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UTILIZING THE TALENTS OF BLUE-COLLAR WORKERS

HEARING

BEFORE THE

JOINT ECONOMIC COMMITTEE CONGRESS OF THE UNITED STATES

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

MAY 17, 1990

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UTILIZING THE TALENTS OF BLUE-COLLAR WORKERS

THURSDAY, MAY 17, 1990

CONGRESS OF THE UNITED STATES,
JOINT ECONOMIC COMMITTEE,
Washington, DC.

The committee met, pursuant to notice, at 10:15 a.m., in room 2318, Rayburn House Office Building, Hon. Lee H. Hamilton (chairman of the committee) presiding.

Present: Representatives Hamilton and Wylie.

Also present: Steve Baldwin, Chris Frenze, and Scott Borgemenke, professional staff members.

OPENING STATEMENT OF REPRESENTATIVE HAMILTON, CHAIRMAN

Representative HAMILTON. Good morning. Sorry for the little delay. We had a vote out there, and I thought I had better drop by for that.

This morning the Joint Economic Committee is very pleased to welcome all of you to the hearing titled "Utilizing the Talents of Blue-Collar Workers."

We have three witnesses who are here to help the committee obtain information on the extent to which U.S. and individual firm productivity can be improved by better utilization of the talents of America's blue-collar workers.

The committee is pleased to have three highly qualified experts this morning to testify on how better utilization of our blue-collar workers can help strengthen our economy.

Our witnesses are Professor Patricia M. Flynn, executive director of the Institute for Research and Faculty Development, Bentley College, Professor David Stern, School of Education, University of California at Berkeley, and Mr. Louis G. Tornatzky.

Do I pronounce that correctly?

Mr. TORNATZKY. Very good.

Representative HAMILTON. Tornzatzky, close enough. Mr. Tornatzky is a scientific fellow with the Industrial Technology Institute, Ann Arbor, MI.

We are very pleased to have you with us. Your statements, of course, will be entered into the record in full, and we would ask you to testify for a few minutes before we turn to questions summarizing your statements as you see fit.

Congressman Wylie, do you have an opening statement?

Representative WYLIE. I was here earlier, Mr. Chairman. I was the first one, and I had a chance to shake hands with the witnesses.

Representative HAMILTON. Good. We're glad to have you.

OPENING STATEMENT OF REPRESENTATIVE WYLIE

Representative WYLIE. I would like to welcome you, and I think your testimony this morning will be very important indeed. The manufacturing output continues to contribute 20 to 24 percent of the gross national product. In this area though the job sector has been flat.

I know that this hearing will explore how an adjustment can be made to facilitate technological change, and I look forward to hearing from you this morning.

Thank you very much, Mr. Chairman.

Representative HAMILTON. Thank you, Congressman Wylie.

Ms. Flynn, please proceed.

STATEMENT OF PATRICIA M. FLYNN, PROFESSOR OF ECONOMICS, AND EXECUTIVE DIRECTOR, INSTITUTE FOR RESEARCH AND FACULTY DEVELOPMENT, BENTLEY COLLEGE, WALTHAM, MA

Ms. FLYNN. Thank you Mr. Chairman.

I would like to thank you for inviting me to speak at this meeting on utilizing the talents of America's blue-collar workers.

My summary remarks this morning are taken from the paper entitled "Blue-Collar Workers at Risk," which is being submitted in full to the committee this morning.

Today I would like to leave you with three key points.

First, technological changes at the workplace have been highly disruptive of blue-collar workers. Technological change alters the quality and quantity of skills required to perform various tasks. It changes the industrial and occupational composition of employment. It also affects the geographic location of jobs. These changes, in turn, affect hiring and staffing practices of employers, career paths of workers, and the economic development of local communities.

Technological change is a key factor in bolstering productivity and economic growth. However, technological change also results in skill obsolescence, worker displacement, and unemployment. Substantial layoffs often accompany technological changes in declining industries or that involve a relocation of a plant to another geographic area. When these situations occur in a labor market dominated by one or two employers, the impacts on the community can be devastating.

The second key point is that the uncertainties and adjustments surrounding adoptions of new technologies are preferable to the known consequences of the failure to adopt. Empirical evidence suggests that the failure of U.S. firms to adopt new technologies contributes more to worker displacement, plant closings, and permanent job loss than does the adoption of new technologies.

Recent findings on technological diffusion show that the United States lags several of its industrial competitors in terms of rates of

adoption and levels of utilization of new technologies. This does not bode well for American workers, in general, nor for blue-collar workers, in particular.

The relatively slow adoption of new technologies by U.S. firms is attributed to a variety of factors, including insufficient investments in human capital, antiquated organizational structures, continued reliance on mass production of standardized products, and traditional adversarial labor-management relationships.

The third key point is that while the impacts of technological change are complex, they are not random. Therefore, management and workers can anticipate and plan to facilitate technological change at the workplace. A variety of technical and organizational factors play key roles in how workers and jobs are affected by technological change.

One of the most useful tools in understanding the technical aspects is something referred to as the technology life cycle. Technologies, such as a numerical control technology, or a data processing technology, are introduced slowly at first, become more widely adopted as R&D efforts lead to improved performance, eventually reach a peak, and are often replaced by a new superior technology.

Extension of this technology life cycle to human resource issues reveals several patterns in skills and training requirements, in the sources of job-related training, and in the supply of appropriately trained workers as technologies evolve.

For example, as skills become more standardized and transferable among firms as technologies mature, schools and colleges begin to provide skill training previously acquired at the workplace. Electronics, computer programming, the setup and operation of numerical control equipment, and word processing are classic examples of this skills transfer.

As technologies become obsolete, a limited market for skills and declining student enrollments result in the termination of occupational training programs in these fields. The responsibility for training to fill relatively short-term skilled replacement needs reverts back to the firm. This has been the case, for example, with skilled stitchers in New England's textile and apparel industries.

While technical factors alter the larger environment in which firms operate, organizational factors, such as management practices and labor-management relations, are instrumental in shaping the impacts of change in workers at a particular worksite.

It is important to distinguish, however, between a newly emerging technology and a technology that while "new" to the firm, is in later stages of development when it is adopted. For instance, firms that choose to adopt newly emerging technologies have to provide the appropriate training themselves or depend on equipment vendors to do so. Current workers are usually the beneficiaries of retraining and upgrading.

In contrast, firms that chose to adopt more mature technologies can hire appropriately trained workers from schools, colleges, or from other firms. This practice, however, can threaten traditional career paths within the firm and generate growing problems of morale and turnover. Current workers who see better jobs going to outsiders while they or their fellow workers are transferred, downgraded, or laid off are likely to resist technological change.

Another important distinction is that between work tasks and jobs. The deskilling of tasks that occurs as technologies mature, need not result in the deskilling of jobs nor in the downgrading of workers. Tasks can often be regrouped to generate jobs requiring similar or more advanced skills than prior to the change rather than allowing jobs to become narrower, easier, and less satisfying. Some firms use job rotation and work teams, whereas others allocate the newly created tasks within a more traditional, and more rigid, hierarchical structure of jobs.

Collective bargaining agreements can significantly influence the organization's flexibility to adjust to change. Contract clauses may specify conditions regarding the staffing of new positions, the restructuring of jobs, the criteria for worker layoffs, and so forth.

There are examples of firms that have remained technologically competitive by effectively integrating new technologies, by investing substantially in the education and training of their workers, and by demonstrating organizational and managerial flexibility. These firms do not, however, appear to represent the norm in corporate America.

In addition, innovative agreements between unions and management in recent years demonstrate the potential for labor-management cooperation to promote technological change through measures designed to enhance flexibility and employment security. Such efforts are too new to evaluate. Moreover, they are still relatively rare, and it remains to be seen how many firms will follow their lead.

In sum, the bulk of retraining in the United States will continue to take place within firms. Managers and workers need to better understand than in the past the dynamics of technologies and organizations if they are to take an active role in integrating change at the workplace.

The life-cycle framework can help identify human resource tradeoffs involved in adopting technologies at various phases of their development. It can also provide guidance in assessing the skill and training requirements to be generated at a particular firm when such change is introduced.

The life-cycle framework also helps to anticipate situations where labor market adjustments are likely to spill beyond the boundaries of the firm, as in the case of plant closings or permanent layoffs. In such cases public policies are needed to effectively utilize the talents of those displaced.

Thank you, Mr. Chairman.

Representative HAMILTON. Thank you, Ms. Flynn.

[The paper submitted for the record by Ms. Flynn, entitled "Blue-Collar Workers at Risk," follows:]

BLUE-COLLAR WORKERS AT RISK

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Paper prepared for the Joint Economic Committee hearing on Utilizing the Talents of Blue-Collar Workers, May 17, 1990.

Workplace turbulence characterized the 1980s and is quickly becoming a watchword of the 1990s. Intensifying international competition, ongoing economic and corporate restructuring, and widespread diffusion of technological changes are trends expected to continue through the next decade. Moreover, between now and the year 2000, demographic projections portray a workforce growing more slowly and aging more rapidly than in any period since the 1930s.

Debate continues over the quantity, quality and skill requirements of the evolving mix of jobs. There is general consensus, however, that: (1) most workers will be affected by some or all of these changes during their working lives; (2) the positive and negative affects of these changes will be spread unevenly across groups of workers and regions; and (3) education gaps and skill mismatches are growing among declining and growing industries.

While structural change has both positive and negative impacts, workers in economically depressed industries and communities are clearly "at risk" from this workplace turbulence. Blue-collar workers, in particular, are vulnerable to the "downside" of these changes.

