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PERCEPTIONS OF WORK REORGANIZATION:
Interviews with Business and Labor Leaders in Four Industries

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ABSTRACT

This study examines the ways in which new technologies and foreign competition are affecting work organization in four industries: autos, machine tools, apparel, and telecommunications. The authors summarize and analyze the results of extensive, open-ended interviews of representatives of business and labor in industries that are undergoing rapid change.

The past few years of intensified competition and new technologies have brought a multitude of intended and unintended experiments involving the use of skills and the deployment of labor. Several distinct patterns of work reorganization emerged from this study. Some cases displayed what the authors term an "integration" model based on training and retraining at all levels and the careful, often incremental blending of workers and automation. In other cases a hardware-centered approach is leading to a so-called bipolar model that concentrates skills at the higher levels, leaving a base of unskilled workers.

Because routine tasks are the easiest to automate, all four industries are undergoing aggregate upskilling, even as total employment declines. Finally, there is evidence of the halting demise of Taylorism, the widening task composition of job assignments, and a perceived shift away from authoritarian styles of management.

These findings have implications for policy makers concerned with education and training consonant with the competitive needs of American industry. These interviews revealed a concern among corporate decision makers that the workforce be better grounded in basic skills such as reading, writing, math, and computer skills, and that these skills be augmented by the ability to think conceptually, solve problems, and communicate with others. Educational inadequacy in these areas is perceived as a significant barrier to the development of the flexible, retrainable workforce required by the new circumstances of dramatically intensified international and domestic competition.

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I. BACKGROUND AND SUMMARY

Most business, labor, and political leaders now recognize that intense competition from America's leading trading partners and the introduction of new technologies are driving fundamental changes in both manufacturing and services. Production is being thoroughly reorganized: from the design of the workplace, the nature of work processes, and the character of the workforce, to the organization of the business enterprise and beyond, even reshuffling the linkages among the production activities that constitute our national economy. The nature of this transformation will seriously affect not only the competitiveness of national industries in international markets, but also the ability of a nation to sustain a high standard of living based on a highly skilled workforce and a high-wage economy.

These momentous changes are not based on some inexorable logic of technological and economic development. Rather, such changes result from strategic choices made by individual firms. When making decisions about how to respond to competitive pressures or how to implement new technologies, firms find themselves deciding how to employ people, what tasks to set them, and what skills are required. Recent years have brought a multitude of intended and unintended experiments involving the use of skills and the deployment of labor. Some companies have chosen to move offshore and to equip inexpensive, minimally skilled labor with standard technologies, while others have chosen various approaches to automating domestic production. Production at home in some cases has meant that automation replaced labor, while in others it has meant higher skill requirements.

Of course, firms operate within the constraints of market and industry structures, not to mention public policies, labor markets, industrial relations systems, and the limits of technological possibility. Most importantly, firms operate within the constraints of the competitive consequences, the success or failure of a particular strategy. The choices firms make constitute different paths through the industrial transition--paths having vastly different consequences for the economy. Changing the context in which firms operate can encourage specific choices. Increasing the level of skills in the workforce through appropriate policies, for example, might encourage the reorganization of production in a way that takes advantage of those skills.

It is necessary to document, analyze, and account for production reorganization at the level of the firm in order to begin to understand the character and possible outcomes of the current industrial transformation. The analytical and methodological problem is to find a way to evaluate the reorganization of production that simultaneously indicates the massive dimensions of the transition and also documents the existence of alternative paths, each having different consequences for the economy as a whole.

BRIE's solution to this research problem is to portray alternative models of production reorganization developed by looking at the way specific firms and industries are changing and by choosing cases that are generalizable in terms of variables such as skill levels, location, and workforce flexibility. For example, we have postulated a model of "organized smarts," which implies the use of highly skilled labor in conjunction with automated technologies, producing a high degree of flexibility based on technologies and on both the ability of the workforce to respond to change and the ability to tap smart resources at home rather than displacing production abroad. By contrast, a model leading to "national deskilling" might imply a skills-bifurcated workforce, automation that strips human labor from production, offshoring of labor-intensive processes, and rigidity rather than flexibility when faced with technological change. Having specified such ideal types on

the spectrum of production organization, the next step is to examine real cases to determine why firms (and to some extent nations) choose one particular path. One can then examine the consequences alternative choices have for the competitive position and skill base of the national economy.

The case studies presented here represent the findings of an initial but critical stage of research: investigating whether our tentative hypotheses about the forms that production reorganization might take make sense and exploring concretely the technological and organizational elements of those changes. We conducted this investigation through a set of open-ended, intensive interviews with corporate decision makers and labor leaders. The interviews focused on changing skill requirements, work reorganization, and educational requirements for the workforce. In today's rapidly changing economic and industrial environment, interviews with participants, especially those in a decision-making capacity, afford one of the best windows into the content and direction of change. We found these interviews to be a rich source of information and ideas, suggesting interpretations of past events, present problems, and possible future trends.

Although we are concerned principally with the way skill requirements are changing (and the ways they need to change for U.S. industry to regain lost competitiveness in domestic and world markets), understanding the direction of skills change requires understanding the broader issues to which skill levels are tied. These issues, as we conceived of them and brought them into our interviews, can be summarized as follows.

What are the principal challenges (competitive, organizational, technological) facing a given industry? How is the organization of production changing in that industry (organization of production understood broadly to range from vertical, horizontal, and overseas linkages through supplier networks, distribution systems, and sales to plant location and organization)? Within this context, how is work organization changing at the firm and plant level? What factors most influence company decisions about the

introduction of advanced production technology and the reorganization of work? What models of work organization exist, and which are having the most success? How is job content changing, and what are the implications for skill requirements? How are workers being trained for new jobs and new work roles? What problems are encountered with resistance to change, and where is that resistance located? How are managerial styles and attitudes toward the workforce changing? How do workers respond to managerial initiatives; what attitudes about work do today's employees bring to the workplace? What is the role of unions in an era of reorganization; what attitudes and powers do unions have, and how do these affect work reorganization? Is the climate of industrial relations changing, and what implications does change or lack of change have for work organization and skill requirements? Finally, drawing on all the above, what are the present and future educational needs of the workforce as U.S. industry grapples with its current unprecedented competitive challenge?

Approach

We conducted 52 interviews in four industries: autos, machine tools, apparel, and telecommunications (both services and equipment manufacturing). We compromised on four sectors as our resolution of the inevitable depth/breadth dilemma. We chose the sectors for their importance to the economy and because BRIE has performed considerable past research in each, research we were able to use as background material. The company representatives we interviewed ranged from CEO to plant manager; union representatives ranged from national vice-president to local president. Usually, we tape-recorded interviews with participants' permission. All participants were assured of anonymity.

Econometric and other statistical models, which may provide useful reinterpretations of past events, have proven notoriously inept at predicting the future. Given our concern with the recent past and likely future, we anticipated no better success than others have

had at extrapolating past trends into the future via quantitative analysis. More importantly, we were convinced that a set survey format might prevent people from telling us the significant stories we hoped to hear in this time of widespread experimentation and general uncertainty. Because our purposes were exploratory, encouraging managers and labor representatives to tell us their own stories in their own words was a way of discovering new and sometimes unexpected perspectives and of forcing us to re-think our original assumptions. For example, we discovered contending and unexpected models of work organization within each of the four industries; and we heard of a widespread, deliberate, normatively reinforced (if all too gradual) shift away from Taylorism in the workplace. Our findings--based on the perceptions, insights, and aspirations of decision makers grappling with the problems of production reorganization--provide a focus for future research into ultimate outcomes of the current transition.

Case Study Summaries

The following paragraphs summarize the results of the case studies in each industry.

Autos. The auto industry presented us with two contending models of work reorganization. One we call "hard automation"--this is GM's recent strategy of major investment in plant overhaul based on a comprehensive introduction of integrated, advanced technology. High cost, persistent operational problems, and low payoff have combined to diminish the appeal of this model for most of those with whom we talked. The alternative, which we call the "labor integration" model (present at GM/Toyota NUMMI and prominent at Chrysler), is based on gradual, incremental integration of labor and new technology, with an emphasis on training and skills development. Both models could be termed Fordist; we found no great shift from mass to batch production. But within the Fordist model we found considerable experimentation and change, with a perceived shift away from Taylorism.

Both managers and labor representatives told us that skill levels are rising in autos for three primary reasons: lower-skilled jobs are easiest to automate; advanced equipment requires skilled repair technicians; and there is a widespread trend toward multi-task production jobs (production workers still comprise four-fifths of the hourly workforce).

People on both sides spoke highly of the jointly run job banks. We found a general expectation of fewer job classifications and more workteams, with ongoing training and retraining as part of work organization. For the individual, jobs generally will be more interesting, with more responsibility and more pressure. New opportunities for mobility based on retraining, however, will be offset by declining employment in this industry. The auto worker of tomorrow will need a solid education and skills such as reading, math, and computer technology to provide a basis for lifelong retraining.

We were told that competitive pressures are digging Taylorism's grave. Managers confess to the authoritarian sins of their past and claim now to promote a participatory, "human-resources" approach. In the new competitive environment, they say, managers need the cooperation and sometimes even input of their employees. They hope for a new climate of industrial relations and credit the union with concessions that make possible a "social partnership." Union representatives, for their part, identify similar trends and claim to support any work reorganization made in the interest of competitiveness as long as individual workers are protected (as through job banks). The union takes credit for considerable advances in job security, training rights, and the establishment of joint labor-management committees (concerning new technology, for example). As yet, however, the union appears to have achieved little formal input into managerial decisions regarding work organization and technological change. And managers at the plant level often fail to allow workers to use much of the teamwork/human-relations training they have received.

Machine tools. As a result of foreign competition, the machine-tool industry has declined severely in the 1980s. We heard many reasons for this decline, the most common

and persuasive of which centered on inadequate marketing. Foreign firms slipped onto the turf of formerly complacent small and medium-sized firms and simply have done a superior job of tailoring product and service to customer needs. As U.S. firms attempt to reorganize and/or retain market share, again there seem to be two primary models of work organization: a "labor-integration" model (with upgrading, new computer-centered training for machinists, and multi-task production jobs for the less skilled); and a "bipolar" model (highly skilled machinists and electronic engineers at the top; unskilled assemblers and operators at the bottom).

Skill requirements are changing in this as in every industry we examined. Some members of the largest employee group, skilled machinists, are learning microelectronic and computer skills; others are being deskilled as craft functions are loaded onto microchips. At the middle level of the labor-integration model, "semi-skilled" workers (having 18-month community college certificates as opposed to four-year apprenticeships) do many of the tasks skilled machinists used to do (from set-up to operation, guided by Computer-Numerically Controlled (CNC) units and programmable controllers). In the bipolar model, these tasks are divided between the highly skilled and the unskilled.

In the face of intense competition, the industry shows a new emphasis on the flexible use of labor, the breakdown of job classifications, internal training, and the active pursuit of employee cooperation. As in autos, some managers claim to be moving away from authoritarian structures toward a more open interaction with labor, one that is better suited to current requirements for worker retraining, adaptability, versatility, and innovation. This claim is especially prevalent at the larger firms. Small firms either don't make the claim or say they have always had informal, good relations with their highly skilled workforce.

Unions are absent from a majority of the firms in this industry, yet managers appear acutely aware of both the threat of unionization and the need to retain skilled personnel. Several managers told us of a changing corporate culture in this generally traditional

industry, as companies loosen up their personnel policies in an effort to attract and retain employees who have scarce skills, such as software engineers and machinists who can program computers. Along with the changes in competitive environment and corporate culture, we heard of a growing need for all employees to have basic literacy, communication, mathematical, and computer skills.

Apparel. The apparel industry is one of the domestic industries most battered by import competition. During the past 10 years many small firms have been driven out of business, and many large firms have been driven overseas by the difficulty of competing with low wages in developing countries and by a dearth of technological or organizational alternatives. Nevertheless, our interviews with executives of large firms in this industry indicated that some alternatives to industrial decline finally may be emerging. While many firms continue to rely on overseas subcontracting or direct foreign investment, some technological, organizational, and marketing changes are increasing firms' willingness and ability to manufacture clothing domestically. Among these are the development of market niches (at either the high or low end), incremental development of automated equipment, and application of computer technologies to design and pre-production of garments. Yet the most talked-about new strategy in this industry (and in fact, the strategy described by almost all the managers we talked to) is known as Quick Response (QR). QR is a synthesis of strategies to shorten manufacturing time, improve communications with retailers and suppliers, and diversify product lines to dramatically decrease response time to market changes. This flexibility presumably makes domestic firms more attractive to retailers, whom they can protect from being overstocked with unpopular items or undersupplied with fashion hits.

The model of work organization in the apparel industry has traditionally been labor-intensive, Taylorized (sewing machine operators, who make up the bulk of employees in the industry, still work for piece rates), and authoritarian. With an increasing emphasis on

faster, flexible response and product mix, this model of work organization clearly must change. What is unclear, due to the QR strategy's newness, is what new models of organization are emerging. While the overwhelming consensus of managers (although not of union representatives) is that skill requirements are rising, the industry's employment structure and opportunities remain as bipolar as always, with few opportunities for advancement from sewing jobs. Moreover, the jobs being automated tend to be those that traditionally have been considered the most skilled, whether or not the new jobs require even more skill. Yet given all this, firms seem to moving away from Taylorist work organization, doing more cross-training, introducing more multi-task jobs, and reorganizing the shopfloor around a more flexible division of labor. It seems likely that the trend toward QR will mean less monotonous and somewhat more skilled work on the shopfloor.

One of the ways firms are trying to achieve workforce flexibility is by changing their authoritarian style of industrial relations. At both union and nonunion firms we heard repeatedly that a changed climate of employee relations--more open management, better communication between management and workers, and some degree of employment security--is a key to increasing flexibility and productivity. Some firms had quality-of-worklife (QWL) programs, although both management and union representatives expressed some skepticism about whether workers want or benefit from the increased involvement that such programs require.

Our interviews with company executives and union representatives yielded a less coherent picture in this industry than in others. While representatives from the two sides did not contradict each other, union representatives tended to present a more pessimistic view of the future, maintaining that despite the innovations managers are excited about, imports are the real threat and protection is the only way to save domestic manufacturing jobs. The difference between the two views indicates a difference of perspectives rather than personalities. The firms we interviewed are at the cutting edge of the industry; they are

large and successful enough to pursue innovative strategies. Such firms make up a relatively small portion of the industry; the union perspective reflects the fact that much of the industry lacks options.

The executives we spoke with all said that their firms will have no problem finding and training workers, even given requirements for a more flexible and highly skilled labor force. Traditional employment in the industry will almost certainly continue to decline. Leading union representatives raised an important concern--that firm-level retraining will not address the problem of displaced workers in this industry. They believe that remedial education must be provided for those who traditionally have filled most production jobs in this industry: rural or immigrant women.

Telecommunications. The telecommunications firms we interviewed represent two sectors: service firms and equipment manufacturers. Both sectors have in common a sensitivity to rapid technological change and a concomitant need for workers who are both technically sophisticated and personally flexible. Nevertheless, our interviews gave us the impression that both sectors have entered a phase of relatively slower change. As in the other industries we examined, there is an increased emphasis on marketing and customer service. While firms in both sectors are in highly competitive markets, the service firms engage primarily in domestic competition, whereas the manufacturing firms must also compete with foreign producers, both in commodities (e.g., telephones) and systems [e.g., private branch exchanges (PBXs)]. This pressure is leading many manufacturing firms to seek to lower costs either through offshore manufacturing or hard automation.

