORKING LIFE
Institute of Industrial Relations (Los Angeles)
University of California
Los Angeles, 90024
(213) 825-8862, 63

FITTING COMPUTER-AIDED TECHNOLOGY TO WORKPLACE REQUIREMENTS: AN EXAMPLE

by

Joel Fadem

Center for Quality of Working Life
Institute of Industrial Relations
University of California
Los Angeles

A paper prepared for presentation to the Numerical Control Society's Thirteenth Annual Meeting and Technical Conference,

March 29 - 31, 1976 in Cincinnati, Ohio.

In this paper, some opportunities in work systems design will be considered in the light of an example involving numerically-controlled machine tools. Two major points are developed. First, that designers of numerical control software are inextricably linked to workplace behavior in the job shop; that is, they are agents of social as well as technical change, whether they realize it or not -- or whether they like it or not. The second point follows from the first: given the central role of software designers as creators of templates for action and control in human systems, there is an accompanying need for them to consider these implications in developing their designs.

In mid-1968 managers at General Electric's River Works in Lynn, Massachusetts were exhibiting great alarm over low levels of efficiency in the production of aircraft engine parts. More specifically, a crippling bottleneck existed in a shop where numerically controlled lathes were in use. Tension and ill feeling between workers and supervisors had been chronic in this shop during the preceeding years, and were reflected in grievance figures -- the highest in the Lynn complex. Other symptoms of disorder included high employee turnover, abnormally low production speeds, unreliable quality, high levels of scrap and rework, and frequent MRB's. The automatic lathing section was especially strategic to the highly integrated production system at Lynn. If engine parts were not produced at sufficient rate or if quality slipped, schedules were delayed, other workers were idled and contracts were placed in jeopardy.

Resentment among the workers was still being nurtured from past struggles with management to upgrade the payment classification for the auto lathes. Strikes over this issue had been very damaging to the company, which remained steadfast in its position that hourly wage rates were commensurate with the skills required. This issue, to a great extent, hinged on conflicting notions of the auto lathes' capabilities. The manufacturer of these large green and gray machines was reported to have been overzealous in estimating the skill required for their operation, so much so that GE announced that "any monkey off the street can be trained to operate the computerized lathes."[1] The company appears to have been convinced that it was providing button-pushing jobs, purely and simply.

But as events later indicated, button pushing wasn't enough. Because of the extremely close tolerances involved, the engine parts produced had to be absolutely flawless. In some cases the tapes were not pre-programmed correctly, resulting in scrapped parts and fouling of the expensive machines, which ranged in value from $70,000 to $250,000. Frequently, the tools would undercut as a result of wear which was not compensated for in the tapes. Resets had to be made for second cuttings. Minor disturbances in the complex circuitry of the numerical control equipment was another regular occurrence. These disturbances were aggravated by the attitudes of the operators. In the words of one man:

> Look, I could slow it down, and it would look completely aboveboard. Say the machine stops running. I go to the foreman and say 'I pushed the button and nothing happened.' He calls in the maintenance man who brushes some lint out of the machine. All that takes time. But if I had wanted to, I could have brushed out the lint myself.[2]

Poor machine utilization brought increased pressure from foremen which in turn aggravated the hostility and mistrust prevailing in the shop. Attempts were made to increase the work pace through the creation of a higher paid category known as "lead hands". This and other forms of divisive inducement, as well as threats between foremen and individuals did not make relations better. They also served to split the loyalties of workers; back biting and squealing were frequent forms of self protection in this atmosphere.

The situation had deteriorated to such an extent that by mid-1968, some kind of comprehensive remedial action by management seemed clearly needed. It came in the form of a local management initiative for a "pilot program" of job enrichment. The program was proposed by personnel and labor relations staff with the cooperation of line management. It was a courageous venture into unknown territory both for the management and for the union, Local 201 of the International Union of Electrical Workers. Management's rationale was clearly revealed by the following statement made at the program's inception:

> The principal reason for a good many of our difficulties is that our hourly employees are lacking in motivation. They perceive themselves as being treated as immature, irresponsible, incompetent people who are relegated to a button-pushing status. A detailed analysis of their duties and responsibilities indicates considerable justification for their feelings. Because of the way their jobs have been structured, these men are not challenged: they have no sense of involvement in the total manufacturing scheme and they appear to derive little or no personal satisfaction from their employment here at GE.[3]

The program was launched in Building 1-74 where seven Monarch Automatic Lathes with Mark Century Controls were located side by side. Recruitment to the project was carried out on a voluntary basis subject to union seniority rules; over the course of the experiment, seniority ranged from six months to 32 years. Each operator was assigned to a single machine. Over the three shifts this came to 21 men including one working leader per shift. The foreman and unit manager were removed. The unit reported to a single manager responsible for numerical control equipment operations. He was assisted by a manager who coordinated the special program, measured its outcomes and provided feedback.