STRUCTURAL CHANGE AND BLUE-COLLAR DISPLACEMENT

The 1980s witnessed an acceleration of the long-term shift away from goods-producing sectors (e.g., mining, construction and manufacturing) and into service-producing employment (e.g., transportation and utilities, wholesale and retail trade, finance, insurance and real estate, services and government.) The service-producing sector now accounts for two-thirds of the employment in the United States; manufacturing employment has fallen below 17 percent of employment. Moreover, in terms of new jobs created over the past two decades, over 90 percent were in service production; only 1

percent in manufacturing. In recent years, the manufacturing sector, which employs the vast majority of blue-collar workers, has been declining in absolute as well as relative size.

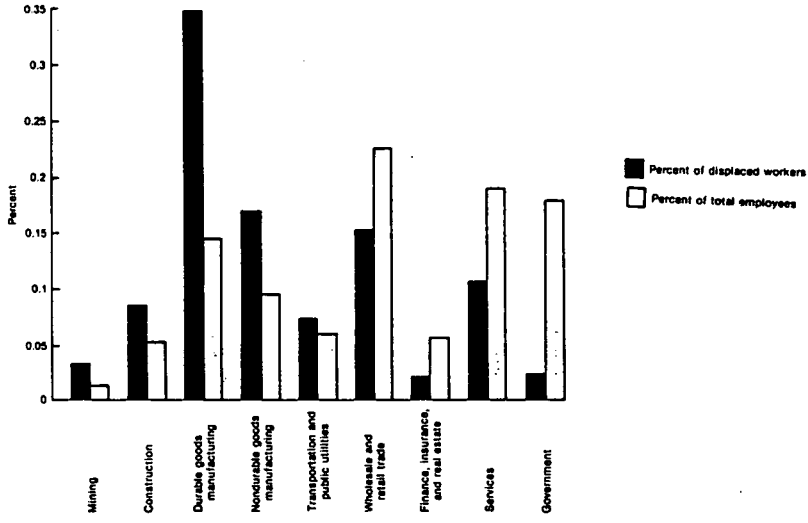
In the United States about 2 million workers a year lose their jobs due to plant closings, relocations, corporate downsizing, rising productivity, and shrinking output.[1] The experienced blue-collar workforce is especially hard-hit by these changes. For instance, data from 1979 to 1984 on "displaced workers" (by BLS definition, job losers who had held their former jobs for at least 3 years) show that:[2]

- The majority of displaced workers are white, of prime working age, and male.
- While manufacturing accounted for less than 20 percent of the jobs, almost half of the displaced workers had been employed in manufacturing industries. (See Chart 1.) Industries that have experienced growing international competition, such as automobiles, steel, textiles, and apparel, contribute to much of this displacement.
- Within manufacturing the jobs most vulnerable to displacement are unskilled, and semi-skilled production jobs.
- Representing 22 percent of the displaced, but less than 8 percent of the workforce, machine operators, assemblers, and repairers lead the list of occupations experiencing job losses far out of proportion to their share of the workforce. (See Chart 2.)

Manufacturing employment, especially production jobs, is projected to further decline in both absolute and relative terms through the year 2000. It is anticipated that those displaced from the manufacturing sector will increasingly have to find jobs in the service-producing industries.

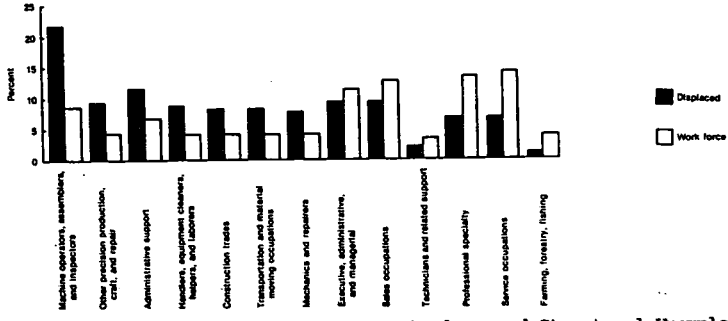
Evidence suggests, however, that most displaced blue-collar workers have chosen to return to jobs in declining industries rather than move into the growth sectors. A study of reemployment patterns of displaced workers in

Chart 1
Displacement by Industry, 1979 to 1984, and Percentage of Total Labor Force Accounted for by Each Industry, 1979.



Source: Office of Technology Assessment, Technology and Structural Unemployment, Summary, (Washington, D.C.: U.S. Government Printing Office, 1986.): 14.

Chart 2
Percentage of Displaced Workers by Occupation, 1979 to 1983, and by Percentage of the Labor Force Accounted for by That Occupation, 1979.



Source: Office of Technology Assessment, Technology and Structural Unemployment, Summary, (Washington, D.C.: U.S. Government Printing Office, 1986): p. 13. 2

1986 shows, for example, that only one-quarter of skilled blue-collar workers moved into white-collar and service jobs, and just over one in three semiskilled workers did so.[3]

Worker transition from declining to growth sectors is hindered by significant education and skill gaps which tend to disqualify blue-collar workers for the better jobs in growing industries. Given their qualifications, which are often derived from years of learning on-the-job, many blue-collar workers find themselves eligible only for low and unskilled clerical and service-sector openings. General education deficiencies compound job-related skill gaps. Moreover, for the relatively high-paid blue-collar workers, comparable wage jobs in the growth sectors often require a college degree.

Reemployment patterns confirm that intersectoral mobility for blue-collar workers generally proves costly in terms of pay and status.[4] Those with the most seniority have been found to suffer the greatest wage declines. Furthermore, in contrast to the experiences of white-collar workers, strong growth in the local economy does not reduce the economic losses of blue-collar workers who were displaced.[5]

Technological Change and Displaced Workers

While a key factor in bolstering productivity and economic growth, technological change also results in skill obsolescence, worker displacement and unemployment. The adoption of new technologies, however, plays a relatively small role in overall worker displacement and permanent job loss in the United States. On the contrary, empirical evidence suggests that the failure of U.S. firms to remain technologically competitive contributes more to worker displacement, plant closings, and job loss than does the adoption

of new technologies.[6] A 1986 U.S. General Accounting Office survey of approximately 400 establishments cites, for example, the most significant cause of plant closings and mass permanent layoffs to be reduced product demand, followed by increased competition, high labor costs, and the high value of the dollar.[7] Facility obsolescence and production automation, factors more directly associated with technological adoptions, were cited by relatively few respondents as key causes for workers being displaced from the firm.

Blue-collar workers, however, are the primary group involved in the exceptional cases in which the adoption of technological changes are characterized by widespread layoffs. Case studies demonstrate, for example, that substantial layoffs are often associated with technological changes that take place in "declining industries" or that involve the relocation of a plant to another geographic area.[8] For firms in industries experiencing a long-term decline in output and demand, such as textiles, apparel and coal mining, transfer opportunities are limited at best. Hence most workers whose jobs are eliminated by technological changes in these industries are laid off.

Considerable layoffs have also resulted when technological adoptions are accompanied by a plant relocation due to the opening of a new plant or an intrafirm consolidation. In these situations, which occur predominantly in the manufacturing sector, workers often refuse reemployment offers that entail a long commute or a residential move.

If these plant closings or significant employment cutbacks occur in labor markets dominated by one or two employers the impacts can be devastating to the community. Empirical study shows that even firms that

exhibit highly paternalistic relationships with their employees -- a common trait of firms that dominate a locality -- could not compensate for the lack of alternative employment opportunities. More generally, while economic growth eases labor market adjustments, even a booming economy does not ensure against layoffs, unemployment and downgrading when firms undergo significant changes in skill or employment needs.

TECHNICAL AND ORGANIZATIONAL FACTORS AND THE IMPACTS OF TECHNOLOGICAL CHANGE

Technological change has long been the source of both positive and negative disruption in the workplace. It alters the quantity and quality of skills required to perform various tasks. It also changes the industrial and occupational composition of employment, and the spatial location of jobs. These changes, in turn, affect hiring and staffing practices of employers, career paths of workers, and economic development of geographic areas.

As implied above, both the adoption of technologies and the failure to adopt present challenges in terms of labor market adjustments and human resource development policies. Depending upon the option chosen, however, the types of skill and training needs, the nature and distribution of costs and benefits, and the roles of the private and public sectors in facilitating the changes, will differ.

Technical and organizational factors play key roles in how job and workers are affected by technological change. Moreover, systematic analysis of these factors demonstrates that while complex, the effects of technological change are not random. Thus, managers, in the private and public sectors, can anticipate and seek to minimize the negative impacts of structural changes associated with the adoption or failure to adopt new technologies.

Technical Factors: The Technology Life Cycle and Human Resources[9]

One of the most useful tools for understanding the impacts of technological change at the workplace is the technology "life cycle." Technologies, like products and production processes, exhibit patterns of growth and development characterized by sequential "life cycle" phases of introduction, rapid growth, diminished growth and stability or decline. Introduced slowly at first, technologies, such as a numerical control technology, or a data processing technology, become more widely adopted as intensive R & D efforts lead to improved performance; eventually reach a peak; and are often replaced by a new, superior technology.

Extension of the life-cycle framework to human resource issues reveals common patterns in skill and training requirements, in the mix of institutional providers of job-related skills, and in occupations as technologies evolve. [See Chart 3]

Skill and Training Requirements

Empirical evidence suggests a skill-training life cycle (STLC) as skill requirements and training needs change over the development path of a technology. The early stages of a technology's life are relatively skill- and labor-intensive. Engineers and scientists are needed for product development, the construction of pilot models, and the implementation of design changes. Equipment used in relatively early stages of a technology's life tends to be general-purpose in nature, requiring skilled operatives able to adjust to frequent changes and to adapt the equipment to individual company needs.