Among service firms, the digitalization and computerization of the telephone system has radically restructured jobs and occupational profiles. For one thing, computerization has drastically reduced the number of employees needed. For another, technical, clerical, sales, and customer service job categories have become blurred. Technical functions are now performed at a desk with a computer terminal: sales and service employees need a

detailed technical understanding of how the systems work. At the same time, management hierarchies are being flattened, both in the interest of "mean and lean" management, and, it is claimed, in the interest of pushing decision making down to the lowest possible level. Manufacturing firms showed a clear trend toward reducing direct labor, both through automation and through simplifying product design for easier manufacture. This has meant a push toward higher aggregate skills, a reintegration of production-level jobs into single multi-task functions, and an increased emphasis on workteams. In any case, these firms will continue to be skewed toward high-level professionals such as engineers, software designers, and white-collar management and service jobs.

These rapid occupational changes in telecommunications, along with managers' professed preference for internal hiring and promotion, have led to major retraining efforts at the larger firms. On-the-job training remains the most important form of basic training, but the push toward theoretical rather than craft knowledge has led firms to supplement on-the-job training with a number of innovative programs. For example, many firms have added self-paced, computer-based programs and satellite television classrooms. As rapid and continuous change becomes the standard, training and retraining become an ongoing fact of worklife for employees in this industry.

There was widespread agreement that employee relations are crucial to company success. In general, managers seem to believe that a happy employee will always be a more productive and creative employee. Given the new emphasis on service, satisfied employees also may be better company representatives. It is important to many of these firms to attract the best and the brightest in professional and technical fields, and many pride themselves on providing an outstanding working environment. The only unionized firms in this industry are the older telephone companies. The two we interviewed have relatively good industrial relations. Cooperation with and from the Communications Workers of America (CWA) around issues of technological change and retraining is seen as a major

factor in these firms' success. This is especially true at the local level, where a new (and possibly fragile) climate of partnership has been jointly initiated between Pacific Bell and the union.

The picture we got from the communications companies and the systems manufacturers conforms to the labor-integration model, with the blurring of job categories, flattening of management hierarchies, increased worker responsibility, and lifelong training and retraining. This trend was less prevalent among the smaller firms and commodity manufacturers: a bipolar split between design and assembly was more pronounced. In the future, all firms will require employees who have math and technical skills, even for jobs that are not explicitly technical. Yet again and again the call we heard was not for better education in math and science, but for employees who have interpersonal communications skills, who can think for themselves, and who are flexible enough to adapt to change.

Results

A number of common patterns emerged from our interview-based study. Each industry displayed various ways of organizing and reorganizing work. In some cases, we found an integration model based on training and retraining at all levels and a careful, often incremental blending of workers and automation. In other cases we found a hardware-centered or bipolar model requiring a concentration of skills at the higher levels; a stripping of labor from the production process, especially at the middle levels; and a residual, unskilled core at the bottom. Based on the reports we heard, we hazard the guess that the former model may win out in industries such as autos and telecommunications by virtue of its superior flexibility in an often harsh competitive environment. But the success of such a model, people often told us, depends on developing a better educated workforce and institutionalizing training and retraining as a matter of firm and government policy. In apparel, although important changes are occurring at some firms, the bipolar model

remains predominant. The outcome is perhaps least certain in machine tools, an industry still reeling from its recent battering in the marketplace.

Many sources presented persuasive arguments against the deskilling thesis. Although the thesis may hold for individual jobs and crafts, most of the people we interviewed saw an aggregate upskilling in their own industries even as total employment declines. The most common explanation was that routine tasks are the easiest to automate. We heard of a widespread breakdown of traditional job classifications and the expansion of multi-task production jobs. Both managers and union representatives told us that, in general, employees in the workplaces of tomorrow will require increased abilities to analyze, to solve problems, and to communicate.

We heard of the halting but persistent demise of Taylorism, the widening task composition of job classifications, and a perceived (and anticipated) shift away from authoritarian styles of management. We were given two reasons for these changes: first, routine command-oriented management no longer works in an unstable, competitive environment that requires production flexibility and shopfloor innovation; and second, today's workers do not accept being ordered around. We heard that both younger and older workers ask more questions, seek more from work than money, and want to understand why they are doing a certain job in a certain way.

Some managers expressed interest in tapping into the creative potential of workers to improve shopfloor productivity. At the same time, however, managers frequently described a need to exert more control over the production process. While the interviews convinced us that the trappings of human-resources management are widespread and that effective responsibility is being pushed downward, we remain uncertain of how far decision-making authority is spreading. As managers grapple with conflicting pressures toward centralization and decentralization of authority, and as unions begin to seek more of the latter, various outcomes are possible. We heard a clearly described trend toward the

integration or reintegration of work (although in most cases this integration takes the limited form of multi-task production jobs). Our sources spoke more ambiguously of the future of authority relations (on several occasions, we heard the same manager speak of pushing down decision-making authority and extending central managerial control).

We often heard complaints about the difficulty of attracting young, ambitious talent to the factories. For those having some education, factories are low on the list of desirable workplaces, and this prejudice was described as a major barrier to the development of tomorrow's more highly skilled and versatile industrial workforce. Many innovations in employee relations are a response to this perception that industrial work has "a bad image."

We heard consistently of the need for a workforce better grounded in basic education: reading, writing, basic math, and computer skills--and beyond these, the ability to think conceptually, solve problems, and communicate. The end of our interviews provided an open-ended opportunity for people to talk about the changes in education required to meet the present and future needs of industry. Often we heard malaise, dissatisfaction, and a sense that the problem is almost too great to be manageable. For the most part, managers expressed dissatisfaction with the functional education levels of their workforce. Often, this educational inadequacy was perceived as a barrier to the development of the flexibly skilled, retrainable workforce required in the unstable environment of dramatically intensified international and domestic competition.

II. AUTOS

"Nothing clarifies your thinking like the sight of the gallows."

— High-level auto industry executive

The decade-long crisis in the U.S. auto industry is well known in its broad outlines and familiar to industry executives and labor leaders. The above quotation refers to the ongoing reorganization of work in a climate of changing industrial relations. It captures the sense that the survival of the industry and of firms depends on the breakdown of "scientific" management and its corresponding plethora of job classifications and adversarial shopfloor relations. Change is necessitated by the market: most managers at the large auto companies and labor leaders at least pay lip service to the need to introduce new technology rapidly combined with a new "enlightened" style of management, a new "negotiated partnership" in industrial relations, and new job content and skill requirements. How fast these changes occur, how substantial they are, and what level of success they attain will depend largely on the results of current plant-level experiments and the resolution of debates within both management and labor.

For the future success of the industry, the challenge is widely perceived to be twofold. First, firms must be much more sensitive to the market. This means getting out and studying the market, finding out what people want, tailoring product and service to customers' needs, changing offerings quickly when necessary, catering to demand. Echoing perceptions relayed to us in the machine-tool industry, one auto executive told us that this sensitivity to the market, not technology, productivity, or cost advantage, was the basis for

Japan's competitive success. Second, and directly linked to the first, is the reorganization of production, with emphasis on technology and the organization of work on the shopfloor.

The history of the U.S. auto industry affords the quintessential model of the Fordist system of mass production. This is also the industry in which contending models and variations on the basic model have recently achieved dramatic success. Within the U.S., there is considerable experimentation on a plant-by-plant basis with new technology and the organization of work. As one labor official mentioned, however, the much-heralded shift from mass to batch production appears not to be taking shape, at least not in its advertised form. Although computer-controlled machinery is more versatile and designs can be changed more quickly, mass production of standard models remains the core organizing principle for the U.S. as for the Japanese auto industry. If anything, production has become more standardized: where once a customer could specify options down to the molding, now selection is limited to a few standard option packages. Ironically, in the context of advanced technology and work reorganization, standardized production may offer more room for shopfloor innovations (such as workteam autonomy) than does the production of customized models, which requires separate orders for each unit or small batch.

But there are many ways to organize mass production in an era of flexible, programmable automation. While the low-wage, labor-intensive (and repressive) model of the newly industrializing countries does not apply to the U.S., and the Volvo "workers' paradise" at Kalmar, Sweden, appears still far off, there is room for widespread experimentation at GM, Ford, and Chrysler. A few years ago, dominant managerial strategic thinking was hardware-oriented. Future success appeared to lie with a hard-automation model of production. Industry executives told us they were entranced with the new technology: they hoped to bring in as much of it as fast as possible and remove as much labor as possible from the automated plants. Ford pursued this strategy at its Taurus and Sable plant. But it was GM, with the most money to invest, that went farthest down this

road. At plants such as Hamtramck and Buick City, GM made massive capital investments aimed at flexible automation, labor substitution, and the rapid transformation of technology and work. The most innovative industrial relations concepts were applied to the remaining workforce. On the edge of insolvency, Chrysler executives watched enviously from the sidelines as GM blazed its hardware-driven trail into the future.

At the same time, however, GM conducted other experiments, most notably the joint GM/Toyota New United Motor Manufacturing, Inc. (NUMMI) plant at Fremont, California. In contrast to the hard-automation model, NUMMI integrates worker training, multi-task jobs, and worksteams with advanced technology [which is flexible and programmable but lower tech than flexible manufacturing system (FMS)-type automation]). A growing current of assessment both within and outside GM regards the hard-automation model as at least a partial failure and the NUMMI plant a great success. The automated plants continue to show various performance problems beyond the expected debugging phase, and it appears that the huge capital investment made at some of them may never pay off. Meanwhile, GM managers, from the foreman level on up, are being flown from around the country to view NUMMI's success. Within GM, NUMMI is viewed increasingly as the model of the future; the hard-automation approach at Saturn may be destined for alteration.

At Chrysler, meanwhile, the limitations imposed by tight finances appear to have had unexpected benefits. Because Chrysler could not afford to follow GM's hardware binge, new technology has been added incrementally and work reorganized gradually, in a way not dissimilar to the Japanese approach. As a result, at some plants Chrysler has gradually and effectively integrated skilled labor, multi-task production jobs, new technology, and upgraded machinery. For the past three years, Chrysler's (proportional) profit margins and productivity have substantially exceeded GM's, and cost per car is lowest of the Big Three. Although top managers at Chrysler are happy to take credit for success, one executive told us that luck (i.e., poverty) was what led Chrysler away from the hard-automation strategy.

While the three major auto companies exhibit wide variations in organization among plants (due to many factors including investment decisions and local collective bargaining agreements), successes at Chrysler and NUMMI seem to be inclining industry opinion toward what might be called a labor-integration model, as opposed to the recently dominant hard-automation model.

All those we interviewed considered labor-force characteristics to be vital to the success of either model, but especially the labor-integration model. Whether the strategy is hard automation or a blend of automation and other changes, workers having skill, attention, and certain attitudes are required to make the equipment work, prevent breakdowns, and make adjustments and repairs. One industry vice-president told us that, given all cost/benefit factors, he considered labor-force characteristics "the whole ballgame" when it came to major decisions regarding new investment and plant location. Labor-force skills, costs, and attitudes are examined carefully, especially at those critical junctures when the company must decide whether to invest in a plant or shut it down. Skill levels, training potential (based on level of education), and current and potential climate of industrial relations are all central to discussions regarding major investment.

The next section describes how these investment decisions, along with decisions to change work organization, are transforming life on the shopfloor, according to the representatives of industry and labor with whom we spoke.

Jobs and Skills

Hourly workers in the U.S. auto industry divide into two groups: there is approximately one skilled worker for every five production workers (unskilled or semi-skilled). Of salaried workers, about half are managerial/supervisorial and the other half scattered across a range of tasks from secretarial to software engineering. Absolute numbers of both hourly and salaried workers are declining. With the emphasis on factory

automation since the late 1970s, the hourly decline has been faster, but the salaried force will also decline in response to increasing automation and efficiency. Since the 1940s, when the ratio of skilled to production workers was one to eight, the percentage of skilled workers on the hourly side has steadily increased. Secretaries and managers (and recently draftsmen) are generally expected to be major factors in anticipated decreases in salaried workers, while only certain professional/technical groups (e.g., electronics engineers) are expected to increase. Some of those we interviewed spoke of a shift from direct to indirect labor. Others, from both industry and labor, said that automation is destroying the distinction between direct and indirect.

Everyone we spoke with in this sector agreed on one thing. The expected trend is toward rising aggregate skill levels across the entire workforce. Our sources gave three primary reasons for this perceived trend. First, unskilled and semi-skilled jobs are the easiest to automate; robots in the factory and word-processing machines in the office provide obvious illustrations. Second, high-skill jobs will develop along with the new technology. Trained workers are needed, for example, to operate, service, and repair new equipment such as robots, programmable controllers, and visual inspection systems. Such jobs often require a mix of mechanical and computer skills. And third, as the perceived shift continues away from Taylorism's narrow job definitions, the number of classifications is reduced and work to some extent is reintegrated into multi-task jobs. This means skilled workers must increasingly tolerate a blurring of the boundaries between craft lines: the millwright, for example, now does some welding when required. For production workers, the change may be even more substantial: firms are pressing for, and some local unions are accepting, an expansion of job content and a wider range of responsibility for the lesser skilled. Typical new tasks include some quality control and minor machine maintenance and inspection, both of which imply problem-solving and communication responsibilities.

If, as most predict, the trend accelerates toward multi-task jobs in workteams, job content and skill requirements will probably continue to expand.

Several people with whom we talked from both industry and labor argued against the deskilling thesis: while a loss of skills may be evident in the study of particular skilled and semi-skilled jobs, a careful look at broader patterns gives a different story.

Most of those we interviewed expect similar patterns for salaried workers. As managers, accountants, and technicians sit in front of linked terminals and secretaries are upgraded to word-processors, workforce size is reduced, but the remaining jobs require more sophistication, different skills, and some training. If, as some suggest, team concepts expand throughout the white-collar ranks in the form of quality improvement teams and cross-functional product teams, communication skills and conceptual thinking will become increasingly important.

The prevalent view is that new skills will be required of most workers and, on the whole, skill levels will rise. There is, however, one important offsetting tendency--the offshore sourcing of skilled work. This occurs, for example, when American plants contract for work from Japanese tool and die makers. It also occurs in the assembly of "transplant vehicles," for which Japan provides the engines and transmissions that require much skilled work. No one with whom we talked knew how substantial this offsetting tendency is, but it is expected to grow as Japanese firms open more plants in the U.S.

As job content continues to change, it is widely expected that most jobs will be more interesting and challenging and will require more training and sophistication. At the same time, workers will have more responsibility and will experience more pressure on the job. In many cases, workers will not experience the responsibility as a positive addition to the workday; removed from the direct process of producing something, they may miss a sense of accomplishment. Increased pressure will result from the heightened responsibility for production as well as from escalating demands for speed, quality, and the computerized

monitoring of production. One executive told us that there was considerable featherbedding in the old job classifications. If this is true, a reduction in or loss of slack time could pose problems for the psychological well-being of workers in modern factories.

Although we did not study auto-parts suppliers, several sources indicated that they expect the job-and-skill trends outlined above to take similar shape in the smaller supply firms, with important differences (which we will mention later) in the character of workforce flexibility, employment security, managerial styles, and the role of unions.

Most of those we interviewed expect what we term the labor-integration model of work organization to dominate in the future; the job-and-skill trends described to us generally assumed this ongoing reorganization. In the hard-automation model, similar job-and-skill tendencies are observed (a shifting of required skills and overall upskilling as routine functions are automated), but with fewer workers and even more pressure for those remaining.

As we expected, increasing workforce flexibility is a concept management consistently emphasized. In auto plants, this flexibility shows in a reduced number of job classifications (for which dramatic predictions are made based on the NUMMI experience and others, e.g., from 100 or more to a handful); the development of multi-task jobs for production workers and workteams in the factory and office; and extensive training and retraining. On the hourly side, union opposition is expected to prevent the spread of part-time and temporary work. On the salaried side and for the increasingly non-union supplier firms, part-time and temporary work is expected to increase as companies apply flexibility and cost-cutting strategies.

If the trends pointed out to us are accurate, most workers in the auto industry will require some training; some will require extensive retraining; and ongoing training will become a way of life in an era of technological change and job-design innovation. We

consistently heard predictions for a better educated workforce, to be attained through internal firm training as well as future education-based recruitment and hiring practices.