Participants in the program were paid a 10 percent bonus. Shift overlaps of 18 minutes were necessary to ensure continuity and payment was provided for this time. In the initial phase, the pilot program had the following additional features: 1) flexible starting times; 2) elimination of timeclock punching for informal lunch breaks, and 3) extra responsibilities for operators, including preventative care of equipment, minor machine adjustments and repairs, debugging of new tapes, tools and fixtures, as well as troubleshooting existing ones. The work teams were to be issued special blue uniforms with "Pilot Program" insignias and, ostensibly, a new lease on shop floor life.

The program began in October 1968, and initial responses from the workers were guarded. Given the fishbowl atmosphere, men in the unit were sensitive to the curiosity, apprehension and occasional ridicule of neighboring workers. Workers in the project were not isolated from others; they were physically located in the midst of Building 1-74's activities. The company sent a number of participants to programming school in the hope that they would be able to devise their own tapes; this proved to be too ambitious and was scrapped, however training was successfully administered in the areas of record keeping and related management paper work. The company's wish that the men carry out their own repairs was dampened by union job demarcation restrictions. During the first three months of startup, productivity and machine utilization dropped to low levels and accompanying attitudes were poor. There was confusion over roles and responsibilities. Absenteeism had not improved.

However, things changed for the better after January 1969. The next three months evidenced significant increases in machine utilization and group productivity. Attitudes and levels of individual involvement also had improved. A pattern had begun to emerge in the unit. The group began to be slightly more cohesive with the development of more stable roles, greater understanding was established with management, and activity within the team became more orderly as efforts were made to regulate work assignments. Group goals concerning machine utilization, quality, scrap, rework, and costs also began to develop. In general, the pilot group had improved its internal communications and level of mutual trust. It also experienced stronger support from outside departments on such concerns as incoming quality, voucher integrity, machine maintenance and planning.

During the next four months, as activities became more routine and doubts faded about the continuity of the program, general operator attitudes appeared less clear, with corresponding declines in machine utilization and productivity. Reasons contributing to this were issues within the group about its informal leadership and its methods of disciplining members, diminished management attention to the project, the appointment of a new program manager, and vacations. The unit's performance was also affected by a strike of maintenance workers in the plant.

From September 1969 through the beginning of a 100-day strike in November by the IUE against General Electric and Westinghouse, performance and attitudes in the pilot program deteriorated rapidly. The strike marked the end of the first phase of the experiment. Until this point the project had yielded some encouraging but by no means settled results. Machine utilization and productivity had increased only slightly if at all. Scrap and rework had decreased significantly, as had the frequency of MRB cases. Lateness and absenteeism had also gone down markedly. The overall effect on unit cost was approximately unchanged.

With the return to work in early 1970, the pilot program was resumed; however, its orientation had shifted. Whereas efforts were made in the first phase to enrich individual jobs within the context of a relaxed supervisory climate, the second phase focussed on the collective group task. Thus, rather than pursue the improvement of jobs in isolation (sometimes known as "horizontal job enrichment"), attention was devoted to making the group viable, self-maintaining unit, capable of routine engagement with outside groups and individuals at different levels ("vertical job enrichment"). Management had the opportunity of gaining insight into the pilot group's problems by attempting to carry on operations themselves during the strike. After firsthand experience, it became apparent that they had underestimated the difficulties faced by operators.