As technologies mature, standardization and the expanded use and complexity of equipment foster a greater division of labor and the

Chart 3

The Skill-Training Life Cycle (STLC)

	I Introduction: New and Emerging Skills	II Growth: Increased Demand for Skills	III Maturity: Slower Growth in Demand for Skills	IV Decline: Skill Obsolescence
Nature of Tasks	Complex	Increasingly routinized	Increasingly routinized	Narrowly defined
Type of Job Skills	Firm-specific	Increasingly general	General; transferable	General; transferable
Effects on Job Structure	Job enlargement; new positions created when significant change in skill needs occurs	Emergence of new occupations	Relatively rigid job hierarchy; occupations associated with formal education and related work experience requirements	Elimination of occupations
Skill Training Provider	Employer or equipment manufacturer	Market-sensitive schools and colleges	Schools and colleges, more generally	Declining number of schools and colleges; some skills provided by employer

Adapted from: Patricia M. Flynn, Facilitating Technological Change: The Human Resource Challenge, (New York: Ballinger Publishing Company, 1988): 19.

subdivision of multifaceted tasks into more narrowly defined assignments. Tasks that have been simplified, i.e., "deskilled," can be performed with less skill, experience and independent decision-making on the part of workers. The tasks of semiskilled operatives, for example, often shift to monitoring and control of the equipment. In addition, product assembly can be done by low-skilled and unskilled workers who concentrate on a limited number of narrowly-defined tasks. Once embodied in the workforce, skills are transferred to the production equipment.

In general, the skill level of the tasks being simplified is inversely related to the degree of standardization of the products and the production processes. When equipment is initially introduced into small-batch production, for example, high-skill handicraft work such as that of machinists and welders is simplified or eliminated. The automation of routinized assembly functions, in contrast, eliminates relatively unskilled tasks.

Shifting Institutional Responsibilities for Training

The nature and source of training for job-related skills also change as a technology matures. For a newly emerging technology, the firm-specific nature of skills required and the lack of workers with these skills mean that employers must provide their own training or rely on the equipment manufacturer to do so.

After a technology becomes more widely adopted and equipment standardized, skills that were once firm-specific become general skills transferable among employers. As with products, increased demand and standardization of skills permit their "production" on a larger scale and at locations away from the R&D sites. Employers are less able to capture the

return on investments in general, as opposed to firm-specific, skills, and generally prefer that such training be provided in the schools, where the government or individual students will pay for it. Moreover, as demand for such skills grows, it is easier to standardize the training and provide it in the schools. Together, these two forces, encourage the shift of skill development from the workplace to the formal educational system as technologies mature. Electronics, computer programming, and the set-up and operation of numerical control equipment are classic examples of this transfer.

As old technologies become obsolete, training focuses on replacement needs and on the retraining of workers for other fields. A limited market for skills and declining student enrollments result in the termination of occupational training programs in these fields. The responsibility for training to fill relatively short-term, skilled replacement needs reverts back to the firm.

Technology, Occupations and Careers

Occupational changes over the development path of a technology can trigger a growing disparity between those who lose and those who gain from technological change at the workplace. More specifically, with the adoption of newly emerging technologies, job enlargement, the relatively high degree of uncertainty, and the lack of appropriately trained workers favors selection and retraining of current employees. As technologies mature, the emergence of occupations and the growing supply of appropriately skilled workers, allows employers to fill their technology-induced needs with workers who have acquired their skills at other firms or in schools and colleges. As occupations become more clearly delineated they often become associated with

particular educational credentials and previous related-work experience -- a trend that further fosters discontinuous job ladders and barriers to advancement within firms as technologies mature.

Organizational Factors: Employment Practices at the Firm[10]

Trends in skill requirements, training needs and occupations as technologies develop alter the larger environment in which firms operate. However, organizational factors, such as management practices and labor-management relations, are instrumental in shaping the impacts of technological change on jobs and workers at a particular worksite.

Management Practices

Management usually determines the timing and selection of technologies adopted and the allocation of tasks among jobs and workers.

Timing. Employers often plan technological changes to coincide with business expansions and economic prosperity. Growing demand within the firm increases the likelihood of internal job opportunities. High labor demand in the local economy provides a range of alternative employment options and reduces the amount of adjustment required within the firm.

The timing of the adoption relative to the "age" of the technology also affects the nature of the workplace adjustment. The life-cycle approach accentuates the importance of distinguishing between a technology that is "new" in its development cycle, and one that, while "new" to the firm, is in more mature stages of its development.

As discussed earlier, firms that choose to adopt newly emerging technologies will experience considerable uncertainty regarding the nature of skills and training required and will have to absorb the costs of appropriate training.

As the provision of job-related skills shifts from the workplace to the schools as technologies mature, employers need to decide whether to "buy or make" the trained workers required by the change. In new and emerging fields, "buying" such workers (from schools or from other firms) can be quite costly given their rapidly rising wages and relatively high turnover rates. If firms choose to "make" their own skilled workers, training programs have to be developed and workers selected for training. The "make" option has lower recruitment costs but raises the firm's training bill.

As the supply of appropriately skilled workers expands, morale issues come to the fore. Hiring trained and experienced workers from outside the firm can threaten traditional job structures and internal career paths. Current workers who see the better jobs being created going to outsiders while they or their fellow workers are transferred, downgraded or laid off are likely to resist the technological change. Workers not immediately affected by the change but who envision their advancement opportunities diminished will also feel threatened by new technologies.

Work Allocation and Distribution. Technological change almost always results in some restructuring in the organization of work. The ways in which management integrates the deskilling of certain tasks and the creation of new skill requirements affect the job structure and staffing practices at the firm.

Case studies confirm that similar technologies adopted by firms at the same point in time can generate dissimilar impacts on jobs and workers.[11] They also demonstrate that technology-induced deskilling of tasks need not result in the deskilling of jobs or in the downgrading of workers. Tasks can often be regrouped to generate jobs requiring similar or more advanced skills

than prior to the change, rather than allowing jobs to become narrower, easier, and less satisfying. With the introduction of numerical control machines, for example, operative jobs have been upgraded when new programming tasks were added, but downgraded when programming functions were assigned elsewhere. Similarly, when flexible manufacturing systems are adopted some firms use job rotation and work teams, whereas others allocate the new tasks within the more traditional, and more rigid, hierarchical structure of jobs.

The decision to centralize or decentralize various functions also influences jobs and employment practices. Centralizing new activities such as data processing in a separate department, for example, rather than dispersing them throughout the firm promotes a greater degree of job specialization. Centralization fosters the creation of new positions, rather than the "enlargement" of established jobs.

Unions and Collective Bargaining

Labor-management relations can significantly influence an organization's ability to adjust to structural changes. Traditional job classifications and pay structures, for instance, are often modified with the adoption of new technologies. While collective bargaining agreements do not usually specify how technological changes are to be introduced at the workplace, various clauses do address the staffing of new positions, the restructuring of jobs, criteria for workers selected for layoffs, changes in compensation systems, and so forth.

For example, empirical evidence confirms the life-cycle framework implication that current employees are usually retrained and assigned to the highly-skilled jobs created with the adoption of newly emerging technologies. The pool from which these workers are drawn, however, often differs between

the factory and the office. For blue-collar workers, negotiated contract clauses on job security and seniority have historically weighted the selection decision in favor of those workers whose tasks were eliminated or deskilled by the technology. In contrast, when relatively high-skill positions were created by office automation, the clerical workers most directly affected by the changes have traditionally been laterally transferred rather than assigned to the new jobs. Instead, workers from other departments in the firm generally were transferred into the better positions and subsequently provided the required skills in company-sponsored training programs.

Facing growing displacement of blue-collar workers in recent years, several unions have accepted concessions in work rules, a broadening of job classifications, and more flexible work procedures, in exchange for a greater commitment on the part of employers to support employment security measures.[12] The United Automobile Workers(UAW)-General Motors(GM) contract, for example, provides the union advance notice of the adoption of new technologies and the creation of a joint union-management committee to handle layoffs related to technological change. Workers whose jobs are eliminated by technological change are guaranteed employment at full pay and fringe benefits for as long as they are willing to retrain.

Labor-management agreements are also beginning to reflect the more broadly based trend away from "job security" to "employment security" which may entail a job with another employer. Unions have negotiated educational and retraining services for displaced, as well as active, workers. The Ford and GM contracts with the UAW, and the AT&T agreement with the Communications Workers of America (CWA), for example, provide for training, counseling and

relocation services to workers displaced from the firm. In addition, union-management agreements have resulted in a broadening of the scope of courses eligible under tuition remission programs, to include, for example, the provision of job-related skills useful for employment outside the firm, and of more general personal development courses such as those in computer literacy, written and oral communication techniques, and goal setting and motivation.

Firm Size

Empirical evidence is scant on how jobs and workers across firm sizes fare when technological adoptions occur. Limited training budgets and relatively small demands for particular skills, make small and medium-sized firms more dependent on external sources -- such as schools and colleges, government training programs and other firms -- to meet their skill requirements. Compared to larger firms that are often able both to develop formal training programs and to offer higher wages and greater promotion opportunities, it appears that smaller firms would be at a disadvantage in training and in retaining skilled workers in areas in which skills are scarce as new technologies develop.

FUTURE CHALLENGES

Empirical evidence suggests that the uncertainties and adjustments surrounding the adoption of new technologies are preferable to the known outcomes resulting from the failure to remain technologically competitive. As highlighted in the life-cycle framework, adoptions of technologies while in their earlier phases of development are associated primarily with the positive impacts of technological change, i.e., relatively skilled jobs, broadly defined work assignments, and a wide range of upgrading and job

enlargement possibilities. In contrast, adoptions of relatively mature technologies or the failure to adopt generate negative impacts: truncated job ladders, diminished advancement opportunities, and rising morale problems in the former; worker displacement, layoffs, and mass permanent job loss in the latter.

The findings in recent studies on technological diffusion show, however, that the U.S. lags several of its international competitors in terms of rates of adoption and levels of utilization of new technologies, such as advanced machine tools and robotics.[13] This does not bode well for American workers, in general, and for blue-collar workers, in particular.