Training

Historically, training of both skilled and unskilled factory workers has taken place principally on the job. Skilled workers gained training through apprenticeship programs, with perhaps some prior vocational training. Production workers were trained quickly, often informally, and under pressure from the moving line. For the large majority of blue-collar workers, educational background has been unimportant.

Educational levels have been higher and much more important for salaried workers. Firms look for articulate receptionists; clerks who can read; secretaries who can type and edit; and (in the past) draftsmen, accountants, engineers, and managers having appropriate training, skills, and education. Even given their higher education, salaried workers were also trained principally on the job.

With the introduction of advanced technology and the reorganization of work comes a dramatic increase in training and retraining throughout the auto industry, and a shift to more formal classroom and off-site training. On-the-job training remains essential and ongoing, but as the equipment becomes more complex, as the work demands new skills and greater responsibilities, more sophisticated training is necessary.

For the hourly workforce, this need meshes well with union demands for employment security and retraining rights in a period of displacement and rapid organizational change. GM, Ford, and Chrysler now have substantial union-negotiated job banks, in which the displaced are kept on the payroll and, when possible, given training for new slots. As collective bargaining contracts require, training and promotion in the factories are done almost exclusively from within; training and retraining within the auto industry are

perhaps more extensive now than they ever have been. Representatives of both industry and labor praise the job banks and other training programs.

Although no contractual training rights exist for the non-union majority of salaried employees, extensive training for new equipment takes place in a less structured way, with a shift toward classroom environments. For both salaried and hourly employees, the opportunities for new jobs and promotions afforded by the expansion of training programs are offset by the industry's declining total employment. Views are mixed on how these opposing tendencies balance one another. It may be that while training is now easier to come by, promotions will be more difficult to obtain.

Everyone we talked with agreed that training and retraining will increase and that future recruitment efforts will look more closely at basic educational background and preparation. Firms will look for employees who have adequate educational foundations on which lifelong training and retraining can build.

In the union view, job banks and other training programs protect displaced workers and contribute to the possibility of more interesting, enriched, multi-task jobs. At the same time, one union official strongly criticized "federal abdication at a time of unprecedented need." As he put it, collective bargaining is made to bear the burden that belongs to public policy. Firms, when pressed by competitive necessity and union demands, can provide significant training resources, but much less than if the federal government used labor market policy to assist in rebuilding the U.S. manufacturing base.

Industrial Relations

> *"When you see a militant workforce, usually it's because you've had knucklehead types on the management side."*
>
> — Another auto industry executive

Since the postwar settlement between GM and the UAW in the late 1940s (which set a pattern for much of American manufacturing), the relationship between union and

management in autos might best be described as antagonistic cooperation. Multi-year contracts gave labor steady pay raises in an expanding industry and assured firms of "managerial prerogative" for the organization of production. Most jobs were fragmented and Taylorist, and management-imposed classifications came to be regulated and defended by local unions, which used them as sources of security and equity (with seniority-based job assignment). Technological change on the assembly line was incremental and generally accepted by the union, with negotiated provisions for displacement protection (e.g., "bumping" rights) and new job classifications and pay levels. Supervisorial styles were authoritarian, while auto workers were often quick to resist abuse through union grievance handlers or other means.

Almost everyone we interviewed in the auto industry claimed that Taylorism is on the way out. Not only is the fragmented division of labor breaking down, in this view, but managerial styles are gradually undergoing a profound transformation. Apart from the "enlightened" personalities who are giving it shape, this change is driven by economic necessity. Competitive pressures call for cost reductions, high-quality products, and labor flexibility. And with the hard-automation model showing early signs of failure, managers are becoming more dependent on workers' attitudes and propensity to cooperate. For some managers in the large auto firms, this dependency translates into a new willingness to treat the union as a partner.

In moving away from Taylorism, auto industry executives claim that they are heading down the road of "human-resources management," a route based both on greater sensitivity to workers as people and on the flexible use of labor. Most of those we spoke with concluded that manufacturing success in all industries absolutely requires a less adversarial climate of industrial relations. One executive said that this change will take place for two reasons: one, because plants with historically militant workforces will tend to be those that are closed when major investment decisions are made; and two, where plants

remain open or new plants are built, the union will be a partner in discussing plans, providing input, and approving decisions.

But Taylorist attitudes are deeply embedded in the American managerial approach. One executive who favored the new trends (and the one whose quotation begins this section) said that so many of the old-school bosses are in place throughout U.S. auto plants, and their resistance to personal change is so high, that it may require a generation to complete the transformation. One union official described it as a struggle within management between the Taylorists and a newer human-resources school. Hinging on the outcome is the future organization of work, as well as the climate of industrial relations. As did most of our sources, this official predicted victory for the new school, based on efficiency and competitive success.

Human-resources management (to the extent that it represents a substantial change rather than Taylorism with a facelift) can of course take place with or without unions. Open-door policies, talk-softly approaches, and QWL programs often are used partly to help keep unions out or to bust an existing union. Where unions are strong, as at Ford, Chrysler, and GM, the new managerial currents can mean a more cooperative union-management relationship. Where unions are disappearing or vulnerable, as in the small and medium-sized parts suppliers, more open management styles can be and have been used as part of a strategy to roll back union presence.

Managers told us that where the union agrees to more flexible arrangements at the plant level (such as reducing the number of job classifications and developing multi-task production jobs), it is almost always under duress. The threat of plant closure or of reduced investment or production is seen as the driving force behind union acceptance of new forms of work organization at the local level (where such agreements must be reached). Within the UAW, however, many believe that current trends in job content are not only necessary but

desirable for individual workers, provided the union can negotiate adequate protection for displaced workers and institutional security for itself.

Auto industry executives told us that while pockets of resistance to technological change have developed at the local level, the UAW has presented no broad opposition, but has shown considerable flexibility and an understanding of the auto companies' needs for attaining competitiveness. High-level managers at least appear reasonably sanguine about the prospects for reaching agreement with the union on changes in work organization that will have to be made in the future.

Union officials stated adamantly that neither the international nor local unions resist technological and job-classification changes, provided that workers are protected. As outlined to us, the union strategy toward work reorganization consists of three key elements: (1) provisions for job security, such as the 1984 agreement with GM that no workers would be laid off as a result of new technology; (2) training and retraining rights, such as those provided by job-bank agreements; and (3) contractually established joint committees in which union representatives are given advance notice of technological change and have the opportunity to contribute to making decisions.

In fact, the union appears to have made historic strides in the first two prongs of the strategy, job security (which means assurance of some job although not necessarily the same or even a similar job, with built-in pay protections) and training rights. As for the third prong, the union receives advance notice of planned changes but as yet has no contractual assurance that its input will be considered. Although in some locations union input may have some effect on the decision-making process, managerial prerogative for the organization of work remains intact.

As long as workers are protected, then, management has a fairly free hand in technological change, just as it did in the 1950s and 60s. Given the magnitude of current and planned changes, the union clearly would like to have more input. New vehicles exist in

the joint technology committees, but a major problem for the union is that it lacks its own strategy for the reorganization of work. Union representatives have their hands full with grievance/arbitration, administration, firefighting, union politics, and so on; few have training in technology, job design, or production processes. In joint technology discussions, the union can listen, react, and suggest, but generally is ill-placed to press for constructive (worker-favoring as well as efficient) alternatives.

The politics of change are complex within both company and union. Just as the old "knucklehead" bosses and scientific managers are unwilling to give up shopfloor and organizational power, the union faces at least two significant sources of internal opposition to reorganization. The first comes from groups of workers who do not want to change jobs. Opposition among these groups usually softens when the alternative is no job (e.g., plant closure) and when job security is guaranteed (as through job banks). The second lies within the structure of industrial relations: the ceding of work rules (based, for example, on job classifications) in the interest of workforce flexibility, efficiency, and enriched jobs decreases the formal power of local and shopfloor union officials, whose authority lies in grievance handling. A union representative argued that the current reorganization, rather than enhancing union power on the shopfloor through joint committees, informal input, and quality of worklife (QWL) or employee involvement (EI) programs, instead contributes to centralizing power within the union (although workers may experience more power within workteams). Although power relations within the UAW appear surprisingly stable at present, the dynamics of internally shifting power may slow union acceptance of shopfloor change.

We found no union officials who spoke enthusiastically about QWL or EI; nor did anyone view these programs as a major threat to worker identification with the union. The general attitude seems to be that if it gives people something of a voice and makes them feel better, why not? The problem with these programs is that they are limited by definition:

most of them do not address the structure or organization of work. As one union officer said, "QWL is not the answer."

Union officials described generally cooperative, constructive relationships with the large auto firms and spoke optimistically of future prospects in spite of the rocky transition ahead (industry executives repeated this opinion). Unionists denounced, however, the antagonistic and often outright union-busting approaches of many small and medium-sized supplier firms that, taking advantage of high unemployment in the industry and the current political climate, attack union presence and power. Such an environment makes it difficult for firms that want cooperative labor-management relations, which the union says it seeks wherever it has representation. As for human-resources management, the dominant union view seems to consider it inevitable: the goal is to achieve as much as possible in the way of more decent bosses, teamwork, and input. The latter, however, requires as yet undeveloped union expertise. Better in this view to expend the resources to acquire the knowledge than to leave it centralized in Taylorism's musty managerial closets.

The industrial relations climate, then, seems to pose no insurmountable problems for the reorganization of work in the U.S. auto industry. Predominant voices on both sides expect the gradual demise of Taylorism, the development of a more constructive labor-management relationship, effective integration of workers and automation, and eventually (through experiments such as NUMMI) the proper combination of technology, training, and work reorganization to keep the U.S. auto industry competitive. We heard an unexpectedly (and perhaps overly) optimistic assessment from within this troubled industry.

Educational Reform

Everyone with whom we talked in the auto industry agreed that the U.S. educational system requires major reform. This industry's largest perceived need is for better educated high-school graduates. This need is based on three related developments: the introduction

of video display terminals (VDTs) and programmable automation in the factories, the trend toward multi-task production jobs and workteams, and the perceived institutionalization of lifelong training and retraining. Managers say that in the future they will look for well-educated high-school graduates who can quickly learn computer-related skills.

One manager described the results of installing VDTs on the assembly line at a GM plant. The terminals relayed instructions to workers, for example about which color of seat to put in which car. The system was simple and designed for communication with workers possessing down to a sixth-grade education. But the system failed at this inner-city plant, where it turned out many production workers had not attained that level.

One union official said that in his opinion the Japanese manufacturing advantage was based first and foremost on a superior educational system. Japanese auto firms recruit from among well-educated high-school graduates, who are trainable for many tasks and can be flexibly deployed, who can think conceptually and solve problems, and who can continue to learn throughout their careers.

As many production workers become monitors of systems, equipment, tubes and dials, as software becomes the integrating mechanism for the plant, the ability to diagnose problems and think conceptually becomes critical. As a trend toward workteams develops, the ability to think creatively and to communicate well with others becomes necessary. The importance of basic education to developing these abilities was emphasized by an executive who compared office and factory automation. At this large auto firm, automation has proceeded more smoothly with white-collar workers, whose educational levels are higher and who are more ready to learn, more easily trained, and less threatened by the job-displacing potential of new technology.

Finally, we asked people what specific educational reforms or improvements they would like to see. The answers emphasized basic education and ran something like this: three Rs for the inner city; computer skills for rural areas (the preferred new plant location);

and in general higher SAT scores and comparative economics, meaning the study of what global competition means to American industries, firms, and workers. In addition, a strong need was expressed for better technical training in math and engineering. The need of most concern was for people who have well-developed technical skills and are willing to work in a noisy factory in this modern era.

III. MACHINE TOOLS

"It's hard to experiment when there's a rope around your neck."

— General manager of a small machine-tool company

If the U.S. auto industry has been battered by foreign competition in the past decade, the machine-tool industry has been pounded into the pavement. From 1981 to 1986, the number of firms building machine tools in U.S. dropped from 700 to 400. Many firms disappeared; others pursued mergers or acquisitions in the hope of salvaging a market share. Most firms lost business and contracted in size. Some of the oldest core machine-tool builders (such as Acme Cleveland, Illinois Tool Works, and Brown and Sharpe) diversified to the point where machine tools have become a minority and shrinking part of the business. As yet, there is little sustained evidence that this industry's recession has bottomed out: from March 1985 to March 1986, for example, domestic machine-tool orders dropped 23%.

We heard many reasons for the decline. The most common story resembled a textbook rendition of the current plight of American manufacturing industries. Japanese and West German firms have captured the high end of the stand-alone machine-tool market. The Japanese rule the middle range, and the low end is split by Japan, Korea, and Singapore. Slow to meet the competitive challenge on its home turf, machine-tool firms have lobbied Congress for protection on national security grounds.

Given widespread retooling and the contemporary reorganization of production across a range of U.S. manufacturing industries, one might expect a growing domestic market for machine tools, one that could provide a market share for both domestic and

foreign firms. We heard a number of reasons why this is not a growth period for machine tools in the U.S. despite retooling and reorganization. Most fundamentally, as the manufacturing base contracts, so does the demand for machine tools. Closely related, widespread plant closures combined with retooling in surviving plants creates a brisk market in used machine tools, often of good quality and capable of technological upgrade by adding a CNC unit or by being integrated into a machining center or system. As auto engines and other machinery increasingly use non-metal components such as plastic, work is displaced from machine tools. And a four-cylinder engine, for example, simply takes less machining than does a V-8. Technological advances have given cutting tools a longer life, and the versatility of computer-controlled equipment means that one machine tool can now do the work that once required many.

For all these reasons, the machine-tool market is down. Yet the success of foreign competition remains the most often cited reason for the decline of the U.S. industry. At one job shop where machine tools are made for the domestic market, we found that the newer machine tools that build the machine tools are often foreign-made. The vice-president of this firm explained the success of his Japanese and Korean suppliers. Their advantage, he claimed, lies neither in cost, quality, nor engineering, but in marketing and service. Foreign firms researched the market carefully; found out what people wanted in the way of modifications, versatility, delivery time, and servicing; arranged to deliver the equipment with a shorter lead time; and provided better service from initial installation, training, and debugging to follow-up. By contrast, long-complacent U.S. firms offered only standard set-ups, lengthy lead time, a take-it-or-leave-it attitude, and inadequate servicing. Even machine-tool builders began to turn to foreign sources for their new machine tools, CNC units, and other equipment.

The response of the U.S. industry to the influx of foreign competition was, by the admission of most managers with whom we talked, slow and inadequate. Since the 1940s,

firms had tended to be profitable, family-run, and secure in the possession of market niche. As one executive told us, owners of American machine-tool companies were "dumb, fat, and happy while Japan got its act together." When these "safe" niches were attacked in the 1970s and 80s by aggressive and innovative foreign marketing, U.S. firms took a shellacking from which, overall, they have yet to recover.

Several interviews in this sector gave us the feeling of a dying industry. Some highly placed executives said they did not know how long their firms would last. Others, diversifying their product lines, said they were cutting back their machine-tool operations as much as possible. At the same time, however, there was a tone of excitement at the firms that were moving quickly into high value added custom equipment and flexible manufacturing systems (FMS). These will likely be prominent among the survivors. Everyone agreed that the competitive challenge requires extensive retraining, rapid introduction of advanced production technology, and shopfloor reorganization.

Our interviews in this sector indicated four challenges as most significant for competitive success in the future. First, new marketing approaches are required. Stiff competition is pushing U.S. firms into the same kind of innovative and aggressive marketing strategies that foreign firms use. And domestic firms have begun to export and acquire plants and/or marketing services overseas. This marks a big change: once secure in a large and lucrative home market, U.S. firms generally showed little interest in exporting or forming overseas link-ups. Today, about half the firms that belong to the National Machine Tool Builders' Association have some international connection (in some cases serving as the U.S. marketing agent for a foreign firm).