The second phase of the pilot project was guided by a new manager (there were eight over the course of the project) who had no technical knowledge of automatic lathes. However, he was instrumental in stimulating the group to become more directly involved in solving production problems and succeeded in expanding overall group responsibility in this area. A division of labor in the group was established whereby workers assumed responsibility for various interface and support functions. Thus, group members carried out liason duties with production control officers, planning, quality control and MRB managers, as well as with maintenance engineers, and payroll officers. They also performed housekeeping and safety functions, training of new operators, and record-keeping. Production control activities included scheduling jobs within the unit by the workers themselves who also determined work assignments within and between shifts. When a bottleneck was encountered at the main tool crib, the workers set up their own and stocked it to suit their requirements. Of course, when breakdowns or equipment difficulties were experienced, maintenance staff were usually required. But operators were often essential to a specific diagnosis, as in the case of a program fault, because maintenance men were spread over a ten-mile area and infrequently encountered the same machine.* Some operators became proficient at making their own programs. Greater interest also was kindled in tool fixturing and design. One instance of this was when operators developed methods of cutting two dimensions simultaneously, thereby saving time and set-up costs. In general, despite limitations in technical knowledge, workers in the pilot unit became highly motivated to meet the challenges raised by multiple role requirements within the group.

An important feature of the pilot group was that individuals were not coerced into accepting responsibilities they didn't want, aside from basic time-keeping and house-tending duties. If an operator did not want to train for other skills, he was not pressured by group members or management. Peer discipline was applied to individuals who violated basic group norms, but a thin line perennially existed between police as distinct from less obtrusive tactics. For example:

> There are other ways of handling the problem. One guy never started 'til 9 a.m. So one day we stood around his machine and stayed there 'til 9 a.m. He got the message.[4]

By all reported accounts, the second phase of the pilot program was an impressive success. Productivity was allegedly so high at one point that parts suppliers were outstripped and additional work had to be undertaken. By September 1972, the project had been expanded to include 63 operators. That month the "Christian Science Monitor" featured an extensive story describing the experiment. GE did not disclose details of productivity or savings to the newspaper, though it was acknowledged that scrap and rework had declined, accompanied by gains in product quality.[5]

At the same time, news of the project had begun to spread within the company and among other locals of the IUE. Inside Local 201 itself, tension had been evidenced for some time over the issue of extending the pilot program to other departments; the 10 percent bonus also had its obvious attractions. It is interesting to note that while the strike in 1969 of 600 maintenance workers was over pay increases, the vehicle used for its attainment was influenced by the pilot program. The different craft groups comprising the maintenance section wished to relax their boundaries and form multi-skilled craft units on a rotational basis. Also, early in 1971 when union and company officials met

> (They) were enthused with the concept of the new Pilot Program and have instructed other management people to set a rate and spread the concept to other day work areas.[6]

This did not occur, though the pilot project itself continued to expand to a total of 77 workers in 1972.

Interest mounted in the union to put the pilot program on the bargaining table. There were reports that corporate level management at GE was apprehensive of the program's implications for their plants in Western Massachusetts, Ohio, Kentucky and New York. Shortly after the "Christian Science Monitor" article, the pilot project drew explicit concern from corporate management on the following points: 1) that they had not been adequately informed by Lynn management regarding the project's expansion; 2) the 10 percent bonus scheme at Lynn was disturbing the corporate-wide pay classification system; 3) the notion of vertically enriched jobs raised the issue of whether or not they could be fairly paid relative to other company jobs; 4) more fluid work group roles might not conform to National Labor Relations Board definitions of exempted jobs carrying management responsibilities; 5) they did not approve of flexible starting times and unclocked lunch breaks; and 6) that longer term reliability of the pilot project as a means for securing better productivity had not been demonstrated.[7]

At approximately this time, the IUE began to lobby with GE management to extend job enrichment on a nationwide basis. Although intervening events are at present unclear to outside observers, this apparently induced corporate management to apply pressure for termination of the project. By early 1973 management at Lynn had reinstated foremen in the pilot program area. This right had been reserved at the beginning, along with any other modifications to the project thought fit by management. Reports by outsiders from this time onward are sketchy. Elements of the program were retained. Management wished to phase out the 10 percent pay differential, but it continues to remain in effect; elimination of the differential would undoubtedly precipitate a strike. The union has taken no official position on the project's termination. In 1974, one operator had the following to say about the altered situation:

> The only difference the foremen have made is that the place is a little cleaner, and some of the guys are squealing on each other again.[8]

In the absence of reliable information, it is difficult to evaluate the results of the pilot project. As it became a more stable fixture in the general work environment at Lynn, evidencing both tangible and intangible benefits, it is likely that an inevitable question rose to prominence: "In an organization of this size, what do you do when you have a success on your hands?" Given the ramifications and complexity of this issue for GE, the difficult choice was made to revert to conventional procedure in the face of a controversial precedent. Paradoxically, success can be an embarrassment when clearly visible in a large organization.