The relatively slow adoption of new technologies by U.S. firms is attributed at least in part to the inability of management to anticipate and prepare for the impacts of technological change at the workplace. Managers have been criticized for failure to: effectively evaluate both the short-term and long-term costs and benefits of technological adoptions; sufficiently invest in human capital; develop organizational structures that can fully exploit the productivity gains associated with new technologies, and establish fruitful, cooperative relationships with workers.[14] A variety of factors, including outdated cost accounting practices, antiquated organizational structures, continued reliance on mass production of standardized products, and traditional adversarial labor-management relationships contribute to these results.

There are examples of firms that have remained technologically competitive: effectively integrating new technologies, investing substantially in the education and training of their workers, and demonstrating organizational and managerial flexibility. These firms do not,

however, appear to represent the norm in corporate America.[15]

Innovative agreements between unions and management demonstrate the potential for labor-management cooperation to promote technological change at the workplace through measures designed to enhance flexibility and employment security. Such efforts are still relatively few in number and too new to evaluate. It remains to be seen how many firms will follow their lead, and if such action will be taken before foreign competition has resulted in significant job losses.

Moreover, major restructuring efforts characterizing U.S. industry today often involve "downsizing" and a growing dependence on the contingent workforce (e.g., part-time workers, self-employed independent contractors, agency temporaries) making it more and more difficult to guarantee employment security in the face of change.[16] Growing uncertainties regarding job and career prospects can curtail worker support for the adoption of new technologies — support proved vital to successful adoptions.[17] Case studies demonstrate that workers and supervisors supportive of a new technology excuse or overlook potentially damaging problems related to the change, such as the failure of management to adequately plan, communicate or retraining workers. In sharp contrast, when workers or supervisors are resistant to technological change, even relatively minor modifications in skill requirements, job content, or training, become major stumbling blocks.

Managers need to better understand than in the past the dynamics of production and technologies if they are to take an active role in integrating technological changes at the workplace. The life-cycle framework, in general, and the skill-training life cycle, in particular, can help managers identify the human resource tradeoffs involved with adopting technologies at

various phases of their development, and in systematically assessing the skill and training requirements likely to be generated at the firm when such change is introduced.[18]

To date, the dynamics of production and technological change have not figured prominently in public policies in the United States. Furthermore, education and training policies traditionally have focused on schools as the primary source of job skills, while other important sources of skill development have received relatively little attention. The life-cycle framework suggests the need to more full integrate non-school providers of job-related skills, such as firms, union apprenticeship programs, the military and government training programs into education and training policies.

The life-cycle framework helps to pinpoint places along the development path of technologies where labor market adjustments are likely to spill beyond the boundaries of the firm and where public intervention is likely to be most effective in fostering a workforce prepared for structural change.[19] It suggests, for instance, that demands for new, highly skilled labor created by the adoption of new technologies will be relatively small compared to total employment needs. The failure to meet these skill needs, however, can hamper the diffusion of technologies at the workplace. The bulk of worker retraining in the United States takes place within firms, and schools cannot hope to prepare workers for emerging skill needs as they initially arise. As technologies mature, however, training can and should be transferred to the formal educational system.

In the life-cycle perspective, skill obsolescence, plant closings and worker displacement are seen as natural consequences of technological

progress. Rather than trying to prevent these events, public policies should be geared toward integrating change and facilitating the readjustment of workers caught in the transition. The skill-training life cycle provides guidance in assessing the likelihood and nature of skill obsolescence over time. It suggests the need for public officials to better understand the firms and jobs that make up the local employment base, and to seek to anticipate major structural changes before being faced with large-scale layoffs and plant closings.

More generally, the life-cycle framework suggests that education and training policies should be a cornerstone of a more broadly based economic development strategy that recognizes the importance of a diversified employment base.

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Representative HAMILTON. Mr. Stern, please proceed.

STATEMENT OF DAVID STERN, PROFESSOR, SCHOOL OF EDUCATION, UNIVERSITY OF CALIFORNIA, BERKELEY

Mr. STERN. Thank you, Mr. Chairman.

Mr. Chairman, Congressman Wylie, I am deeply honored to address you today on how the talents of America's nonsalaried workers can be more effectively mobilized, rewarded, and developed. There is growing recognition among U.S. employers that successful competition in today's world economy requires involving nonsalaried workers in continuously devising new methods to improve quality and productivity.

Observers of Japanese management practices agree that Japanese firms have developed to a high degree the art of involving production workers in a ceaseless search for better ways to get the job done. Awareness of Japanese practices—and of worker-involvement practices in Germany, Sweden, and elsewhere—has spurred renewed interest in this concept here.

The concept, of course, is not new. For instance, during the past 50 years, hundreds of U.S. companies have made successful use of the Scanlon plan, which provides a monetary incentive and a communication process for manufacturing workers to contribute suggestions that improve productivity.

What is new is not the concept that nonsalaried workers have useful ideas, but the recognition that this is a key to competitiveness. You may have noticed the current issue of Fortune magazine on the cover has a cover story entitled "Who Needs a Boss?" which highlights the greater worker involvement in several leading American companies.

During the past 3 years with my colleagues Clair Brown and Michael Reich of the University of California at Berkeley, I have been witnessing efforts by four leading U.S. employers to implement new management strategies that make better use of nonsalaried workers' talents. To protect confidentiality, I will not refer to the companies by name.

This research has been supported by the National Center for Research in Vocational Education, authorized by the Carl D. Perkins Act. At one company, a nonmanagement employee, who was involved in collecting ideas for improving health and safety in the plant, remarked, "When you steal an idea from one person they call it plagiarism, but when you steal ideas from lots of people, they call it research." Like him, I willingly acknowledge that the ideas I am presenting to you today come directly from the people working in these four firms.

To be concrete, here are two typical examples of suggestions contributed by nonsala ried workers. In one of the manufacturing companies, a conveyor chain broke down four times during a 9-month period, resulting in costly downtime and destruction of materials. Rather than buy a new chain, the suggestion was to purchase additional trolley wheels and standardize the distance between the wheels, which previously had been inconsistent, resulting in undue stress on the chain. The resulting net saving, after deducting the

cost of implementing the suggestion, was approximately $100,000 per year.

Another suggestion was a better method for removing sludge deposits from overspray basins in a paint shop. Instead of shutting down operations and contracting with outside companies for cleaning out the sludge, nonsalaried employees suggested using a submersible pump attached to a small portable frame that can be manually maneuvered into the sludge basins. This suggestion saved an estimated $17,000 per year.

The firm where these suggestions were made pays employees for making successful suggestions. That is not unusual, but nonsalaried employees' rate of participation in the suggestion program at this company is unusually high: more than 70 percent in 1988, or approximately six suggestions per employee. That is high by U.S. standards, but we should keep in mind that some companies in Japan reportedly get more than 30 suggestions per employee per year.

To increase the number of suggestions for reducing cost and improving quality, the two manufacturing firms in our study both provide formal instruction in problem solving for nonsalaried workers. Classes teach employees to delve into the root causes of problems in the production process, so that problems will not have to be fixed again and again. Workers are also taught to think through the implementation of a new idea, and to get whoever is involved to buy into the solution.

The existence of these classes may be as important as their content, because they give a clear message to employees that production of ideas is part of their job. In the words of one assembler, "This is the kind of involvement they want of people: not just the hands, it's the mind." His tongue-in-cheek description of his initial response on hearing this message was, "Uh oh, this is tough—they are going to ask me to work and think at the same time." [Laughter.]

In addition to teaching formal procedures for problem solving and communicating a new workplace culture, classes in problem solving or quality control also produce useful ideas right in the classroom. Problems from the shop floor are the raw material for students to work on, using concepts presented in class. The result can be called doing by learning: using the class as an opportunity to examine the work process and produce ideas for improving it.

Motivation is a key to continuous improvement. The union chairman at one company has expressed the continuous-improvement ethic in the slogan, "If you don't have a problem, that's a problem." In other words, do not be complacent, be a problem seeker, be obsessive in the search for better quality and efficiency. Instead of seeing problems as trouble, to be denied or blamed on someone else, this ethic views problems as opportunities for improvement.

A high degree of employment security appears to be one of the necessary conditions for maintaining this kind of motivation. Employees would be irrational to seek improvements in efficiency if the effect might be to eliminate their own jobs or those of their friends. Furthermore, employers would be irrational to invest in the continuous training that supports continuous improvement, if they did not expect employees to remain for a long time.

Accordingly, three of the four companies in our study have made explicit commitments to avoid involuntary layoffs, and one has an implicit employment-security policy that dates back to before the Depression of the 1930's.

In one company, which is unionized, the contract requires the company to adopt such measures as cutting managers' pay before laying off members of the bargaining unit. In 1988, demand for this company's product declined significantly, but layoffs were avoided by reassigning employees to planning for future products, working on projects to improve quality and efficiency, and additional training.

In the other three companies, the commitment to employment security has also been tested in recent years, as all three firms have undergone substantial downsizing of their nonsalaried work force. They have tried to use early retirement, voluntary severance packages, and reassignment within the company, but, in spite of these efforts, morale has been hurt. When people expect employment stability, taking it away is demoralizing.

Protecting employment security has been a Federal responsibility since the 1946 Employment Act. This responsibility becomes more important now, as more employers seek to create the conditions necessary for involving nonsalaried employees in continuous improvement. Since it is relatively less costly for an individual employer to maintain employment stability if the economy as a whole is operating near full employment, keeping the overall unemployment rate as low as possible is one way the Federal Government can encourage more firms to adopt employment-security policies.

In addition, a number of States have modified their unemployment insurance laws to permit shared layoffs. For instance, if an employer in California must cut payroll by 20 percent, it is possible, instead of putting 20 percent of employees on full-time layoff, to put everyone on furlough for 1 day a week, so that everyone collects 4 days of regular pay and 1 day of unemployment insurance benefits.