The second perceived challenge is to introduce new technology rapidly into the production process. This is occurring at all levels of operation, from adding a CNC unit to a stand-alone turret lathe or milling machine to systems integration at the larger firms. Until a year or two ago, FMS was viewed as problematical and perhaps unprofitable, but now we

hear that these systems may be taking off. The third challenge is thus perceived as developing a workforce having appropriate skills, as described further below. The fourth perceived challenge is for management at the larger firms to flatten out the hierarchy and put "hands on," with the aid of computerization, to the entire operation of the firm, from marketing through inventory and on-time delivery of parts, to production, innovation, and accounting.

Models of Work Organization

Unlike the auto industry, the machine-tool industry is composed of many firms of various sizes. Historically, firms have tended to be family-run and paternalistic and/or authoritarian in management. The majority of the industry is non-union. Average size is about 100 employees; small firms range from 10 to 50 employees, the larger up to several thousand (the largest, Cincinnati Milacron, has about 8000 employees). Showing a diversity of size, managerial style, and product specialization, firms have responded to current competitive challenges in various ways. In most cases, production reorganization appears to have proceeded haltingly, although most managers now stress the urgent need to keep up with new technology and to retrain and reorganize the workforce.

One significant characteristic of this industry has been the high ratio of skilled to unskilled workers. Everyone agrees that this ratio will remain high for the foreseeable future; the hard-automation model attempted in the auto industry appears foreclosed by the nature of machine-tool building. Instead, four models of work organization emerge from our interviews in this sector, two for the larger firms and two for the smaller.

For the larger firms, the models might be termed "integrated" and "bipolar." Given the diversity of firms, these names are ideal types only. The integrated model emphasizes reorienting and wherever possible upgrading the skills of workers as new technology is introduced. Extensive formal training within the firm (often using the services of equipment

suppliers) is part of a shift toward more complex, multi-task jobs even for the unskilled and semi-skilled. While there may be some deskilling for the traditional craftsman (skilled machinist), basic metalworking skills are still in demand, and machinists are encouraged to learn electronic skills. The workteam concept, having its own history in an industry where two to five skilled machinists collaborate to build a new machine tool, supports the development of teams for designing and building flexible equipment, centers, and systems such as FMS. With a shift to higher-knowledge, value-added production, participatory management is pushed down through the ranks to attract people who have skills and to take advantage of shopfloor ideas for innovation.

The bipolar model is similar to the integrated model at the high end: everyone agrees that the new technology requires the integration of automated equipment and people who have both mechanical and computer skills. But this model includes a "disappearing middle" in which, for example, new technology eliminates the work of a semi-skilled machine operator. At the low end, a core of unskilled jobs remains in assembly, shipping and receiving, the tool room, janitorial services, and the like. Although managerial style is less authoritarian at the upper end, it remains so at the low end, perhaps with the trappings of human-resources management--Taylorism in disguise.

In similar fashion, small firms exhibit one of two models, except that they are nothing new. On the one hand, some job shops have highly skilled, flexible workforces. Here almost everyone is a skilled machinist of one kind or another, except for a few younger workers receiving training. Profitability is based on custom market niches, with careful attention to what the customer wants and the ability to shift production quickly. Industrial relations tend to be casual in these highly skilled environments: keeping up with technology is simply a way of life.

The second type of smaller firm includes two types of workers: those with skills and those without. As competitive pressure intensifies and accuracies get tighter and tighter,

workers double up on jobs, one unskilled and one skilled who does the thinking for both. The quotation that begins this section came from the vice-president of one such firm. Industrial relations exhibit the traditional family-firm blend of paternalism and authoritarianism. Critics claim that although large firms may move toward enlightened management at the high end, the predominance of the authoritarian model has contributed greatly to recent competitive failings of the U.S. machine-tool industry.

Jobs and Skills

At the larger firms, about 60% of the workforce is hourly (blue collar) and 40% is salaried (white collar and supervisorial). In the smaller firms, the hourly percentage is generally higher, although we found one small firm that was top-heavy in pursuit of orders for business. Most firms (except the latter) expect these ratios to remain about the same. But for the industry as a whole, absolute numbers of both groups and most subgroups have declined as total employment has dropped by almost half in the past decade.

The majority of hourly workers are skilled. These include machinists, machine builders, electronics technicians, tool and die makers, jig-board operators, and punch-press operators. The rest are semi-skilled (such as maintenance workers, spray-painters, carpenters, and those having routine machine jobs such as injection molding machine operators) and unskilled (materials handling, assembly, storeroom, tool crib, shipping and receiving, janitorial). We heard varied opinions of the trends in skills and in the ratios of these groups relative to one another, most likely based on different models of work reorganization. Perhaps the most salient point of consensus was that a high ratio of skilled workers, with the skill base shifting to include computer as well as mechanical skills, is essential to the future of this industry.

Everyone agrees that design and software engineers will be in demand. Disagreement centers around the future of the skilled machinist. Clearly, much of the

specific knowledge and skill base of the journeyman is being loaded into CNC units and integrated computer systems. The job content of the skilled craftsman is thus changing, but changing in different ways at different firms (which accounts at least in part for the deskilling/upgrading debate we heard in our interviews). Everywhere, some skilled machinists are learning computer operation, programming, and other electronic skills. Such people are in demand; we often heard that it is easier to teach computer skills to those having well-developed mechanical skills than vice versa.

At smaller job shops, computer-related skills are simply de rigueur for journeymen machinists, for whom learning and experimentation are a way of life. The human-resources vice-president at one of the larger firms told a typical story. A new job category had been created entitled "manufacturing engineer." Many of the people who hold these jobs are skilled machinists whom company training programs have taught to operate and program computers. The new job consists of setting up one or several machines, getting them started and checking their operation, and then spending the next few hours in the office (working on programs, writing reports, sitting in front of a VDT, going to meetings) while the machines run. A lesser skilled (or unskilled) machine operator keeps an eye on the machines to make sure they continue to operate properly. At this firm, the newly trained manufacturing engineer becomes a salaried employee and is no longer in the bargaining unit (pursuant to the company's victory in a union-initiated arbitration hearing). The promoted employee makes less money due to loss of overtime and certain benefits, but the tradeoffs, according to the company, are (1) he is able to keep a job; and (2) he has more interesting, varied, and challenging work with the possibility of promotion.

For the skilled machinist who does not learn computer-related skills (either by choice or because the firm does not offer the opportunity), deskilling is the reality. In many cases, even where some computer training occurs, the skill content of the machinist's job is downgraded as programming and monitoring are removed from the shopfloor. Although the

machinist who knows basic feeds, speeds, and types of cut and who can tell when a tool gets dull is still in demand, hands-on involvement in production has dropped significantly. Several managers told us that the machinist's trade, including the ability to read a CNC program and communicate with a computer, can now be learned in 18 months to two years as opposed to four or five years for the traditional journeyman. These managers and others told us that the highly skilled will continue to be needed (partly because this is an aging group rapidly approaching retirement); but much of the traditional work will be done by lesser skilled machinists.

This brings us to the debate about the middle-level job. For those espousing some version of the integrated model of work organization, aggregate skill levels are on the rise (while shifting toward electronics). Although some older skilled machinists may experience short-term deskilling before retirement, most workers who remain after the current shake-down will have a wider variety of tasks, responsibilities, and learning opportunities. At the high end, skilled workers and professionals, especially those having electronics skills, will be increasingly in demand. In the middle, a range of intermediate tasks, requiring a two-year degree or equivalent experience, will include quality testing, debugging, machine and systems maintenance, and machine set-up and operation. Jobs composed of one or more of these tasks will require computer skills and will include much of the work formerly done by traditional craftsmen. At the low end, many jobs such as product and material handling will be automated out, and many unskilled jobs will be lost as a result of global out-sourcing (that is, unskilled work in parts, assembly, and semi-finished goods will be exported to low-wage countries). Other lesser-skilled functions will be combined into enriched jobs offering advancement to the middle levels.

For those espousing or predicting some variant of the bipolar model of production, the middle levels are disappearing. At the high end, the skilled machinist retires or becomes some kind of "manufacturing engineer" who sets up a machine that then runs itself, tended

only by an unskilled operator who watches for trouble on several machines (or a system of linked machines). Some unskilled jobs will be automated, but others will remain: the low-paid jobs of assemblers, stock clerks, and janitors, in the absence of a middle, will be even more dead-end than they are today.

Even most of those who see the machine-tool workforce splitting into two camps (those with and those without the skills appropriate to the new microelectronic technology) predict that the ratio of skilled to unskilled will increase. These days managers talk about a more flexibly useful workforce, which means breaking down job classifications and increasing short-term training opportunities. On the hourly side, flexibility does not generally mean an increase in part-time work (since expanding or decreasing overtime usually is more cost-effective), although in some firms it may mean more temporary work for the unskilled and for the "maverick" skilled machinists who prefer to work under contract.

Among salaried workers, increasing numbers are predicted for electronics engineers, technicians, and sales representatives, all of whom will require increasingly sophisticated skills. Most of those with whom we talked see the managerial ranks being pared down as a result of cost-cutting, the need for a flatter "hands-on" managerial structure, and the computerization of many managerial functions. Some predict stability for the clerical ranks. Others see the numbers declining as data goes electronic, word processing increases productivity, and technology eliminates tasks such as taking dictation. All agree that skill levels for the clerical workforce will rise with the spread of new responsibilities such as word processing and "public interface." Clerical work is the one area in which part-time work is predicted to increase--e.g., women who have families and who work from 10 to 2.

Most of those we interviewed agreed about two other things: skill characteristics of the labor force are critical in location and investment decisions; and there are and will continue to be shortages in the skilled trades, in particular for those having both practical knowledge of machinery and computer skills. In the Midwest, for example, new businesses

such as robotics and electronics applications have opened up in support of the auto and other manufacturing industries and to take advantage of the floating pool of skilled tradesmen cast off by plant closures and reorganizations. As a result, the skilled, especially the computer-literate and electronics technicians and engineers, are greatly in demand.

More than one executive told us that location decisions are based on both the skill base and available training resources (e.g., community colleges and universities), as company leaders anticipate a continuing need for a flexibly trained and retrainable workforce. One dissenting firm told us that finding both general and specific skills had not been a problem; this major employer in a small town had always found good personnel to train within the firm. But most managers appeared concerned about future skill shortages. "Young people don't want to go into manufacturing these days," one general manager told us; "they all want to go into services, to be doctors or lawyers or something." Several firm representatives said that a lack of manufacturing and technical expertise had prevented them from doing all that they wanted to do.

Training

Most firms indicated an increasing emphasis on internal training. Representatives told us that, given new technology and job content, training is more important now than in the past, and thus there is a shift toward more formal, structured programs. Often, these programs are provided by equipment suppliers: a builder of jig grinders who once included a day or two of training with the cost of the sale now offers a month, as the machine has become more sophisticated. In some cases, training programs are offered by community colleges or trade schools, but we heard a common complaint that these schools are not up to date on current technology.

Most firms use some combination of expanded internal training, especially at the middle to high end, and incentives and encouragement for externally acquired skills (e.g.,

night-school computer training). Many companies, for example, provide tuition refunds for courses taken or two-year certificates earned in electronics. One firm, whose vice-president we interviewed, provides employees with full tuition refunds for all tertiary education, including liberal arts. This executive told us that the firm had provided tuition refunds for an employee attending law school, even though they knew he would leave the company upon graduation. The logic was that while he remained at the firm, he was a better, more creative worker because of this opportunity. We constantly heard that the new technology requires new training, and that competitive pressures require a more flexibly skilled, better educated workforce. We also heard a strong majority position that for most new skills internal training and promotion take precedence over hiring from the outside.

More internal and external training mean at least the possibility of expanded internal mobility. At present, such mobility is severely limited by the contracted state of the industry. But even under present circumstances, the following story is not uncommon: an un- or semi-skilled assembler is exposed to some electronics education, which leads him to train for a job in machine service and installation, which then leads him into a career in sales. Such mobility may be partly the product of the general shortage of computer skills in the workforce. If this is true, such mobility will diminish as computer skills become more prevalent (as the Atari generation comes of age).

Almost everyone speaks regretfully of the dying out of apprenticeship programs, but no one seems to know what to do about the loss (this aspect of the skills shortage in the trades is commonly bemoaned). Both large and small firms claim to have cut back on apprenticeships in response to the "entrepreneur" problem: companies often made a multi-year investment in training a young worker, who then jumped ship to open his own shop. Firms claim they can no longer afford such expenses that fail to pay off. As a result, the skills shortage in this industry persists, the average age of a skilled machinist is 50, companies raid one another for the best people, and machinists continue their tradition of

"voting with their feet" (as opposed to accepting disagreeable circumstances or forming a union).

Industrial Relations

Management styles vary widely in this diverse, multi-firm industry, with paternalism predominating among the many small- to medium-sized, family-run firms. Some of the smaller firms are run in a sort of craft community spirit; others (of the bipolar variety) involve considerable sweating of labor at the low end. In general, management styles vary considerably even within the same firm, large or small, with more open, collegial relations for the skilled and a more Taylorist and authoritarian approach to the middle and lower levels.

The majority of the machine-tool industry is non-union. Several of the firms we studied have no unions; most of the rest have union representation at only one or two plants. In an industry comprised of a high percentage of skilled tradesmen, this low level of unionization at first appears paradoxical. The explanation seems to lie in (1) the paternalistic tradition; (2) the large number of small- to medium-sized firms; and (3) the tradition of mobility mentioned above, whereby machinists whose skills are in demand simply move down the road in search of better conditions. Where unionization drives have succeeded, they often have been initiated by assemblers, operators, and others in the middle to lower skill ranks.

The union having the strongest presence in this industry, the International Association of Machinists (IAM), has its primary bases elsewhere, for example in aerospace, electronics, and auto repair. In aerospace and electronics, at least, the IAM is on the cutting edge of technology and professes non-opposition to change, provided appropriate adjustments and protections are provided for the workforce. According to one union official, the IAM has generally cooperative relations with some of its larger firms, especially in the

defense industry, and would like to see such non-adversarial relationships develop throughout American industry, including with machine-tool companies. The biggest obstacle, in the union view, lies with management: a common company strategy is to take advantage of the current political climate and relatively weak labor movement to eliminate unions. Some of the larger firms that profess (and at established plants participate in) a cooperative labor-management climate fight tooth and nail to keep the union out when they open new plants. Union representatives say that the IAM would like to develop partnership-style relationships in the machine-tool industry as elsewhere, but managers are not interested.

Executives in the machine-tool industry generally say two things about unions. First, it is much better to be non-union because unions cause all kinds of problems, resisting technological change and interfering with managerial decision-making ability and thus the capacity to adapt to a rapidly changing environment. But secondly, most managers at firms that have unions say that the union presence is weak. Some claim to have decertified unions in recent years. Others say that the union has agreed to reorganization plans and in that sense has become a cooperative partner, largely because the union had little choice--it was either cooperate or close the plant.

High-level managers identify three sources of resistance to technological change and the reorganization of work: skilled workers, who may see their skill base threatened; unions, which force negotiations about job classifications and pay levels and thereby slow down the process; and middle management, especially those who see change as a potential threat to their established power. Most commonly, however, we heard that resistance is located not in any one group per se, but in the individual afraid of an uncertain future. Such individuals are found in every group. In direct opposition to the first point made in this paragraph, the majority view was that the skilled are least resistant to new technology and

in fact most likely to be interested in learning and new challenges. By the same token, those having the fewest skills are least likely to be interested in acquiring new ones.

As in autos, almost everyone spoke of new managerial styles. Many managers described a major shift in the past decade from the authoritarian approach to a more open worker-management relationship. Many executives said they were establishing problem-solving groups, pushing down decision making, and trying to encourage innovation and identification with the firm at all levels. We do not know how substantive this change is--one union representative said that much of it is window-dressing and the rest manipulation. One company vice-president agreed, saying that at his firm the transformation in corporate culture was real, while most of his competitors maintained the old authoritarianism in the guise of the new human-resources fad. But almost everyone claims to be making fundamental changes in managerial style.