To summarize key aspects of the pilot program which have a bearing on work systems design, the numerical control system demanded more complicated behavior from operators than had been expected. Management assigned a wage rate that was viewed to be commensurate with the expected behavior, only to realize that individual role requirements had been understated. Under this reward condition, and in conjunction with a rigid supervisory climate, performance and work attitudes were poor.

The first phase of the pilot program attempted to rectify this by relaxing managerial restrictions, broadening the scope of tasks comprising individual jobs (horizontal job enrichment) and acknowledging that these were unique differences by offering a wage differential. Some elements of performance improved, others did not. In general, it fluctuated as did attitudes. This, of course, was complicated by the emergence of the 100-day strike.

Further progress was made in the second phase, primarily because the structure of the group, with the encouragement of management, came to resemble that of an open system. Individuals performed multiple roles consonant with identified group objectives. These roles included internal work scheduling and assignment, as well as regulatory functions at the boundary of the unit; such things as liason with planning, production and quality control staff. The properties of the phase-two pilot group have been translated into the language of socio-technical systems theory in order to highlight the contrast with the relatively inferior performance of the group during the early months. In the first phase of the project, the unit tended to be a closed system. Although more mutually interdependent less attention was allowed toward regulating inputs by engaging with outside groups. More group attention was necessary for establishing and maintaining an internal structure. The unit could not realize its potential, however, until greater autonomy developed in relation to functional areas outside the group. Not all duties at the boundary of the unit, by the way, were desirable. During phase two, the group found it more convenient to establish a tool crib inside its area, rather than regularly depend on the main source of supply.

The sophisticated numerical control equipment at Lynn was designed to improve the reliability of producing flawless engine parts. In attempting to reduce lathe operation to essentially that of pushing start and rewind buttons, other elements of key variation in the process were neglected. This variance remained uncontrolled until supporting group activities were enlisted and functionally organized. Thus, by attempting to eliminate the human element from the job, the precise opposite was required to make the technology work. Coping with unpredictable events required coordination between workers, as well as enhanced scope for initiative on the part of individuals - in short, brainwork. Somewhere along the line, it is to be inferred, the latter commodity was relegated exclusively to the software designers.

The principal lesson of this example is that technology, however simple or elaborate, provides opportunities for the formation of group activities. These activities can either be structured to resist or support the technology. What is always slightly discouraging about experiments like the case at Lynn is that we continue to express surprise when ordinary working people respond positively to opportunities for greater freedom and autonomy in their jobs. When will our consternation end and programmatic action at the workplace begin so that "success" ceases to be an object of controversy?

Footnotes

* General Electric also had major installations at West Lynn, Everett, and Wilmington.

Bibliography

1. David Geiber, "Bring Back the Punch Clocks, Welcome the Foreman," The Real Paper, October 9, 1974.

2. Ibid.

3. Ibid.

4. Trudy Rubin, "The Workers Work Better Without Bosses," Christain Science Monitor, September 5, 1972.

5. Ibid.

6. Henry Blanch, "Fighting the Establishment," Electrical Union News, January 29, 1971.

7. Dr. William Lytle, "The Nature of Work Life is Beginning to Change," 1975 (unpublished).

8. Geiber, op. cit.

* This paper was also informed by a presentation on the Lynn experiment given by Peter di Cicco, President of District Council No. 2, International Union of Electrical Workers, AFL-CIO-CLC. The talk was given on September 24, 1975 at the Center for Quality of Working Life's Short Course on Job and Organizational Design held in Los Angeles.

Biographical Information

Joel A. Fadem

Formerly Research Associate, Industrial Relations, Oxford University; Economics Consultant, Rand Corporation; Wilson University Fellow, Yale University; Fulbright Research Scholar, Department of Economics, University of Melbourne, Australia; undergraduate training, Economics, University of California at Berkeley. Professional experience includes work in the following industries: aerospace, automobile, confectionary, government agencies, longshoring, maritime, medical services, mining, scientific research, shipbuilding.

CQWL

CENTER FOR QUALITY OF WORKING LIFE