Employers who have used this option have indicated that it enables them to avoid losing valued employees, who might leave the company if they were laid off full time. However, only a small fraction of employers have used this work-sharing option, reportedly because they must pay out more in fringe benefits if they keep everyone on the payroll part time instead of cutting some people from the payroll entirely. Possibly, new legislation might correct this problem.

In conclusion, to help firms that are trying to make better use of the talents of hourly employees, the Federal Government might seek in various ways to facilitate the adoption of employment security policies.

Thank you again for the opportunity to speak to you today. I am also providing a paper I wrote for a conference last month on Technology and the Future of Work organized by Professor Paul Adler at Stanford University. The paper contains additional information relevant to this discussion.

Representative HAMILTON. Thank you, Mr. Stern. The paper will be made part of the record, without objection, at this point.

[The paper submitted for the record by Mr. Stern, entitled "Institutions and Incentives for Developing Work-Related Knowledge and Skill," follows:]

INSTITUTIONS AND INCENTIVES FOR DEVELOPING WORK-RELATED KNOWLEDGE AND SKILL

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David Stern is an economist whose research deals with education and human resources. His writings include two books: Managing Human Resources, The Art of Full Employment (Auburn House, 1982) and Adolescence and Work (Erlbaum, 1989; co-edited with D. Eichorn), in addition to numerous articles. He is associated with the National Center for Research in Vocational Education at U.C. Berkeley. Currently he is engaged in two research projects about how work and learning take place at the same time. One project is a study of companies involved in learning-intensive production. The other is a longitudinal study of how students' paid employment affects their subsequent success in school and work. This paper is based in part on these projects, supported by the National Center for Research in Vocational Education.

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INSTITUTIONS AND INCENTIVES FOR DEVELOPING WORK-RELATED KNOWLEDGE AND SKILL

Competitiveness, Automation, and Learning on the Job

This paper provides background for discussion about how to accelerate production of work-related knowledge and skill in the U.S. An important context for this discussion is the argument that insufficient "human capital" has become a constraint on economic competitiveness. In particular, a **faster rate of continual learning** by employees appears to characterize firms that successfully adapt to changing market forces and new technologies. Furthermore, recent research in cognitive science has given new credence to the idea that work-related knowledge and skill are best learned in the workplace itself. These ideas are briefly discussed in this section. The rest of the paper then analyzes the range of existing U.S. institutions where individuals seek work-related skill and knowledge.

The strategic importance of human capital and ceaseless learning has been highlighted by recent analyses which have described how successful firms in Japan, Germany, and certain other countries use productive strategies that rely on, and continually cultivate, employees' problem-solving abilities (Aoki, 1984, 1988; Mincer and Higuchi, 1988; Soskice, 1989; Streeck, 1989). A defining characteristic of the "flexible systems" proposed by Reich (1983), or the "flexible specialization" described by Piore and Sabel (1984) is their critical dependence on employees' skills in teamwork and problem solving. As Piore and Sabel put it, "a plant community of multiskilled workers seems a precondition for agile maneuvering in a hostile world" (p. 213). Only by cultivating these skills can American employers succeed in entering what Reich calls the new "era of human capital." Jaikumar (1986) observed, "Success comes from achieving continuous process improvement through organizational learning and experimentation." (p. 70)

Similarly, Cohen and Zysman (1987) have argued that a strategy of "organized smarts" is probably the best way to reconcile the goal of a high wage economy with the imperative of international competition. Bailey's (1989a, 1989b, 1989c, n.d.) studies of four industries also found market forces leading to increased dependence on production workers' problem-solving skills.

In highly automated manufacturing plants in the U.S., Hirschhorn (1984) described how work has been organized to promote continual learning and problem-solving by workers. A report by the National Academy of Sciences (1986) similarly points to the importance of teamwork, problem-solving, and the capacity for continued learning on the part of production workers using advanced manufacturing technology in the U.S. In firms employing such technology, information and decision-making are brought closer to the production process itself. Employees, often organized in semi-autonomous teams, have broad responsibility for monitoring production, trouble-shooting, maintenance, and quality control (see also Thompson and Scalpone, 1985). These broader responsibilities have brought changes in the kinds of skills required, as reflected in company-sponsored training. "Training requirements remain skills oriented, but the skills are defined more broadly to include the ability to think about the process, as well as interpersonal and team skills" (National Academy of Sciences, 1986, p. 54). Helfgott (1988) has provided similar descriptions of learning-intensive production in U.S. manufacturing firms that have installed programmable automated equipment.

In Japanese machine-tool firms using flexible manufacturing systems, Jaikumar (1986) found production workers had time purposely set aside for process-improving experiments, observation of machine behavior, and analysis of performance data. In Germany, Schultz-Wild and Kohler (1985) studied automated manufacturing plants and concluded there was a net advantage to organizing work in a way that allowed time for cross-training operators.

Outside of manufacturing, Adler's (1986) study of automated banking found that employees had to develop new skills because the new technology required them to take more responsibility for the quality of information they entered into the new computer system. It also required them to have a more abstract understanding of the process, and to work in a more

interdependent fashion. Like Hirschhorn, Adler sees the requirement for additional learning as dependent on these inherent characteristics of the technology itself, rather than resulting simply from the necessity to change from one technology to another. However, not all researchers have concluded that more advanced technology requires higher levels of skill for employees. There is a tradition of thought in which the opposite hypothesis is considered more likely to be true: i.e., firms use new technology to simplify work in order to reduce wages and make workers more interchangeable. Some case studies have substantiated this view. Spenner (1985), Burke and Rumberger (1987), the National Academy of Sciences (1987), and Attewell (in this volume) review the arguments and evidence in this "de-skilling" controversy, and conclude that there is some truth on both sides. In general, the level of skill and knowledge firms expect employees to possess in order to operate a particular technology depends not only on the technology itself, but also on the kind of relationship that exists between the firm and its employees. Levin (1987) and Zuboff (1988) have explained how the effect of technology on skill demands in any particular workplace depends on managers' recognizing that new technology is likely to be more productive if employees are given responsibility for using it intelligently.

The debate over technology and skill demands includes several points of contention. First, there is an argument about trends over time: some (e.g.. Levin and Rumberger, 1987) do not see much change, but others do (Johnston and Packer, 1987; Bailey, n.d.). Second, there is the argument about how much of whatever skill trend we see is due to automation, as distinct from purely organizational changes in employment practices, or the simple effect of change itself. Third, as noted above, some analysts believe that a skill-intensive mode of production is more competitive, but others believe de-skilling is still profitable, at least sometimes.

Although the introduction of automated technology itself has not always increased the level of skill demanded of production workers, much of the evidence indicates that effective use of new technology to keep improving quality and reducing cycle times does entail continual learning in the production process. Firms that have had greatest success with new technologies have involved

production workers, engineers and managers in a deliberate process of continual discovery and experimentation.

Recent research by cognitive scientists, psychologists and anthropologists on "situated learning" (Resnick, 1987a, 1987b; Brown, Collins, and Duguid, 1989; Raizen, 1989) is relevant here. This research suggests that learning through the work process itself may, in general, be the best way to acquire work-related knowledge and skill. "Learning and cognition," argue Brown et al. (p. 32), "... are fundamentally situated" in the context where learning takes place. What is learned in classrooms is useful in classrooms, and does not readily transfer to actual work situations. A considerable number of empirical studies have now demonstrated the absence of correlation between school-taught knowledge and problem-solving in the context of actual production (for a summary, see Raizen, 1989; for a recent example, see Scribner and Stevens, 1989). Scribner puts the point well:

"Skilled practical thinking incorporates features of the task environment (people, things, information) into the problem solving system. It is as valid to describe the environment as part of the problem-solving system as it is to observe that problem-solving occurs 'in' the environment.... [This view] emphasizes the inextricability of task from environment, and the continual interplay between internal representations and operations and external reality throughout the course of the problem solving activity." (quoted in Raizen, p. 42)

Sticht (1979, 1987) reports evidence of success with a kind of situated instruction called "functional context education". Military trainees were taught reading skills in the context of technical training. Tests of general reading ability showed some improvement as a result of this instruction, but there were bigger gains on reading tests that contained items related to the technical content of the courses. Sticht concludes that "specific literacy skills can be developed and assessed for generalizability in the domain area that corresponds to what was taught" (1987, p. 3.18).

Some researchers are now giving renewed attention to apprenticeship as a model of efficient learning (Lave, 1988; Gott, 1988: Brown, Collins, and Duguid, 1989). At the same time, public policies are being formulated to make greater use of workplaces as a site for students'

learning (Grant Foundation, 1988; U.S. Department of Labor, 1989). In the description of schools, below, special attention will be given to cooperative education, which is a time-tested method of learning from the work situation itself.

Despite the arguments in favor of situated learning, U.S. employers have not yet displayed much eagerness to take over more of the training business themselves. To the contrary, corporate spokesmen concerned about skill development have decried the necessity for employers to conduct education in basic academic subjects and have focused attention on improving schools (e.g., Committee for Economic Development, 1985; Kearns and Doyle, 1989). Given the perceived shortcomings or outright failure of schools, coupled with the theoretical advantage of situated learning, why have employers not tried to move more of the skill development effort into workplaces themselves? Obviously, training costs money, and firms seek to minimize costs. But, if the cognitive psychologists are right, employers are in a better position than schools to use at least some portion of the training dollars cost-effectively. A later section of this paper will consider the economics of work-based learning, and will examine the question whether employers currently underinvest in training of their employees.

The Continuum of Institutions for Developing Work-Related Knowledge and Skill

This paper describes opportunities and motivations to learn in various settings where individuals may seek skills and knowledge for use at work. The settings differ in their proximity to actual production. At one extreme are school courses in academic subjects. At the other extreme is the work setting itself, which becomes a more important site for learning in places where technology or market forces have accelerated change in the work process. Between these two ends of the proximity-to-work continuum are vocational courses in schools, government-sponsored or subsidized training outside of schools, formal instruction provided by employers, and work-school hybrids such as apprenticeship and cooperative education.