Again, we heard that change is taking time, that many of the old-school bosses are still in place, and that these are the people who have the most problems with industrial relations. But those at or near the top say that they are tearing down the walls, insisting on more open and responsive communication from top to bottom, and instituting open-door policies, whereby top managers have weekly "office hours" open to all employees. In this view, the way to obtain productivity, flexibility, and innovation is to treat people with respect, seeking (rather than demanding) cooperation, asking people's opinions about whether a proposal will work (which one executive told us has a simply euphoric effect on employees). Several people told us that programs such as quality of work life (QWL) burn out; the work environment is determined not by a specific program or gimmick but by the overall climate of the organization, the values driving managerial behavior and personnel policy, and the culture of the corporation.

Opinions differed about why these changes are occurring, but the most common explanation was simply that a more open approach works better in the new competitive

climate. Clearly, however, old attitudes are deeply entrenched. The manager who gave us the "rope around your neck" quotation expressed the machine-tool industry's general reticence regarding these human-resources changes. The most widely expressed attitude could be summarized as, "We are doing some of these things; we would like to be doing more, but there is a limit to how much energy we can put into change when our backs are against the wall."

One human-resources vice-president gave us an intriguing analysis of why and how corporate culture is changing. He said that his past efforts had been thwarted by deeply entrenched authoritarianism. Now, however, change is resulting from the following dynamic: design and software engineers are in demand, and firms will go to great lengths to keep them happy. These tend to be "Ph.D. types with long hair and so forth from places like MIT"; if they want to be casual in dress and relationships with management, they can get away with it. In his view, management's acceptance of these new styles spreads down through the ranks. In time, because the new values work better to stimulate employee morale and thus work performance, the culture is transformed.

Most managers in the machine-tool industry told us that today's workers have different attitudes and expectations from workers of a decade or two ago. Younger workers lack idealism [they don't want to change the world], but they want more from work than a paycheck. Several managers told us that workers today want more interesting work, varied job assignments, the opportunity to learn new skills, and input into decision making. They do not like taking orders, and they want to understand the reasons behind directions. If they believe they have thought of a better way to do something, they want that idea tried. They are ill-suited to the old military approach, which is another reason managerial styles must change [and are changing, in this view]. We heard that while these attitude changes may have begun as a generational phenomenon, they have spread to young and old alike.

We heard, however, the common dissenting view, especially at smaller firms, that young people today simply do not want to work. The biggest recruitment problem for these managers (aside from the scarcity of appropriate skills) is finding young workers who will make the commitment to learning machine-shop skills, who will stick to it, who have any decent work habits. From this perspective the problem lies in the broader environment, the general culture: the welfare state saps ambition, and who wants a factory job anyway?

Yet everyone agreed that worker attitudes are crucial to the success or failure of the industry. New human-resources techniques are aimed at reshaping these attitudes; advocates claim to represent an historic break with traditional authoritarianism in the workplace. Workteams (especially at higher levels) and participatory management are necessary to retain the best people and to compete in a rapidly changing environment. This dominant view, be it lip service or sincere belief, has a simple logic: people perform better if treated well.

Educational Reform

Two of the executives we interviewed said they saw no problem with the caliber of today's entering workers. Both managers represented firms that were a (or the) major employer in a small town. One said the company policy was to locate away from large cities because in smaller towns young workers want to work and learn. They also have a better attitude toward business than did workers of a decade ago. The other said that, as the major employer, they could attract a line around the block any time and could always find applicants having the required educational foundation.

Everyone else we interviewed spoke at length about the shortcomings of the educational system as regards meeting company recruitment needs. The criticisms addressed two issues: work habits and basic skills. In a typical commentary, one person told us that primary and secondary education simply represent a conveyor belt from grades

one to 12, and that a youth who hops off even at the end lacks both habits and elementary skills. For unskilled, semi-skilled, and machinists-in-training, firms look for a decent high-school foundation, which includes reading, writing, some algebra and geometry, some science, the ability to use a calculator, and the ability to communicate clearly. One personnel manager told us that about 50% of the young applicants he interviews lack these basic skills. The most common response to our open-ended query regarding educational reform was a plea for stricter high-school requirements.

In addition to the secondary and primary school problem, we also heard complaints about the demise of apprenticeships; the inadequacy of trade school programs (for assemblers and operators at the middle levels and for the basics of machining--metal removal, shaping, and forming); and the deficiencies of higher education (we heard, for example, that many engineering graduates are inadequately prepared).

We were also told that if young entrants to the labor force lack basic skills, not only will it hurt industry competitiveness (the ability to perform as well as to innovate), it will also seriously limit career prospects for the individuals concerned. Gone are the well-paying union jobs for the unskilled and uneducated in autos, rubber, and other basic industries. In an era of computerization and ongoing technological change, only people having a solid foundation for training and retraining will have the ability to change and to achieve at least some employment security. In the machine-tool industry, where skill levels have always been crucial for the majority of workers, employment prospects will be directly related to an ability to learn.

Consistently, we heard of the importance of education at almost any level: the more education a person has, the more open he or she is to training, to learning, to contributing ideas, to participating in a problem-solving group or workteam. In an industry famous for its recent inability to compete in world or domestic markets, these voices described perhaps the only prospects for salvation.

V. APPAREL

"We can't all live in Santa Clara."

— Chairman of the board of an apparel firm on the importance of maintaining domestic apparel manufacture

Competition in the apparel industry is nothing new: there are some 15,000 domestic firms, more than 70% of which employ fewer than 50 workers. What is new is the surge of imports that between 1973 and 83 cut domestic manufacturers' share of the domestic apparel market by 15% while imports grew at 12% annually. In the same period, the domestic industry lost more than 200,000 jobs.

Although rising imports have pushed many U.S. industries into various competitive strategies, apparel firms face significant barriers to modernization. The first is the atomized structure of the industry: most firms simply cannot afford the kind of investment that would make the workforce more productive. Moreover, technological difficulties seem to be involved in automating the task that accounts for 80% of production time: moving different types of material through a sewing head. As long as clothing manufacture remains labor-intensive (with production workers accounting for 85% of all employees), the apparel industry will be hard-pressed by foreign competitors whose labor costs are a fraction of the minimum U.S. wage. As a result, some company representatives, and all the union officials we spoke with, believe that some form of protection is the only hope for saving an industry that traditionally has been the country's largest employer of people who have less than a ninth-grade education.

Because of its extreme labor-intensity, low start-up costs, and relatively easily learned skills, the apparel industry is often seen as the obvious first step on the ladder of

industrialization. Similarly, its competitive difficulties conform nicely to the view that the U.S. will abandon older manufacturing industries to low-wage, newly industrializing countries. Following this scenario to its logical conclusion, we might expect manufacturing employment in the domestic apparel industry to decline dramatically as American clothing needs are supplied increasingly by merchandising firms such as Esprit and Liz Claiborne (which design full lines and source their manufacturing all over the world), by retailers (who are now heavily involved in direct importing), and by foreign competitors. This type of global restructuring clearly implies massive change for the domestic labor force involved in clothing manufacture.

We present these facts--salient to the view of the union organizers we spoke with--at the outset because the large firms we interviewed are atypical of the industry as a whole. In the first place, small firms make up most of the industry. More importantly, almost all our sources were pursuing manufacturing strategies domestically, and two were even moving production back to the U.S. at the expense of offshore operations.

In other words, neither protection nor imports is the whole story. The ability of firms to pursue innovative competitive strategies is affected by factors such as size, profitability, and the character of the product and its markets: not all product sectors are equally susceptible to imports. Blue jeans, for example, because of a relatively low ratio of labor content to fabric weight, are less economical to import than are lighter-weight products. Men's suits, as another example, involve higher start-up costs than do other types of garments, in part because such highly tailored clothing requires more skilled labor than do less complicated, flat-seamed garments. At the same time, because men's suit fashions change gradually and relatively minimally, these firms have had more of an opportunity to standardize and automate parts of the production process. Women's apparel, by contrast, tends to be the most affected by imports: construction is simpler (especially since fashion dictated the disappearance of the fitted waist) and fashions change frequently.

The managers we interviewed described innovations that may provide an alternative to protection or decline. Based on these stories, we have identified four trends that are changing the nature of domestic production in the segment of the industry that is able and willing to innovate. These four trends can be described as four competitive strategies, although none of them are mutually exclusive, and most are mutually reinforcing.

The first strategy is for a firm to mix importing and manufacturing, in many cases supplementing domestically produced lines with articles that are subcontracted abroad. One firm, for example, produces its standard line overseas and more high-fashion articles domestically. It should be noted that subcontracting is not a new activity for large and medium-sized firms. Small firms typically have provided production flexibility--the ability to "turn on a dime" as one union official put it--for larger firms and retailers. A number of the executives we interviewed expressed concern about the quality of foreign-produced goods, due to the difficulty of maintaining close supervision. In one of the most interesting cases we encountered, problems of reliability and inventory control pushed a men's shirt company into automating domestic plants. A few years ago the company imported 75 to 80% of shirts sold under its label; today it has only one overseas plant.

A second strategy is for firms to find a market niche above or below the politically negotiated trade barriers. A manufacturer of children's clothing sold to chains and mass merchants until 1980, when the decision was made to cater to specialty shops and high-end department stores. Volume was cut dramatically, and product diversity was increased. In fact, the changeover from mass to batch production took the company through bankruptcy and cut the workforce to one-third (it has since increased back to two-thirds) of its 1980 level. Nevertheless, an executive from the firm believes that the company is now effectively insulated from import competition in the high-fashion segment of children's clothing (although the firm has major domestic competitors). At the other end of the spectrum, but apparently no less successful, is a T-shirt manufacturer that sells high-volume, low-cost

products in a protected segment of the market. As this company's chairman of the board explained, import quotas push foreign producers into higher value added garments. High-volume, low-price goods such as T-shirts are now almost all domestically produced.

The third trend is automation or, more precisely, technological and organizational labor-saving innovations. Technological advances in automation per se have been significant, but not dramatic, although improving productivity is a major goal of the domestic strategy. Computer-aided design (CAD) systems have been prevalent in the industry for some time and greatly improve firms' ability to change designs swiftly in response to the market. On the shopfloor, these systems can convert designs into pattern markers (and different size markers) using only a computer terminal, and can relay cutting instructions to a computerized fabric cutter. Perhaps even more importantly, according to some accounts, CAD systems have changed the nature of garment design, significantly increasing productivity as the garment is re-engineered to reduce work content. In fact, most of the labor time spent on a garment goes into material handling and sewing. Automating these functions has proven difficult for a number of reasons, including the variability and limited volumes of material types. As one executive put it, "The human hand turns out to be a very good tool for moving pieces of cloth through a sewing head." Nevertheless, some routine sewing functions have been automated by firms working with high volumes--automatic pocket setters, hemming machines, and bagging machines, for example. Finally, shopfloor reorganization seems to be taking hold: in the past, garments were moved through the factory by bundles; now most firms seem to be going to a unit production system.

It is important to note that firms' commitments to technological change--as well as their abilities to invest in new equipment--vary tremendously. CAD systems and cutting machines seem to be fairly common among the large firms we spoke with, but union representatives reminded us that such equipment is beyond the means of smaller shops.

Moreover, the transfer of technology overseas is not only possible, it is routine, meaning that any domestic advantage gained by automation will be lost quickly. While some firms we spoke with are investing incrementally, a few are attempting to transform production from top to bottom. Most noteworthy was a shirtmaker attempting to revamp production comprehensively: from pre-production planning through various automated sewing functions to computer-controlled material handling.

Technological and organizational change is, perhaps most importantly, central to the fourth strategy the American apparel industry is pursuing, a strategy that has come to be known as Quick Response (QR). Quick Response involves, first, enhancing communications links with customers (that is, retailers); second, reducing the time from design to delivery by up to one-half. Every manufacturing firm we spoke with, regardless of its involvement with importing, market niching, or automation, regarded shortened manufacturing cycles, increased flexibility, and greater responsiveness to customer demand as the (at least potential) source of competitive advantage for the American apparel industry. Labor officials acknowledged that, within the past year and a half, QR has been a popular buzzword. They were not ready to assess its potential.

The logic behind QR bears explanation. The apparel industry has always responded to customer demand, has had to be extremely flexible in response to fashion, and has had to meet the rigorous deadlines of the fashion seasons. On the other hand, clothing, more than many commodities, sells not based on price but on intangibles such as fashion, label loyalty, and status. A shirt sold at K-mart may be identical to one sold at Saks under a Saks label; the shirt will still sell for less at K-mart. On the other hand, consumers are not the customers of large apparel firms, retailers are, and retailers are very price-sensitive. The lower cost of imported garments has not driven down consumer costs, but instead has increased retail profits. Retailers have led the drive for imports because imports allow for a higher mark-up. The other side of this consumer/retailer/manufacturer relationship is,

however, that buyers and designers often err in their pre-season guesses of what will sell. This means lost retail revenues due to forced markdowns of unpopular items, and lost potential sales of items that turn out to be popular. It is estimated that mismatches between supply and demand cost $25 billion each year in the $100 billion apparel industry. QR is meant to solve this problem: batch production and quick turnaround are meant to reduce inventories that don't sell and facilitate speedy transitions to what does sell. It could enable domestic firms to compete by making them attractive to retailers on a basis other than price. As one executive told us: "We feel that the tremendous opportunity for the future in our business lies in our ability to respond quickly to the market. The fashion aspect of this business makes our location in the middle of the market a competitive advantage versus Hong Kong or China."

According to most of the executives we spoke with, refining the Quick Response strategy--by improving links with retailers and suppliers, by introducing technological improvements, and most importantly by reorganizing production on the shopfloor--is the major challenge facing the apparel industry. As one executive summarized:

> I'm certainly not going to be guilty of saying that technology isn't important.... But I really think that where we're going to be successful is through the development of an organization that is talented, that is flexible, that has the necessary systems support to help them to function, so that we can improve our response time. Our product, even ten years from now, will still be produced on conventional sewing equipment.

The ability of the industry to meet these challenges will depend in part on the ability of its workers to provide an organization that is "talented" and "flexible." Moreover, all four strategies noted above have potentially major implications for the types of jobs the U.S. apparel industry will offer, and in fact whether there are likely to be U.S. apparel jobs at all. The next section presents the perception of industry executives and labor representatives concerning the effects that these trends will likely have on jobs and future skill needs.

Jobs and Skills

The apparel industry is highly labor-intensive. Among the firms we interviewed, production workers ranged from 37 to 93% of the workforce (national statistics place the average for apparel firms at 85%), with the largest firms carrying the greatest proportion of white-collar workers. The vast majority of production jobs are for sewing-machine operators, although others include sewing-machine mechanics, pattern markers, spreaders and cutters, finishers, pressers, material handlers, and a small number of hand sewers and finishers. Three of the firms interviewed were vertically integrated into textile production and included knitting machine operators and dye technicians. Non-production employment in the industry includes management, administration, and production planning; clerical jobs, from secretarial to data processing; and design and marketing. Two firms had their own retail outlets and included retail employees and managers in their workforce.

The managers we interviewed expect the proportion of white-collar jobs to increase slightly as production becomes more efficient. For firms that are moving toward merchandising (i.e., design and import) and for those pursuing comprehensive automation strategies, this could be a major workforce shift. On the other hand, at least one firm had recently "trimmed the fat" from managerial ranks and expected to remain "mean and lean" at the top. The executive we interviewed from this firm said that the firm's previous competitive difficulties had stemmed from being a family-run, poorly managed outfit. Another executive noted that his firm had been pursuing production innovations for some time, and that the next significant productivity increases are likely to occur within the white-collar ranks, due to increasing computerization and office automation. Overall, and despite these individual stories, our impression is that shifts in the balance between production and non-production jobs are likely to be incremental, but that production employment will almost certainly decrease more rapidly.