To get a more concrete sense of how schools and workplaces participate in skill formation, consider Table 1. Here are manufacturing employees' answers to questions in the 1983 Current

Population Survey about participation in training either to qualify for the present job or to improve skills since taking the present job (U.S. Department of Labor, 1985). A relatively large proportion of engineers and technicians say they went to school to get the skills or training required to obtain their present jobs, but large fractions of these groups also say they needed formal or informal on-the-job training (OJT). Formal OJT was relatively important for tool and die makers, machinists, repairers, and welders, many of whom have participated in formal apprenticeships. Operators and assemblers relied on informal OJT, either in the current firm or a previous one, to learn skills needed in the current job. After obtaining their present jobs, relatively large proportions of engineers and technicians continued formal schooling or OJT. In contrast, little or no further training of any formal kind is reported by machinists, welders, operators, or assemblers. This is a common pattern (Lillard and Tan, 1986): employees who have completed more years of formal schooling before starting their careers also spend more time in continued formal training throughout their careers.

Figure 1 (from Mangum, 1989) maps the array of training sites by participants' age and perceived "ability". Adults spend more of their time in work settings, as the diagram indicates, though teenagers' employment rates have been steadily climbing since the early 1960s. The "ability" ordering in Figure 1 could also be read as a socieoeconomic scale. The mainstream consists of individuals who become employed, for example, as secretaries, technicians, supervisors, and skilled craft workers or machine operators. This group straddles the great legal and organizational divide between salaried and hourly employees, "exempt" versus "non-exempt" from provisions of the federal Fair Labor Standards Act.

Figure 1 makes it appear that the mainstream all flows through the "general" track in high school, but in reality high school track designations are very imprecise, with most students taking a mixture of academic and vocational courses (Wirt et. al., 1989), and students who take more vocational courses sometimes achieving greater success in the labor market than those in the general track (Bishop, 1989b). Schools do sort students by various measures of school-related "ability", but some of the students who score highest on school achievement tests do not even

finish high school, let alone go to college (Stern, Catterall, Alhadeff, and Ash, 1986). It is important not to attach too much validity to high school track designations, not only because they are imprecise, but also because they carry a historical expectation that college-bound students should pursue rigorous academic courses not connected with their current experience, while non-college-bound students are expected to learn more practical things but less "theory" (see, e.g., Oakes, 1985). This dichotomy makes it difficult to organize programs in high school that would give more students practice in learning-intensive production.

Schools

Americans look to schools as the main set of institutions for developing work-related knowledge and skill, and there is widespread agreement that preparing students for work is one of the schools' key missions. Several kinds of evidence indicate that schooling does contribute to economic productivity (see below).

At the same time, there seems to be something seriously amiss in American schools. American students perform poorly on achievement tests compared to students in other countries, even allowing for differences in the percentage of students in each country who take the tests (Bishop, 1989a).

Lack of motivation, especially in high schools, appears to be one of the main factors contributing to American students' poor performance. Many American high school students exhibit flagrant apathy toward school work (described below). Lack of extrinsic incentives for academic achievement is part of the problem. Also important is the fact that "decontextualized" classroom environments often fail to engage students' intrinsic desire to learn. Vocational education, with its "hands-on" approach to learning, is a traditional method for motivating some students who are not interested in conventional academic classes. However, the effect of vocational education on students' success in the labor market has sometimes proved difficult to demonstrate (Psacharopoulos, 1987; but cf. Bishop, 1989b). Separating academic from vocational classes also leads to invidious and unproductive forms of tracking, as mentioned above. One of

the most promising new forms of high school education (described below) attempts to integrate the academic and vocational sides of the curriculum, in addition to providing school-supervised jobs that let students apply and extend what they are learning in classrooms. There is evidence that this kind of program can improve the motivation and performance of high school students.

Schooling and economic productivity. On average, individuals who have spent more years in school earn higher incomes. This is true around the world, and the difference in earnings is generally high enough to pay at least a 10 percent real rate of return (often more) on the amount of time and money invested in schooling (Psacharopoulos, 1985). In the U.S., recent trends show a growing monetary payoff to schooling at all levels. The change has been most pronounced at younger ages. For instance, in the 25-34 age bracket, Levy (1988, p. 125) reports that the annual earnings gap between men with four years of college and men with four years of high school grew from $3,925 in 1973 to $9,405 in 1986 (in constant 1987 dollars, including only men who were employed at least one hour during the year). Among women the gap grew from $4,962 to $7,742. The earnings difference also has widened between high school graduates and dropouts. Over the period from 1961 to 1981, among full-time working men aged 25 to 64, the difference grew from $2,387 to $4,489 (in constant 1981 dollars; Grant and Snyder, 1983, p. 191). Evidently, despite a temporary decline during the 1970s (Freeman, 1976), the economic payoff to staying in school remains large. Furthermore, if these earnings differences reflect differences in productivity due to schooling, then schooling makes a substantial contribution to national economic growth (Denison, 1962; Jorgenson, 1984).

However, skeptical researchers have questioned whether earnings differences really show any contribution of schooling to production (Berg, 1970; Arrow, 1973; Spence, 1973). Schools, they have argued, may simply be a mechanism for selecting more able individuals and certifying their ability to employers. More able individuals can get through school more easily, but the process does not make them any more productive. This argument implies that the additional earnings of people who have been to school longer exceed the actual contribution of schooling to total economic output.

More recent research has indicated that, in fact, the additional earnings of more highly educated people are an accurate measure of schooling's contribution to total output, without discounting for pre-existing ability. In theory, as Arrow (1973) recognized, the conclusion that schooling is only an unproductive "filter" is deduced most directly from a model where ability is one-dimensional. If, however, school-related abilities are useful in certain jobs but not in others, then schools serving as screening mechanisms may make a productive contribution -- over and above whatever they may contribute by actually teaching people something. Willis and Rosen (1979) explicitly developed this argument in a model of schooling and self-selection. They found evidence that individuals do, in fact, sort themselves into educational categories where their particular abilities will have the greatest comparative advantage. Garen (1984) obtained similar results.

More direct evidence of education's contribution to production has come from studies of independent farmers, both in the U.S. and in other countries. Farmers with more schooling are more efficient (Jamison and Lau, 1982; Wozniak, 1987). While small farms seem far removed from automated factories, they are the best place to look for the direct effect of schooling on productivity, because there would be no reason for a person who intended to become a self-employed farmer to stay in school unless it was economically useful. Furthermore, the kinds of improvised problem-solving and practical innovation that help make small farmers successful bear some similarity to the trouble-shooting and process improvement required of hourly employees in "factories of the future".

Outside the agricultural sector, more highly educated labor is complementary with plant and equipment (Hamermesh and Grant, 1979), and in particular with new plant and equipment (Bartel and Lichtenberg, 1987). Mincer (1989) and Tan (1988) also have found higher average levels of education among employees in industries where productivity growth is high. These findings, and those for farmers, are consistent with the view (Schultz, 1975; Welch, 1970) that schooling enhances individuals' ability to improvise solutions for problems arising from use of new

equipment or materials. Schooling pays off for those who are paid to think about how best to use new technology.

Dissatisfaction with schooling. With all this evidence of schools' contribution to the economy, one might expect that schools would be held in high esteem by employers and the public at large. However, this is not the case. A particularly heavy barrage of blame rained on American elementary and secondary schools in the 1980s, beginning with the celebrated Nation at Risk report (National Commission on Excellence in Education, 1983). Much of the criticism has focused on the schools' alleged failure to prepare young people for the workplace of today and tomorrow.

One might dismiss school-bashing, like football, as a sport Americans particularly enjoy, observing that both drew large and enthusiastic audiences in the 1980s -- except that there really are disturbing signs of poor performance by American students. Scholastic Aptitude Test (SAT) scores declined rather sharply and continuously from 1963 through 1979; the decline seems to have stopped in the 1980s, but the 16-year decline has not been reversed (Hanushek, 1986). According to Murnane (1988, p. 215), "a large part of the decline [in SAT scores] is due to an increase in the number of students with relatively low ability who are taking the test." However, scores on tests other than the SAT have also declined during the same period, and these downward trends are still "not well understood". Moreover, compared to students in other countries, American students in the 1980s have scored low on academic achievement tests (Lapointe, Mead, & Phillips, 1989), and the poor showing is not attributable to any disparity in the proportion of the relevant age groups who have been tested in the different countries (Bishop, 1989a).

The problem of students' motivation. To some extent poor performance comes from lack of trying, and this seems to be part of the problem with American students. Student apathy is chronic and widespread in U.S. schools, especially high schools. In a 1977 survey, high school principals in the United States cited "student apathy" as a serious problem more often than they cited lack of resources, bureaucratic regulation, or any other issue (Abramowitz and Tenenbaum, 1978, p. 86). Likewise, high school teachers report "lack of student interest" as the biggest

problem for them (Goodlad, 1984, p. 72). The Goodlad study also asked high school students what was the "one best thing" about their school. The top choice was "my friends," by 34 percent of the students. Only seven percent chose the "classes I'm taking," and three percent said "teachers" -- while eight percent chose "nothing"! (p. 77). A 1984 survey by the National Association of Secondary School Principals found the same thing: friends and sports ranked much higher for students than did teachers, classes, or learning. The fact that high school students in the U.S. typically report spending as much time watching television during one weekday as they spend on homework in a whole week (Jones and others, 1983) likewise reflects little interest in school work.

Recently Bishop (1988, 1989a) and Rosenbaum (1988, 1989) have suggested structural reasons for this evident lack of motivation among high school students. Bishop identifies four separate possible causes. One is that, for students who go to work after high school, the labor market rewards completion of high school but **not** higher grades or test scores. Bishop and Rosenbaum both review the empirical evidence showing that high school grades and test scores have little if any statistical correlation with employment or earnings after high school. Rosenbaum contrasts this lack of linkage here with Japan, where schools choose students with better grades to nominate for job openings assigned to the school by certain employers. Therefore, while American high school students who are not competing for admission to selective colleges do have a clear economic incentive to stay in high school until they are given a diploma, they have no practical reason to try to learn much while they are there.

Bishop also points out that rewarding grades or class rank creates zero-sum competition among peers, forcing many U.S. students into a choice between academic success and a happy social life in high school. Rosenbaum even cites a report that one employer actually refused to consider hiring students with high grades, because of a concern that such students would be socially inept!

Third, Bishop notes the almost complete absence of special awards or recognition by schools for students who are not at the very top of their class. Many students in the unrecognized

majority therefore reject official school values. Rosenbaum reminds us that this dilemma was described by Stinchcombe 25 years ago. These features of American schools are not new.

Fourth and last, Bishop points out that, for students who seek admission to selective colleges and universities, aptitude tests are important but achievement tests are not. Compared to many other countries where college admission depends on a battery of achievement tests, in the U.S. even college-bound high school students have less incentive to learn much about many of the subjects taught. This further reinforces the culture of student apathy, the teachers' main complaint.

Bishop and Rosenbaum make a number of practical suggestions to increase incentives for high school students. One idea is to create better documentation of what an individual student has done while in high school, in a form that employers can quickly obtain. In fact, the Educational Testing Service (ETS) is currently developing a combined transcript/curriculum vitae that could be periodically updated and sent by schools to employers electronically or on paper (Rothman, 1989). The ETS project is being actively supported by the National Alliance for Business and the American Business Conference.

This approach to motivating students emphasizes extrinsic incentives: Get students to work harder by making good grades and achievement tests a requirement for getting good jobs or going to college. A different approach emphasizes intrinsic motivation: Get students to work harder by making them want to learn. The second approach is more subtle, and probably even more difficult, than the first. How can a teacher who interacts with 150 students a day, and spends less than an hour with each one, find a way to make students hungry for knowledge of the subject? It can be done, as charismatic teachers occasionally demonstrate, but the structure and culture of the school militate against it.

Historically, the American high school took its present form during the period from roughly 1890 to 1935. High schools were transformed from elite academies to institutions of mass education. Compulsory schooling and child labor laws were enforced, and minimum wage laws enacted -- all in response to the transition from a predominantly rural and agricultural to a prodominantly rural and industrial economy. As the hierarchy of jobs in the industrial economy

took shape, schools were seen as places to keep children safe from the dangers of low-level work in factories and sweatshops. Keeping children in school also kept them from competing for jobs against adult wage-earners, and nourished hope that able children of immigrant or working-class parents could nevertheless rise into the ranks of managers and professionals.

In spite of John Dewey and others, the high school remained organized on the classical, subject-centered model that prevailed when it was still an elite institution. The curriculum is still organized that way, in large part because most colleges and universities are -- and for reasons that have more to do with the perpetuation of academic specialties than with the world outside schools. So today, as Sizer (1984, p. 83) put it, "'Taking subjects' in a systematized, conveyor-belt way is what one does in high school.... The adolescents are supervised, safely and constructively most of the time, during the morning and afternoon hours, and they are off the labor market. That is what high school is all about."

Actually, increasing numbers of high school students have found their way back into the labor market for 20 or more hours a week during the school year. As discussed below, this provides an opportunity to "recontextualize" classroom learning for some students. But most students' coursework is unrelated to their current jobs. Classrooms, cut off from the world outside, remain boring places for many students much of the time.

This state of affairs never made much sense, but it was tolerated in previous decades when young people were a glut on the labor market. Now, however, the baby boom has entered middle age, and the small size of subsequent cohorts has created a new scarcity of young workers. In the U.S. labor market of the 1980s and 1990s, "warehousing" young people in schools is less tolerable than before. This may account for the current interest in altering incentive structures that have been allowed to undermine students' motivation for so long.

Vocational education, old and new. But what can be done to cultivate students' interest in school? One early answer was vocational education, which became a common feature in American comprehensive high schools during the expansion of secondary schooling in the early decades of this century. Vocational education was seen, and continues to be seen, as a way to keep non-

college-bound students interested in finishing high school (Bell, 1975; Weber, 1987; Kennedy, 1988). The practical content and relatively informal conduct of vocational shops and labs are seen as appealing to students who chafe in conventional academic classes (e.g., Goodlad, 1984, pp. 146, 230). The fact that so many students elect to take vocational courses in high school is prima facie evidence that some students would have less reason to come to school if those courses were not available. There is also some statistical evidence that taking vocational classes has a significant, though small, effect on reducing the probability that a student will drop out of school (Mertens, Seitz, & Cox, 1982); however, that statistical link is not always evident (Catterall and Stern, 1986).

While vocational education may help motivate some otherwise unmotivated students, it also has contributed to invidious tracking (Oakes, 1985). Federal laws have defined vocational education as preparation for occupations not ordinarily requiring a bachelor's degree. Although federal money pays only about 10 percent of the cost of vocational education, federal laws and regulations have had a major influence on shaping vocational programs. Most high school vocational classes are therefore oriented toward non-professional, non-managerial jobs. Since these jobs, on average, offer lower income and, in the eyes of some people, lower prestige than professional or managerial careers, vocational education can become stigmatized.

In response to this problem and to the academic "excellence" reform movement of the 1980s, instructional objectives for vocational courses have been expanded to include more proficiency in academic subjects. For example, the California State Department of Education has developed model curriculum standards and program frameworks for secondary vocational programs. Under the heading of General Employability Skills are standards and proficiencies in listening and speaking, reading, writing, grammar, capitalization and punctuation, spelling and vocabulary, whole number math, decimals and fractions, measurements and tables, and computer awareness, among others. In addition, standards and proficiencies that are specific to particular industries contain a certain amount of general, theoretical knowledge. For example, California high school students preparing for careers in financial services are expected to be able to

"demonstrate an understanding of the nature of credit and its influence on the economy, business, and the individual."

Representatives of large employers have asserted that tomorrow's workers will need not only a solid foundation of basic academic skills and knowledge, but also general cognitive skills in problem-solving and "learning to learn" (National Academy of Sciences, 1984; Committee for Economic Development, 1985). These objectives have also been incorporated into new vocational curricula. For instance, the Occupational Education curriculum developed in New York State includes an Introduction to Technology for grades 7 and 8. This course features segments on using technology and technological systems to solve problems. Students are invited to learn about problem-solving by taking on real projects such as improving air quality in the classroom, using a computer to transmit a text from one school to another, or designing a community service activity that addresses a local technological problem (University of the State of New York, 1987).

Vocational "academies", which organize the core academic curriculum of the high school around a vocational theme, are an important example of programs that combine academic subjects and general cognitive development with vocational education. For instance, some academies focus on computer-related occupations, others on electronics or health care. Each academy is organized as a school-within-a-school, where students take most of their classes together, a team of teachers collaborate on curriculum, and local employers are directly involved in several important ways (Dayton et al., 1987). One set of these are in Philadelphia (Neubauer, 1986). Another set are in California, where two academies on the peninsula south of San Francisco started in 1981 and achieved such positive results that the California legislature financed the replication of approximately 25 more. Results of the first 10 replications, which began in 1985, have been generally positive after three years (Stern et al., 1988, 1990 forthcoming).

The Philadelphia and California vocational academies have selected students who had poor attendance, low grades, and few course credits at the end of freshman year, and who therefore seemed unlikely to finish high school. The evaluations show academy students have progressed more successfully through high school than other students in the same schools who had similarly

poor records at the end of freshman year. Academies solve the motivation problem for some students by integrating a group of students and teachers, a school curriculum, and workplace applications into a more coherent whole. Academies also solve the tracking problem by including sufficiently rigorous academic content to enable students to go right to college if they wish.

Working students and cooperative education. Since the advent of mass secondary education, discussions of school and work have assumed that the former precedes the latter. That was true for most students during the middle decades of the current century. However, it is not true now.

Working for pay while in high school or college has increasingly become the norm in recent years. Greenberger and Steinberg (1986) have pieced together various government figures from 1947 to 1980 for 16- and 17- year-olds who were attending school. Among boys, the labor force participation rate rose from 27 to 44 percent, and for girls it rose from 17 to 41 percent (p. 15). Labor force participation rates measure the fractions of a population who are employed or looking for work at a given point in time. Rates measuring cumulative work experience are higher. For instance, data from the 1980 High School and Beyond survey revealed that 80 to 90 percent of high school students had some kind of paid work experience by the time they graduated (Lewin-Epstein, 1981).

The employment rate of college students also has been rising. From 1959 to 1986, it rose from 35 to 56 percent among females, and from 50 to 57 percent among males (Stern and Nakata, 1990 forthcoming). For males and females combined, the percentage employed rose from 45 to 56. These numbers include part-time and full-time students between the ages of 16 and 34, at both two-year and four-year colleges. Most of the increase occurred during the 1970s, despite the relative surplus of young workers in that period due to the 1945-1960 baby boom. The steadily rising trend also reached through the 1960s and 1980s. Economic explanations, such as the rising cost of college, do not seem to account for the trend. A desire for greater financial independence, especially among women, may well be the motivation.

The fact that most students now hold paid jobs during the school year can exacerbate problems of motivation and performance. Work time may crowd out homework time. Students who have spent the previous evening at work are sometimes tired in class the next day. Concerns about work may distract attention from school demands. Students who go to work every day do not have to rely on teachers to tell them what the outside world is like, and may therefore be more resistant to teachers' authority. There is evidence that students who work during high school get less post-secondary schooling (Mortimer and Finch, 1986), though they earn more money after they leave high school (this evidence is reviewed in Stern, McMillion, Hopkins, and Stone, 1990). This and other evidence caused Greenberger and Steinberg (1986) to warn that paid employment for students may make them "economically rich, but ... psychologically poor" (p. 238).