The majority of production jobs are for sewing operators, a job that seems to embody the current debate over what constitutes a skilled worker. According to a representative of the International Ladies Garment Workers' Union (ILGWU), anyone who is a garment worker has a craft: it is difficult to sew well and make money at piece rates. An employer who concurred that sewing requires a high degree of manual dexterity nevertheless echoed the union official by adding that sewers are highly skilled, not highly paid. Skill is also measured by the training requirements for a job: the estimates of training time required for a sewing-machine operator ranged from one month to 16 weeks. Many we interviewed agreed with the vice-president of manufacturing who said, "We can take any average individual who's willing to learn and teach her how to sew to where she's able to earn a nice hourly rate." Or, as another executive put it, sewing jobs are "good work for people of average ability," especially because piece rates enable a good sewer to earn twice what a secretary makes.

In cases where automation has affected sewing jobs, the effect on skills was something of an open question. Many managers pointed out that the least skilled jobs are the easiest to automate; thus automation raises skill levels in the aggregate. Others assessed skill requirements based on the value of the machinery used. By this measure, automation raises skill levels because operators work with--and are presumably responsible for--more expensive equipment. By the same token, one employer expected pay levels to increase slightly as capital-to-labor ratios increase. Finally, several employers pointed out that operators working with semi-automated equipment require just as much, if not more, training as those sewing on conventional equipment, especially because operators of semi-automated equipment must do minor mechanics and diagnostics. Several union representatives questioned this assessment, pointing out that operators of automated equipment usually resemble machine feeders more than computer technicians.

One determinant of skill requirements for sewing-machine operators is the type of work performed (sewing fitted garments as opposed to sewing hems, for example). Perhaps as importantly, the skill requirements for sewing operators depend on the organization of work. To take two extreme examples, it takes more skill to complete a garment--from first seam to final hem--than to repeatedly sew the correct cuff onto the correct sleeve in Taylorized fashion. One significant indicator for the future of sewing skills, therefore, is the number of firms that claim to be turning away from Taylorism to more cross-training (preparing workers for different sewing tasks), multi-task jobs, and skills centers (grouping operators according to somewhat more flexible tasks than assigned on the assembly line). As one union researcher reminded us, our looking at large firms makes a difference. Small firms have always had to cross-train workers, simply because their workforces have been so small.

No one was experimenting with workteams; it was generally agreed that piece rates precluded such a move. The tendency to do more cross-training is linked directly to the search for greater flexibility, diversity, and customer responsiveness--that is, to QR. As one executive pointed out, if the product changes all the time, the use of workers must be flexible, too. It seems likely that the trend toward QR will mean less monotonous and somewhat more skilled work for sewing-machine operators.

Sewing-machine operators make up the bulk of shopfloor employment, but the shopfloor jobs most affected by technological change are those in pre-sewing procedures, most notably marking and cutting. These jobs traditionally have been considered the most highly skilled. The consensus is that CAD markers and programmable cutting machines deskill this segment of the workforce. A dissenting opinion, however, came from one executive vice-president who maintained that programmable equipment is "taking away skills of manual manipulation but adding sophisticated equipment that requires just as

much training." In his view, running programmable equipment requires computer skills, which are not comparable to the skills being replaced.

Technological innovation may most strongly affect the non-production side of the business, where the increasing importance of computerized systems implies a new set of tasks for white-collar workers and a new set of skill requirements (usually lumped under the heading of "computer skills"). Of course, QR, the product-flexibility strategy, has been made possible by the increasing sophistication of available information and telecommunications technologies applied to uses ranging from production planning to sales. Firms described the particular system they were implementing, or had implemented, and the effects of new methods and styles on individual executives and clerical workers. The character of systems being implemented varied greatly, in some cases decentralized, with PCs on every desk, in others highly integrated, with a centralized Management and Information Systems department.

CAD systems have dramatically changed fashion designers' jobs: rather than working with cloth and scissors, designers work increasingly with video display terminals (VDTs). These systems contain an internal library of patterns so that designing a raglan sleeve, for example, means simply typing in a command. Marketing new designs is vastly more productive because showing a client a variety of models no longer requires constructing sample garments. From one executive's point of view, the primary issue is not whether designer jobs are becoming re- or de-skilled, but that the productivity gains in design make it possible for a company to grow without adding to the most costly part of the workforce.

Finally, the jobs that are changing the most, especially due to the requirements of Quick Response, are production planning and front-line supervision. According to one executive, computerization means that the production planner's tedious information-gathering has been eliminated. However, with a more flexible or diverse product mix, the

job carries more responsibility. Front-line supervisors may also receive increased responsibility as firms re-distribute shopfloor work in a way that makes supervisors more responsible for continuous workflow. Greater product diversity and more rapid style changes complicate the production process and require, according to one manager, more supervision to "take care of problems." According to the same executive, production managers now must be less dictatorial and more team-oriented.

Although the apparel industry traditionally has been very labor-intensive, most executives told us that the availability of a white-collar labor pool is an important consideration in their location decisions. Moreover, because sewing is considered an easy skill to learn, blue-collar skills are not nearly as important as are labor costs. One executive explained that their firm seeks locations that have an abundance of secondary wage earners--usually rural areas. Even more important is staying away from areas such as Boston, where the high-paying electronics industry has pushed up prevailing wage rates among the female labor force, and the cost of living is high.

Skills shortages were not a big concern for the firms we interviewed, although almost everyone agreed that the one group becoming more skilled and more scarce was sewing-machine mechanics, especially those capable of working on newer pneumatic and electronic equipment, not to mention CAD systems.. Admittedly, this scarcity exists largely because of pay differentials between this industry and others that need mechanics who have electronics expertise.

The other story we heard about skills shortages was more localized. A firm in Pennsylvania, a part of the country where apparel employment has been declining for many years, has experienced great difficulty finding cutters, markers, and dye chemists (this firm is integrated into textiles), leading the company to invest hundreds of thousands of dollars in sophisticated equipment that otherwise would be unnecessary. As this firm's chairman

of the board explained, "We've exported these jobs, and over the past 10 years the skills have disappeared from the labor pool."

Training and Retraining

Most training for sewing operators is done on the job, often from scratch. As one executive put it: "We take people off the street and teach them to sew. They're not knocking on the door with these skills." Nevertheless, a few of the firms have highly formalized programs. The firm that has made the most sweeping innovations also has a fairly complex, standardized training program. The vice-president of the firm said that they train on a "scientific basis," using video tapes and classroom work to supplement on-the-job training. Finally, a firm that currently does all training on the job is bringing in a training director to establish a more sophisticated program, primarily because their QR strategy requires more flexible sewing skills.

All the firms preferred to retrain workers when job requirements change due to technological or organizational innovation, or when new jobs open. Many executives cited the same reason: employees know the product and the company; new hires do not. Employment security is also a facet of many firms' employee-relations policies. Retraining seems to prevail for all occupations: cutters, sewing-machine operators, and mechanics, as well as white-collar workers. Nevertheless, there was no mention of retraining that involved internal career mobility from production to white-collar jobs (although sewers may become supervisors or trainers), and only one story that involved promotion of clerical workers to computer service jobs.

Moreover, some executives questioned whether employees are interested in being retrained. According to one manufacturing vice-president, "Most employees don't want to be bothered; they just want to get in and out." This executive's firm has, nevertheless, a policy

to identify, train, and promote individuals who want to get ahead. All of the firm's supervisors and plant managers had been trained from within.

The real question may be the one asked by an ILGWU official: "Retraining for what?" Insofar as production employment in apparel is declining or stable overall, it seems unlikely that vast numbers of jobs will be available for retrained workers. An executive with a company that is pursuing automation admitted that despite his firm's efforts to guarantee employment, displaced workers are often laid off for up to a year. To put it another way, if a programmable cutting machine enables one cutter to do the work of 20, retraining the one cutter is only part of the story. Moreover, garment workers statistically are less socially mobile than are other workers. According to the ILGWU organizer, the problems facing the union's members, many of whom are new immigrants with limited English skills and limited schooling, are beyond the capacity of firm-level retraining. He asked, "How many people now in the industry could make a transition to a high-techie, automated job?"

Industrial Relations

In an industry that has a long-standing reputation for sweatshops and paternalistic management, it was surprizing and significant that almost every apparel firm we spoke with emphasized a changed climate of employee relations as a key to success. We heard repeatedly that employee attitudes are critical to increasing productivity, and that better communication between management and workers is essential to employee morale.

In many cases, this commitment to fostering a more open environment has been formalized. Although everyone called their program by a different name, organizational formats and functions appear similar to what has come to be known as quality-of-worklife (QWL) management: some kind of forum has been established to bring workers into contact with top management to discuss problems related to the organization of work. Many executives stressed that the forum gives management a chance to explain their problems to

workers: for example, to describe import pressures, reasons for automating, and how automation will affect jobs. Yet there also seem to be opportunities for employee input. One executive we spoke with claimed that employees contribute to decisions about what type of automation equipment to buy.

In fact, facilitating technological and organizational change was the major perceived benefit of greater employee involvement. The view was that employees cooperate more if they understand why changes are taking place. Moreover, employees cooperate with changes if they believe that their employment is secure. Employment security is a part of many firms' climate of more open management, but it is important to note that none of the firms has a formal "lifetime employment" policy. Rather, the emphasis is on making employees feel like part of the company; informal employment security is an adjunct to that goal. Nevertheless, most of the managers we interviewed admitted that many people resist technological change, that many managers as well as workers feel that "if it works, don't fix it." (For sewing-machine operators working for piece rates, this is a rational attitude: changes in the production process are likely to affect piece rates and, in the short term, operator speed.) One executive told us that there is an art to introducing new technology: to combine the benefits of change with sensitivity to people.

Some executives explained their firm's shift in management style as part of a drive to become more competitive, especially insofar as "making workers feel like part of the company" makes them more flexible (willing to do a variety of jobs, for example) as well as more productive. Others attributed the change to management's gradual enlightenment. Finally, many said that workers' new attitudes and expectations are driving these changes. As one executive put it, "The day has long since past when you can expect people to just clock in and clock out." In fact, many employers said (although this went against the common wisdom) that education and ability levels had risen among their workforce, and that younger employees are "more aware" of the world at large.

About half of the firms interviewed were unionized, which corresponds to the proportion of the industry organized by the two largest unions, the Amalgamated Textile and Clothing Workers Union (ACTWU) and the International Ladies Garment Workers Union (ILGWU). Everyone we spoke with, employers and union representatives alike, agreed that the era of serious disputes has passed in firms where a union has been established for some time. As one union organizer put it, "We have to make employers see that we have a common interest in keeping the workers happy and the business solvent." On the other hand, union membership has been declining along with employment in this industry, and organizing new and previously unorganized workplaces remains a difficult and confrontational battle. Where cooperation exists, it is often attributed to the atmosphere created by international competition, because job losses make workers less militant and because the fight against imports pulls management and unions together. In fact, at a national level, the unions and manufacturing companies worked together as a political coalition to pass the Textile and Apparels Trade Enforcement Act (and to override its veto).

Neither union takes an oppositional stance toward technological change. In fact, the ACTWU is on the board of the Textile and Clothing Technology Company (TC2), which sponsors a project at Draper Laboratories to develop a prototype of a fully automated sewing machine. Nevertheless, many labor organizers stressed that technological change has destroyed many fewer jobs than have imports. As for changes in work organization and employee relations, many union leaders are skeptical, one calling them "just frills." In one case, however, an ACTWU local is working with a company (and an outside consultant from Cornell University) to develop a QWL program within a plant. An executive of the firm where this is taking place saw the union's proactive stance as a positive step in labor-management relations.

Educational Reform

As noted above, the firms we interviewed were almost all at a certain "cutting edge" of the industry. Yet the executives of most of them did not expect labor or skills shortages to threaten their future competitive abilities. In most cases, the managers of these firms had little to say about how educational reform might help their firm, or even their industry. According to one, his company can find qualified people anywhere: "The U.S. workforce is still the best in the world."

From the union perspective, however, the important question is much broader: how can educational policy address the problem of a class of workers (rural, new immigrants, women) who are being displaced by import penetration, technological change, or upskilling? Some of the labor leaders we spoke with focused on remedial education: reading, mathematics, and language skills. They recommended we improve teaching by paying teachers more. But more importantly, all of them stressed the importance of vocational training linked to a realistic assessment of lasting employment: "You absolutely must train them for something real; otherwise you're creating the basis for chaos within the country." And, one labor researcher added, educational policy makers will have to participate in efforts to create new jobs.

If the Quick Response strategy becomes the dominant model of manufacturing organization in the domestic apparel industry, workers may need new work habits and tasks. Production workers will have to be more flexible, and white-collar workers will need more computer and telecommunications skills. All presumably will need better communications skills to deal with new management styles and responsibilities. Perhaps the reason this change was not reflected in management concerns is that the character of the workforce in these large firms has already changed. A number of employers mentioned that the average educational level of their workforce has risen in the past few years: production workers generally are now high-school graduates, whereas they often used to

have no more than a sixth-grade education. Years ago, employers found that women worked for secondary incomes. These women are now primary wage earners and often "much more capable of moving up." Although the guess that the rural female workforce has "grown up" in terms of ability to adapt to new shopfloor conditions is only that, it fits with the observations made both by a company vice-president and an ACTWU researcher regarding the history of the American apparel industry. The industry grew up in urban centers, drawing on the huge skilled labor pool of new immigrant workers. When that pool disappeared--as the second generation went on to different and usually better jobs--the industry did two things: adopted the sewing machine, and moved south to take advantage of a new rural labor pool. Perhaps, as several employers observed, there has been another generational change in apparel's industrial labor force. This might help explain (as for many employers it did explain) the move toward improving employee relations.

One concern shared by a number of the executives we spoke with was a feeling that the new generation is unprepared to accept factory employment. They point out that apparel manufacturing does not have a high-tech "glamour" image. The sweatshop image still prevails, despite the fact that many factories are clean, well-lit, and regulated. One executive wished that the educational system could help remove the stigma of working in manufacturing. Another concurred that what students need is not specific training, but "factory training." A similar concern was that students do not know how to handle everyday life, whether balancing a checkbook or going for a job interview.

In short, the messages from the apparel industry are mixed, especially regarding skills and education. It is true that the industry is in a state of flux; QR strategies are only now coming on line. For now at least, the industry is not worried about finding qualified, competent workers among the available labor pool. On the other hand, labor leaders expressed a clear, and perhaps more difficult, imperative for the educational system.

VI. TELECOMMUNICATIONS

"We're not in an ideal world yet but I think there's been some improvement."

— CWA local president

I used to think things would stabilize. I don't think so anymore."

— Telecommunications equipment manufacturing manager

While firms in autos, machine tools, and apparel have been fighting for survival against the market assaults of foreign competitors, domestic competition is still the name of the game for at least half the telecommunications industry. The break-up of the Bell System in 1984 dramatically changed the conditions faced by the domestic telecommunications industry. After years of regulated monopoly, providing long-distance telephone and information service is now a highly competitive business. At the same time, the manufacture of telecommunications equipment, previously bound by the set of standard specifications and products demanded by AT&T, has expanded and diversified. In both segments of the industry—service provision and manufacturing--technological innovation remains a central component of any firm's competitive advantage. Yet there are also signs that the industry is maturing: much of the advanced technology has reached a plateau, and companies are looking to such things as price and customer service to expand their markets.

Of the industries examined in this study, telecommunications offered the most diversity. First, firm size ranged from the still-giant AT&T, with more than 200,000

employees, to two equipment manufacturers having fewer than 100 employees each. More importantly, however, there are really two industries: the telephone companies, including the three largest long-distance carriers and the local operating companies, and the telecommunications equipment manufacturers. Telecommunications equipment generally involves "high-tech" microelectronic components, but these products range in sophistication from durable commodity products such as telephone headsets to highly customized information systems such as private branch exchanges (PBXs), as well as office automation products such as voice-mail.

The diversity among this set of firms makes it all the more surprising that so many of the perceptions regarding broad trends in work organization were consistent across the sector. Nearly all the managers we interviewed saw their firms being driven by the market into greater product diversity plus an increased emphasis on sales, marketing, and customer service. These firms say that they now depend more heavily on employees' communications skills and responsiveness. All stressed that their firms, and thus their employees, operate in a rapidly changing environment. In spite of such common themes, it is helpful initially to disaggregate the firms in order to understand the competitive pressures shaping these trends.

Among service providers, AT&T remains the major long-distance company. While two challengers broke into the market on the basis of discount service, the price difference among the three carriers is no longer remarkable, due in part to FCC and Department of Justice regulatory policies that subsidize competition. On the other hand, the quality of transmission has also converged, as MCI and Sprint have completed their own networks, including microwave and fiber-optic transmission systems. With this convergence, competition focuses much less on quality of transmission or price and much more on quality of service, including special service packages for large (business) users.

Moreover, firm strategies are now directed toward identifying and pursuing potential customers--that is, toward marketing. As one executive put it, "We've gone from being an engineering-driven company to being a market-driven company." The same is true of the regional operating companies. Although Bell regional companies do not directly compete with long-distance carriers for providing telephone service (and are of course specifically regulated to provide local service), they do compete in a number of ways with other service providers. They sell (but can't manufacture) lines for customer premises equipment (CPE) and cellular phone service systems, and they compete for the provision of private local bypass systems (that is, systems that bypass the public telephone network).

It should also be noted that the two older companies face challenges different from those faced by the two relative newcomers. The first is the technological challenge of replacing the embedded (literally and figuratively) analog lines and electromechanical switches with digital, electronic network equipment. MCI and Sprint have been able to come on line with new equipment much faster. Because both firms subcontracted the original network construction, the transition has not produced the massive job displacement seen in other companies. Pacific Bell, for example, has only recently computerized functions that were previously handled with ledger book and pencils. Under the old system, up to 73 people would handle a service or repair order; now, 90% of the orders a service representative keys in are not "touched" until installation technicians initiate service. These technological changes mean not only labor displacement, but skills displacement as well: the jobs created by computerization often differ radically from the jobs that are lost, and the scale of change is remarkable.

This is a tricky transition for the older carriers for another reason: both are unionized while the new telephone companies are not. The Communications Workers of America (CWA) and the International Brotherhood of Electrical Workers (IBEW) both have substantial representation at AT&T and the local operating companies. The CWA primarily

represents service workers, while the IBEW has membership in manufacturing and some technical service occupations. Of the two, the CWA has by far the largest representation in telecommunications. The IBEW represents workers in a number of industries such as construction: its representation in telecommunications is relatively small. The wages in the non-unionized companies are, according to their executives, competitive with those the union has negotiated, partly because these companies are determined to keep unions out. The non-union companies also emphasize human-resources management as an alternative to unions. On the other hand, AT&T and some Bell operating companies have, for the most part, relatively cooperative relationships with their unions.

Some of this may be due to the influence of the CWA, which has a commitment to proactive but cooperative bargaining in response to technological change. Pacific Bell, for example, claims to view the union not as a constraint on its competitive choices, but as a source of competitive advantage. According to representatives of the company and the union, Pacific Bell has undergone this fairly radical change of attitude within the past year or so. Rather than spending resources to fight the union, the company apparently concluded that partnership was a better deal. According to one company manager, the union is a business partner: collective labor agreements benefit both sides: and because the union is able to represent employees in the planning process, change is facilitated.

The manufacturing side of the telecommunications industry can be split further between "high-tech" system (or network) products, and commodity goods such as telephones and telephone headsets. Even within the latter segment, however, there is a further split between consumer products and specialized products such as the telephone headsets used by switchboard operators, travel agents, etc. Consumer products have been especially susceptible to imports, as well as to offshore subcontracting. One manager we spoke with explained that his firm subcontracts "Volkswagens" in the Far East, and builds the "Cadillacs" at home. These firms have been highly affected by the breakup of the Bell

System, which opened up the market. Formerly they were tied to a single set of fairly stringent quality specifications, and many were subcontractors to Western Electric (the manufacturing division of the old AT&T). Now their markets are often business users having widely varied requirements. Meanwhile, technological changes such as the miniaturization of components have made it possible to build more functions into smaller products.

The systems products are marketed primarily to large business users. According to the executives we talked with in this end of the industry, things have stabilized in the past few years; their style is now much less entrepreneurial. In the past, a technological and quality edge was enough to allow these firms to charge high prices. Characteristically, production efficiency was not an issue. Today, Japanese competitors offer products that match the quality and sophistication of U.S. products, but at a lower cost. This has pushed the firms we spoke with into a number of productivity improvements, both on the production line and in the office. Efforts range from Just-in-Time manufacturing to a system of "total quality control" adapted to administrative functions as well. Managers in all departments are expected to track processes and devise measures of productivity. Finally, engineers are increasingly required to "design for manufacture."

These firms (as well as one of the headset manufacturers) are also automating parts of the production process. Nevertheless, automation has been selective: as usual, volume is a consideration, and many of these products must be customized. In the manufacture of PBX systems, for example, printed circuit (PC) boards are produced and stocked in a limited number of patterns, then combined into customized systems. For some firms, therefore, it has made sense to automate PC board manufacture, while system assembly and testing remain relatively labor-intensive. The technological changes mentioned above (the miniaturization of components) have also affected the character of electronics manufacture. Since more functions are integrated on a single chip, correspondingly fewer wire

connections need be made. PC board manufacture has been automated, in part, by surface-mount technology that has greatly simplified assembly. Volume is not the only consideration, however; it is necessary to automate some parts of the production process for quality reasons. For example, electronic components are so small that even minor contact with dust or skin oils is enough to ruin them.

It is important to note, however, that only one of the equipment manufacturers we interviewed has moved production abroad in search of cheaper labor. One firm has factories around the world, in Europe as well as Asia, but everyone we interviewed there told us that they locate abroad for market reasons rather than labor costs. Another manager described the cost and quality advantages of offshore manufacturing as "elusive." In the case of semi-customized systems products, we were told, manufacturing and design must be linked. As one manager put it, the manufacturing operations are the customers as far as the engineers are concerned. If manufacturing moves offshore, the designers are likely to forget what these customers need!

The challenges facing firms in the telecommunications industry involve adapting to the evolution of electronics and computer technology, capturing a share of the market as its expansion begins to level off, and (for the equipment firms) restructuring manufacture around cost and variety as well as quality. These challenges will be discussed further in the context of their effects on jobs and skills. From the start, however, we will simply note the feature that seems to characterize the perceptions of managers from firms throughout the industry. In spite of some sense that a period of major transformation has just passed, everyone stressed that the "only thing constant is change." The situation calls not only for flexibility in what the company is doing or producing, but also for employees who are personally flexible. Despite the massive changes many of these firms have undergone, all say that they still prefer to retain and retrain employees. The wish to provide employment

security in the face of competitive pressures for change--to balance stability and flexibility--is a major challenge facing firms in this industry.

Jobs and Skills

When describing trends in jobs and skills, it is again helpful to divide our discussion according to the two sectors, communications services and equipment manufacture. People in both sectors told us that aggregate skill levels will continue to rise as labor is displaced from production and lower-level clerical jobs. On the other hand, it is unclear what the effect will be on the skill levels of individual job classifications. The terms "upskilling" and "deskilling" were used a number of times, but these terms appeared to mean different things to different people. One consensus, however, is that the skill requirements for many jobs will be qualitatively different.

At the two new long-distance companies, the workforce is predominantly white-collar. One human-resources executive said he considered the entire company to be white-collar because none of his employees are unionized, and none of them wear work clothes. Ten to 20% of the workforce in the two companies are technicians, some working in the field in service and installation, many (more today than a year ago) working at computer terminals. There are increasing numbers in a few of these technical job categories, especially those associated with the highly specialized computer systems and specialties such as fiber-optic testing. But overall, according to both labor and management representatives, technical jobs are disappearing rapidly. Some "inside" technician jobs are being decimated, while "outside" jobs such as installation are being cut by about 40 to 50%.

More significantly, we were struck by the degree to which the easy distinctions between technical, clerical, and white-collar jobs are disappearing. For example, an entire category of jobs that now carry clerical titles involves functions that once were performed by technicians. Repair and installation, for example, used to require a highly skilled technician

who would work with wires, jacks, and gauges to test and connect lines. With the digitalization of telephone networks, these functions are performed at a computer terminal. The effect on skill requirements is rather complex. As explained to us, the person who works at a computer terminal clearly needs less practical knowledge of such things as what a certain gauge reading means when two wires are crossed. The computer now handles the diagnostics, and in some cases even makes the necessary adjustments. On the other hand, the new job requires a technical, theoretical understanding of telephony: if anything, it requires more knowledge about how the whole system works. Moreover, according to a CWA local president, decision-making authority is being pushed down to these job levels. People in these semi-clerical, semi-technical positions make decisions in areas that were formerly management's responsibility. In his view, while the judgment about what is wrong with a certain line now belongs to a computer, the judgment about what to do about it belongs to a highly skilled clerical/technical employee.

To take another job category, we previously noted that the sales and marketing workforce is growing quickly as these firms attempt to attract and maintain a large customer base. Yet we were told repeatedly that these sales positions require a great deal of technical knowledge. The product itself is a technical one: sales and marketing people need to understand how network systems work and how to gauge what systems package will fit a customer's needs. And they must be able to communicate this technical information. In fact, one executive told us that he considers his sales force to be technical employees (some have B.S. degrees in electrical engineering), even to the extent of reporting them under this category for Department of Labor surveys.

At Pacific Bell and AT&T, another job category that is blurring is the operator's (the two new companies have no operators). It is generally acknowledged that the operator's job has been the most highly mechanized and regimented in the business. Technological changes have required tremendous work speed-ups. The job is so high-pressure that in

most locations operators must ask permission to go to the bathroom. With the shift to a competitive environment, however, and an increasing emphasis on customer service, performance expectations may change. According to a CWA representative, Pacific Bell has realized that operators are the employees who have the most consistent customer contact. Organizationally, these jobs have been moved into marketing, and operators are trained to identify potential customers for special services.

An AT&T executive told a similar story: operators are now given much more latitude to interact with customers and make decisions about how to handle calls. Management is gradually moving away from the strict time discipline that has characterized these jobs. The operator is now considered a value-added service. And, as this executive stressed, this is not a technology-driven change, but an organizational/managerial change.

As job titles and occupational categories are blurring, management hierarchies are also flattening, and the sphere of worker control is expanding. At AT&T, deregulation has brought a massive shake-down of managerial and supervisory staff. For many firms, the switch to a competitive market has required that middle management be trimmed. This shift has been aided by increasing office automation (which also reduces the need for low-level clerical staff). Many union researchers and leaders told us that the shift is also being aided by the introduction of more participatory forms of work organization, such as Quality of Work Life (QWL) teams, which shift management responsibilities to workers. According to a CWA local president, skill requirements have changed greatly at all levels. While employees used to be responsible only for doing their own jobs efficiently, now they must understand how systems are interlinked and anticipate how their actions may affect other parts of the company. And many jobs now require a range of "people skills" that used to be the domain of management.

For the two challengers, meanwhile, "mean and lean" management is a critical part of the competitive strategy. Executives from the two firms disagreed, however, about what

this management style means for employees. According to the first, the company has stripped away decision-making hierarchies that impede flexibility. This is pushing decision-making power "way down," a trend that will continue. Apparently, this is possible partly because electronic technology makes it relatively simple to reverse mistakes made at low levels. According to the second manager, however, the hierarchy is not flattening, it is being split. He sees a move to eliminate middle managers, leaving a group of broadly skilled and knowledgeable executives at the top and highly specialized, compartmentalized employees at lower skill levels.

What the changes mean for both job enrichment and job mobility is a matter of dispute. Ironically, the executive at the firm where hierarchies are being flattened and worker responsibilities increased said that he expects there will always be "dumb, dull, boring jobs for dumb, dull, boring people." New technology--giving a secretary a word processor, for example--may make a job more interesting for a while; then the thrill wears off and the job may be more routine than ever. In his view, what makes a job interesting is changing tasks, and these are not available at lower levels. Career paths are still fairly rigid; secretaries do not move into sales positions, for example. On the other hand, jobs in sales and operations change constantly and quickly. For this reason, the firm looks for people having information and computer skills, but even more for people who seem to be personally flexible. Thus the firm is interested in college graduates from the liberal arts as well as from engineering. Meanwhile, the second executive, who expected his firm to be split increasingly into specialists at the bottom and generalists at the top, said he expected that individual jobs would become more challenging. For him, the key is to hire people who want to be specialists. Finally, neither firm stresses workteams or interdependency. As one executive put it, his company's entrepreneurial culture stresses individual responsibility and risk-taking.

In spite of massive changes in the industry, there was no report of specific skills shortages (except in regard to some equipment so sophisticated that nobody has mastered it yet). Location decisions generally have not been based on skills; for some types of facilities, location is constrained by existing network arrangements. On the other hand, labor costs have entered the picture. A number of managers told us that they have begun to move "back office" jobs (administrative, customer service, and telemarketing functions) into suburban areas where labor is "cheap and plentiful." Several predicted that in the near future, many jobs will be performed at computer terminals at home. The technology for such arrangements already exists; implementation problems are mostly organizational. Problems include worker isolation and lack of job mobility, not to mention lack of supervision.

It is difficult, if not impossible, to draw a composite picture of the changes taking place in the communications side of the telecommunications industry. For example, the fairly radical organizational and cultural changes that have taken place at companies such as Pacific Bell are unique even among the regulated local operating companies. It should also be remembered that these changes are fairly recent, and possibly fragile. Nevertheless, if this strategy produces outstanding market success, the features of the company's labor arrangements--including increased worker responsibility, increased emphasis on workteams, and broader job categories across the board in addition to union/management cooperation--may become a model for other companies in the industry.

As noted in the first section, the challenges facing the older companies differ from those pushing the new ones. Nevertheless, the transformation from analog/mechanical to digital/electronic network technology is massively affecting jobs and skills across the industry. It is clear that, on the technical side, jobs now require less "craft-technical" and more "systems-technical" knowledge. White-collar jobs such as sales also require some sophisticated technical knowledge. Jobs throughout the industry clearly require computer

skills more than ever, and, in some cases, where they didn't before. Not surprisingly, communications skills are valued more than ever.

The manufacturing firms showed a clear trend toward reducing direct labor. This process is only partly the effect of automation and robotics. Stressed to us was something related to automation: "design for manufacture." Design for manufacture is a prerequisite of automation. By simplifying and standardizing product design, labor content is reduced regardless of whether the process is mechanized. One fairly small employer told us that he had reduced his direct labor force from 100 to 25 workers on a conventional assembly line simply by redesigning his product line for easier manufacture. Meanwhile, as noted above, the evolution of microelectronic technology is also reducing direct labor content as miniaturization places entire circuit designs on single chips. In short, as one production engineering manager told us, "There is a constant push toward the design end of things." For the time being, this means a push toward the highest skills as well.

Employers seem to agree that all this means, perhaps paradoxically, a need for higher skilled workers on the shopfloor as well as overall. Of course, a number of skilled craft positions--machining, tool and dye, glass-blowing, and drafting--are being eliminated by product changes. On the other hand, skilled technical positions in manufacturing will require, according to one manager, less breadth and more depth in a specific area. Simplification and standardization of product design were not expected to de-skill jobs for the bulk of the direct labor force, responsible for assembly and testing (although one manager said that both skilled and unskilled jobs are being eliminated). Production is being reorganized so that tasks that once were categorized as separate jobs are being merged. Work is being organized on a team basis at a couple of the larger firms, and production workers are being trained to be more "process-oriented." According to one manager:

> Rather than sitting in a chair, worrying about pushing one little component into a box, you're part of a process, you understand the entire process, you pay attention to critical measures of productivity like defect rates. You are really much more part of a team. It's a thinking job. It involves mathematics. We have people

> using statistical control techniques, and they need basic math. It involves taking responsibility--being aware of problems--taking a much more active role.... We require a different kind of person--not that traditionally we haven't had bright production workers. But we have hired people with poor language skills--for example, recent immigrants. It makes it difficult for them in a situation where communication is important--you're a part of a team to solve problems.

The consensus regarding automated facilities is that automation requires more skill and makes jobs more interesting. By all accounts, automation requires workers to understand the entire production process, rather than just concentrating on their own jobs. According to one manufacturing engineer, people working with programmable automation equipment must be flexible because everything eventually breaks down, but breakdowns happen unpredictably. Finally, because automation usually reduces routine tasks, overall job content is likely to be more interesting. A manager estimated that the repetitiousness of job content has dropped from 90 to 10%.

It is important to note, however, that compared with most manufacturing industries, telecommunications has never been labor-intensive. The highest reported proportion of direct labor employees was 50%, and most executives we talked with reported about 30%. Other job categories include, on the technical side, installation and systems technicians as well as engineers, software designers, and computer programmers. According to the communications director of one large firm, the last three are the "jobs of the future." Engineering, according to several accounts, will need to be more specialized as the technical field grows more complex. On the other hand, one manager pointed out that "design for manufacture" requires engineers who understand the entire production process and can coordinate and communicate with others--engineers who are not only technically creative but also have business skills. White-collar jobs in the industry include not only management and administrative positions, but also marketing and product support. As in the communications sector, many of these jobs require technical knowledge about how systems work, as well as good communications and public relations skills. As

manufacturing efficiency has gained importance, many middle management positions have been upgraded (materials management, for instance, is critical to a Just-in-Time environment). Unlike in the communications sector, there was no perception that middle management is the focus of employment cutbacks.

By contrast, we heard many stories about office automation's impacts on clerical and administrative jobs. Word processing and electronic mail have reduced paperwork in the larger firms, making secretaries, according to one account, three to four times more productive. Thus there are fewer secretaries, but those remaining are more highly skilled; they need computer skills as well as the usual business skills. Several people told us that the line between clerical and administrative support is being blurred. A number of firms claimed to have eliminated personal secretaries altogether.

The manufacturing sector did not give us the sense that management hierarchies are being flattened. But we heard a lot about increased employee responsibility and a continuing emphasis on workteams. Of course, the companies we interviewed have never been particularly bureaucratic--all were high-tech, "Silicon Valley" firms. Internal job mobility was stressed; all the firms train and promote from within. On the other hand, the two largest firms we spoke with are in a no-growth mode after years of rapid growth. This has meant, according to one personnel manager, that "the hurdles are higher." Competition for jobs is tougher; and there are fewer opportunities for people to advance, especially if they don't have college or advanced degrees. An engineering manager made the point more emphatically: he sees developing at his company (and in the country at large) a "dual-type society," with highly trained and degreed people at one end, and assembly people at the other. According to him, "The rift is growing at a tremendous rate."

Across the telecommunications sector, major employment groups are being eliminated by technological and organizational change: many skills are obsolete, and new ones required. And yet, nearly everyone we talked with in this sector insisted that their firm

is committed to maintaining employment security (again, this must be differentiated from job security). This means two things. First, employees at all levels must be "personally flexible," that is, willing to change as the company's needs change, to accept new job assignments and to accept training. This theme was reiterated by union representatives and corporate executives alike. Second, most of the firms, especially the large ones, have engaged in massive retraining efforts, which will be continued for some time. In a number of cases the levels of potential job displacement seem so high that the goal of employment security may be unreasonable. On the other hand, a number of executives expressed confidence that the jobs will be absorbed by attrition and market share increases, without requiring lay-offs. In either case, few of the telecommunications firms we interviewed are likely to be hiring extensively for some time.

Training and Retraining

All the managers we spoke with preferred internal promotion and retraining (except, of course, where an appropriate person cannot be found within, or when the firm needs someone immediately). In all cases, on-the-job training remains the primary approach. Yet for some larger firms, the fact that fairly large groups of people are being displaced by technological change calls for more formalized retraining efforts. This is especially true for firms in which direct production workers are undergoing major displacement. The large manufacturing firms we interviewed hoped to retrain many production people for technical jobs. Similarly, massive retraining is necessary for communications technicians who once worked with wires and analog readings but now perform the same tasks at a computer terminal with digital read-out. One communications executive pointed out that as craft skills are replaced by more theoretical knowledge (the "hands-on work is done by a machine"), training moves from "on-the-job/practical" toward "theoretical/educational." Finally, we heard again and again that a fast-paced environment undergoing fast-paced

technological change requires a constant effort to redeploy people (and to keep them technically up-to-date).

On-the-job training is thus supplemented with vendor training, classroom work, supplemental degrees, and computer learning programs. Many firms work through local community colleges and universities to sponsor programs specifically designed to keep technicians and engineers up-to-date, as well as to enable employees to acquire various degrees. One firm, for example, had designed a special business program in conjunction with a community college to help clerical workers upgrade their skills to the administrative support level. The large firms almost all pay employees' tuition for outside classes--sometimes even for subjects that have little to do with their current jobs. The state of California subsidizes computer training at one large communications firm, and the CWA runs a program to prevent lay-offs by retraining workers to become service representatives. A researcher from the CWA national office told us that his union would like to see a jointly managed training fund established on the model of the GM/UAW agreement, as an alternative to government-sponsored training.

Many larger firms have developed fairly innovative, flexible methods of retraining. A few of the communications firms, for example, have computer learning programs for technicians whose jobs have become computerized "desk" jobs. Employees work through self-paced computer lessons and drills at their workstations, combining on-the-job training with the kind of formal learning usually provided in a classroom. According to several executives, training has become more efficient because there is less redundancy, and employees do not need to gather in one location. Flexible training packages have been developed for salaried employees as well. A couple of the firms offer management training courses that employees can choose as needed; this approach is termed "training on demand." Finally, several of the firms participate in teleconference programs broadcast by a

California State University. Employees can, for example, earn a Masters in Computer Science over a satellite TV network.

Not all training and retraining efforts concentrate on developing employees' skills per se. For many firms, adaptation to corporate culture is an important facet of training. For example, one firm has put much effort into persuading employees that the company is seriously committed to things such as employment security, worker responsibility, and union-management cooperation (we heard about this training effort from both the company and the union). Many employees are involved in "leadership training seminars" to prepare for increased responsibility. In other firms, where cutting manufacturing costs is a relatively new challenge, management training seminars stress efficiency and increased quality control.

Of course, in the smaller firms, or in growth periods for the larger firms, certain levels of personnel must be hired from outside based on education and experience. Management positions in almost all the firms require at least a college and usually a business degree. Engineers and software designers, obviously, are highly trained and educated when they are hired. Nevertheless, the nature of technological change in the industry requires these technical employees to update their knowledge almost constantly. To a lesser degree, this is true almost all the way down to production and technical employees. Everything we heard about training stressed that when firms hire today, they look not only for specific skills, but also the willingness and adaptability to learn new ones.

Industrial Relations

In this industry, as in others, union leaders and company management generally agreed that relations with employees are critical to company success. In all cases the rationale is similar: a satisfied employee will be more productive and, insofar as the company values employee input, more creative. Given the communications companies' new

orientation toward providing service, a happy employee is also a better representative for the firm: more self-confident, more attentive to customers' needs, and more devoted to the company. For companies that wish to attract and retrain highly skilled personnel, as all high-tech companies do, a good working environment is a must.

The question is, what keeps employees happy? While the answers to this question differed, one common theme was employment security. According to many people, employees will produce more if they are secure in their jobs (as noted, it is not a question of specific job security, but employment security within the company). According to the managers we interviewed, their companies have become convinced that, given the major changes they are undergoing, the benefits of employee cooperation outweigh the costs of slowing the pace of change to accommodate redeployment and retraining. In situations of technological change, employees who are secure are more likely to facilitate change than to resist it. One manager speculated that by retaining employees during bad periods, his firm benefits in times of upturns: the firm is not required to retrain a lot of staff, but is able to jump immediately into full gear. For the most part we heard, "It works--I can't prove it works, but I know it does." Of course, the degree of company commitment to employment security varies. A couple of executives, however, told us that "people issues" had constrained their company's investment decisions, preventing them from laying off workers even when doing so made economic sense.

Another element of keeping employees happy includes involving employees in decision making, treating them as individuals, and maintaining open communication between employees and management. Where such arrangements are formalized, they are often known as Quality of Work Life (QWL) programs. In many companies that seem to operate according to these principles, such programs are not formalized, but exist de facto as part of the corporate culture. In unionized firms, QWL is not only formalized, it is often the subject of collective bargaining. AT&T, for example, committed to QWL at worksites

scattered throughout the company and the country. The company coordinates these efforts through a corporate office, but they are locally initiated and organized.

Many union leaders we spoke with were sceptical about QWL. Their complaint was not that QWL is a union-busting tool, but that it is usually insincere. As one researcher from the IBEW commented, "Managers want to give the impression of participation, but they want to keep control too." A CWA official agreed, indicating that some programs have real substance, but in many cases "it's only a shell." Yet labor and managers generally agreed that QWL can work only if both sides have a commitment to making it work--that is, real, personal commitment on the part of local leadership. This level of commitment is necessary because the transformation can be painful for old-style managers--giving up power is not easy. As one CWA official admitted, when decision making is truly participatory, mistakes are bound to be made. As an executive said, "For a manager who's used to making decisions in five minutes, to sit through a day-long QWL meeting is hell--it takes a special kind of person." For these same reasons, we were told, QWL works best when it evolves out of increasingly cooperative labor/management relations rather than being imposed as a kind of "experiment."

In the non-union companies, making employees happy took a number of forms. Two companies we interviewed are included in recent best-selling analyses of the New Management (books such as In Search of Excellence and The 100 Best Companies to Work For). These companies emphasize things such as employment security and employee participation, and then add some environmental amenities. Most others where we interviewed are only slightly more traditional. Several had bonus programs and profit-sharing arrangements that their managers said were important guarantors of employee morale. In a number of cases, we heard of a human-resources manager devoted to ensuring that work relations remain trouble-free. In at least two cases, managers made clear that keeping "a union-free environment" was an important goal of this attention to employee

attitudes. In both cases, the managers said that there was no reason for a union to represent workers as long as the company is attuned to their needs and does not hide anything. As one human-resources director put it, "Why should employees pay for someone to represent them--I represent them, and my services are free."

Nevertheless, industrial relations in the unionized sector are fairly cooperative. Both the CWA and the IBEW cooperate with technological change, even when it displaces workers. Their view is that technological change is going to happen in this industry no matter what (and is necessary to keep the industry healthy). Since that's the case, there are two choices, as one CWA local official put it: active resistance to slow it down, or involvement in long-term planning. The second alternative makes it possible to address issues such as the pace of change and plans for retraining. Beyond that, the CWA is interested in helping to shape the new technologies, making sure, for example, that technological changes are developed in such a way that job content is broadened rather than narrowed. Moreover, the CWA does not automatically associate new technology with job loss. One CWA official was willing to state flat out, "If you do technology responsibly, you can actually create jobs...they're just different jobs." The unions' question is whether they will be able to represent the new jobs, because often these are in the white-collar or "high-tech" part of the company.

Many of the managers we interviewed consider their firms to be part of a new climate of industrial relations emerging in the United States. One manufacturing manager stated, "It's changing because it's no longer possible to compete with antagonistic employee relations." A few executives attributed the change to the example of Japan, where large corporations are famous for harmonious labor relations. No one saw this style of management as unique to telecommunications or high-tech companies, although some viewed it as part of the "information age," in which relations differ from those in the old smokestack industries. Several managers attributed the general decline of unions to this

transformation, although some union representatives saw the decline as resulting from such factors as an unfavorable political climate. According to a CWA researcher, however, it is possible that expanded worker participation will become a broader trend, and that unions will be a part of it:

> It's certainly possible for us to stick to the current organizational structures, rigid hierarchies and so on, but I think if that continues then we're certainly not, as a country, let alone as industries - and even further on along the line as companies - going to maintain any kind of health and vitality. It seems to me that there's a requirement, an economic mandate almost, mandated by the market, to reevaluate, to structurally change the deal that was made by labor and management somewhere around the second world war.... That's not to say that collective bargaining is going by the wayside.... But by the same token I think it has to change. I think that they can't just be wage and benefit packages any more, they have to include dimensions that the companies need to allow them to be more flexible and the workers need to increase the chances of employment and income security. And the way to do that is through labor-management involvement in joint decision making, rather than one-dimensional decision making by management.

Increased flexibility is one characteristic of the new relations between companies and their employees. There was widespread agreement that employees today are more willing to accept change than in the past. According to some managers, younger employees welcome change. We heard repeatedly that it is no longer possible for workers to consider themselves narrowly, as having one particular skill. We often heard that today's employees expect change and new challenges, that they're more mobile and individualistic as well as better educated. One executive told us that his company is rethinking and renegotiating employee relations because the company must accept that today's employees identify their career interests in terms of advancing within their field, rather than within a company. (One question, of course, is whether these attitudes have been adopted in response to increasing uncertainty, or whether they are part of a generational change in what employees demand from work. We heard both explanations.)

Nevertheless, a number of managers agreed that the climate of industrial relations is changing because today's employees demand more participation and respect. According to

one human-relations vice-president, these workers have a different set of values--"and it drives a company like ours. If we don't satisfy their needs, they'll go someplace else, and we have a hard enough time with skills right now." At the same time, many managers agreed that workers are better educated, and that's why they demand more respect: "More and more, there are employees who say, 'I won't let you be disrespectful to me, and I won't let you make me stand at a copier all day when I have a college degree.'" While there was widespread agreement that the educational levels of employees have increased, there were also concerns about the educational system's response to the demand for a new type of employee.

Educational Reform

A number of employers said that future jobs will require technical and computer skills that schools emphasize insufficiently. One executive expressed concern that Japan graduates many more engineers each year than do American universities. Nevertheless, people called for better math and science education much less frequently than we expected in this high-tech industry. Instead, we heard repeatedly that schools need to do a better job teaching communications skills--from reading, writing, and following directions, to working as part of a team. A personnel director we spoke with said she is constantly shocked that even highly educated people in her company have trouble writing, and that a good percentage of job applicants seem to speak and write at an elementary level. There is a feeling that as decision making is pushed down and hierarchies are flattened, it becomes increasingly important for all employees to have the leadership and communication skills that once were required only of management. A union researcher who has given the matter some thought suggested that the style of education must change to fit the new style of industrial relations, moving away from a hierarchical, authoritarian educational system

toward a more participatory and student-directed one. In this view, it is not enough to change the content of education, we must change the way students are taught.

Similarly, a number of people we interviewed stressed the connection between "personally flexible" workers and the kind of education they received. For some employers, this meant that schools should "pre-route" children less. Others said that schools need to expose young children to different job possibilities while realistically assessing the preparation that different jobs require. This might require a "polytechnic" approach to high-school education, similar to the routing of students in the European system. Yet according to another executive, schools need to give youngsters the message that adaptability is good. Finally, many said that the education system as a whole needs to accommodate more adult retraining and continuing community-based education.

Some suggestions seemed linked more to a general social concern over the quality of American education than to the specific future workforce needs of the telecommunications industry. For example, a manufacturing engineer expressed concern that the educational system seems to reproduce a dual society in which the transition from one level to another is increasingly difficult. The situation is exacerbated by the fact that people having higher levels of education are doing lower levels of jobs than in the past. Just as a high-school diploma was once a job ticket, even a college degree no longer ensures a good job. Nevertheless, this manager was unsure what his company could do about the problem.

Managers from another company, on the other hand, said that the company is committed to affecting educational policy (for example, the company has a fund to support minorities who want to pursue advanced education) because they need an educated customer base. Finding skills in the labor market is not a problem, and managers from this firm do not expect it to become a problem. But illiteracy, drop-out rates, and lack of technical training are market problems: the customer base for telecommunications products and services is a well-educated, highly skilled labor force.