On the other hand, the fact that most students are working creates an important opportunity to "situate" more learning in the practical context of students' jobs. For instance, the vocational academies described above arrange summer jobs for students that are related to the course content they have been studying. This kind of connection reinforces students' motivation at school, and enriches their experience on the job. If such connections occurred more often, the fact of students' working could be converted from a potential liability to an educational asset.

A traditional mechanism for connecting school with paid employment is cooperative education, which was imported into the U.S. during the first decade of this century. It started in the four-year colleges, and still flourishes there, where it usually involves students spending a year or semester in full-time work, in between periods of full-time study (Cooperative Education Research Center, 1987).

In contrast to this "alternating" form of cooperative education which prevails in four-year colleges, a "parallel" form predominates in high schools and two-year colleges. Students in the parallel mode spend part of the day or week in classes and the remainder of the day or week in paid employment. In high schools and two-year colleges, the cooperative method is most often used as part of vocational education, and is called cooperative vocational education. Students are given course credit for writing a paper, fulfilling their training plan, or taking a class in connection with

their job. Use of the cooperative method in vocational education has been sanctioned by federal policy since regulations were written implementing the 1917 Smith-Hughes Act, which first provided federal support for vocational education.

The defining characteristic of cooperative vocational education is the close connection between students' activities on the job and in the classroom. Normally the classroom instructor arranges job placements and writes a training plan detailing what each student is expected to learn on the job. The job supervisor evaluates a student's performance in terms of these training objectives, and this evaluation becomes part of the student's grade in the "co-op" class. The classroom instructor usually has some released time to visit students' job sites and monitor the situation. "Cooperation" thus entails job supervisors taking on some of the responsibility of instructors, and vice versa.

Most cooperative education arrangements are worked out locally, between individual employers and school staff, subject to various state laws and local customs. One example of a cooperative education program that has been organized on a national scale is General Motors' Automotive Service Educational Program (ASEP), which prepares service technicians to work in GM dealerships around the country (Casner-Lotto, 1988). Local community colleges and GM dealers cooperate in supervising a planned two-year sequence of full-time work and full-time study periods lasting one or two months at a time. Before they begin the program, ASEP students sign employment agreements with the dealers. This in itself is not unusual: students in cooperative education programs other than ASEP may also be required to find their jobs at the outset. What is most unusual about ASEP is how a whole sequence of community college courses is integrated with related work experience.

Evaluations of cooperative vocational education have generally found that "co-op" students express more positive attitudes toward school and work than other students. After leaving school, co-op students have not generally been found to prosper any better in the labor market. (A review of the research is in Stern, McMillion, Hopkins, and Stone, 1990.) Previous research has had

serious shortcomings, including inadequate control for the fact that many non-co-op students also have paid jobs, and some of these non-co-op jobs also have educational and economic value.

Approximately 700,000 students were enrolled in cooperative vocational education programs in 1981-82 (Craft, 1984). The numbers are not exact, and I do not have more recent ones. Ironically, the educational reform movement of the 1980s probably has cut into cooperative vocational education enrollments. A major feature of these reforms in almost every state has been to increase the number of academic courses required for high school graduation. A similar movement has occurred in two-year colleges. As a result, students have less time in their schedules to take vocational classes, especially those which occupy two-period blocks, as many co-op classes do. Cutting cooperative education seems perverse at a time when cognitive psychologists are calling for more situated learning, and cooperative education is specifically being advocated as a valuable program for the "forgotten half" of the high school students who do not go right to college (Grant Foundation, 1988; Committee for Economic Development, 1985).

Apprenticeship. In the U.S., approximately 300,000 individuals are enrolled in formal apprenticeships (U.S. Department of Labor, 1989). Most apprenticeships are governed by joint agreements between labor unions and employers' associations, and typically require three or four years to earn journeyman's papers. There is evidence that young men enrolling in apprenticeships after graduating from high school obtain higher earnings for at least ten years than other young men who do not go to college or enter apprenticeships. Currently, the Bureau of Apprenticeship and Training in the U.S. Department of Labor is exploring the possibility of creating opportunities for "structured workplace training" where formal apprenticeships do not exist.

Worldwide, the most extensive and apparently successful system of formal apprenticeship is in the Federal Republic of Germany (Hamilton, 1990). Currently 1.7 million young people are apprenticing with approximately half a million employers to earn formal certification in 380 different occupations (Schmidt, 1989). About 70 percent of the 16 to 19 age group are enrolled in apprenticeships (Raddatz, 1989). (In comparison, formal apprenticeships in the U.S., which usually start at age 18, enroll only about two percent of the 18 to 21 age group.) German

apprenticeship standards are developed and examinations given by the Federal Institute for Vocational Training, in concert with representatives of employers and labor unions. Unlike employers in the U.S., German employers have opposed locating more training in the schools, and prefer to keep it at the workplace.

Government-sponsored training not contracted directly with schools. Finally, the U.S. government sponsors a number of programs intended to prepare individuals for employment. The JobTraining Partnership Act (JTPA) is currently the largest; it replaced the Comprehensive Employment and Training Act (CETA) in 1982. A large fraction of CETA funds had been supporting public employment; JTPA eliminated almost all of that and concentrates almost entirely on training. This and other federal training programs are targeted for needy individuals: low income, unemployed, on welfare. Although not administered through the school system, training supported by federal programs in the end is often provided by schools, or by community-based educational organizations. For recent descriptions of federal training programs, see Barnow and Aron (1989) or Simms (1989). Many states also sponsor such progams (Creticos and Sheets, 1989).

Arrangements for Training of, and Learning by, Employees

Three contrasts. In addition to education and training in schools, most employed people also have opportunities for learning in connection with their work. Opportunities for learning by employees are **formal and informal**. Formal training occurs in classrooms or other settings away from employees' actual work locations; these settings may be in schools or on the premises of the employer. Opportunities for informal learning occur at the actual work location, while the learner is working. Costs and benefits of formal and informal learning are different. This is a well-known distinction, useful to note at the outset.

A second contrast is between **learning what other people already know versus solving new problems**. As Carnevale and Schulz (1988, p. 18) put it, "The ability to seize and sustain a competitive edge requires two kinds of technical learning systems: one to teach employees

and another to learn from them." Learning as problem-solving is required in connection with new products, new technologies, or new organizational arrangements. This kind of learning is unique to the workplace itself; it cannot happen in classrooms that are separated from the work process (though some of the work process may take place in classrooms, as described below). While simulations outside the work process may help develop the capacity to solve problems, actually solving a problem that has immediate, practical consequences is, by definition, part of the work process itself.

Where versus how much. Where learning or training should be located -- in schools or in the work process -- is one question. A separate question is whether more time and money should be invested in work-related education or training. For the three partners in these investments -- taxpayers, employers, and trainees (including unions representing them) -- a predictable answer is that the other partners should invest more. But should the total investment be augmented, or is the current level about right? One approach to answering this question is to estimate the rate of return on investment in training. If the current rate of return is very high, the implication is that the level of investment should increase. Some recently estimated rates of return are reported below. Another approach is to consider how learning can be achieved at less cost. Since more learning -- especially the practical problem-solving kind -- is always useful, reducing the cost would make it worthwhile to invest more. Many employers have made deliberate efforts to enhance opportunities and motivation for learning in the work process, in order to speed the pace of productive problem-solving. As described below, some of these are manufacturing firms which have undertaken these efforts as part of the transition to more highly automated production. Building a "factory of the future" is widely seen to include redesign of jobs and relationships among jobs, adoption of new compensation systems, and a greater commitment to employment security for hourly employees. These can be seen as investments whose payoff is learning -- at a faster rate, therefore at lower cost. Whether employers in general could profitably increase their investment in learning-intensive production is an open question.

How much company-sponsored training currently occurs? The most straightforward way to estimate how much firms currently invest in training is to ask them. Table 2 lists amounts reportedly spent by various firms on formal training. The three last entries show the ranges reported in three different surveys. Unfortunately, this listing is less informative than it may appear. The numbers on different lines are not all measuring the same things. Some include only the direct cost to the companies of formal training they do in-house. Others also include training contracted to outside vendors. Some count, in addition, tuition reimbursement for work-related courses employees take on their own. Furthermore, the companies and samples listed in Table 2 are not representative of all U.S. employers. With such mushy numbers, we can make only an order-of-magnitude estimate that the average employee works in a firm that spends between $100 and $1,000 a year on formal training for each employee, and probably less than $500. With total employment at about 110 million people in the U.S., that implies a total expenditure somewhere between, very roughly, $10 billion and $100 billion a year on formal training by employers, and probably less than $50 billion. This is consistent with the often-repeated figure of $30 to $40 billion put forward by Craig and Evers in 1983, which they derived by supposing that the average employer spent about half of what AT&T did per employee! By way of comparison, U.S. institutions of higher education spent roughly $60 billion a year on instruction in the mid-1980s (Stern and Williams, 1986, p.110).

These estimates do **not** include the cost of wages, salaries, and benefits paid to employees for time spent in formal training during regular working hours. They also do not include time or money spent on **informal** training. Surveys that have inquired into the prevalence and duration of formal and informal training for employees are summarized in Table 3, from Brown (1989). Like the surveys on companies' direct expenditure, surveys of employees' time involvement also have used various definitions of training. However, it appears that roughly 20 to 30 percent of employees report having been involved in some kind of formal or informal training since they took their present job. Other studies, summarized by Mincer (1989), report that employees currently involved in training spend approximately 20 to 25 percent of their time on it. In any particular

period, therefore, employees in the aggregate are spending something like four to seven percent of their paid time in training. Given the total amount of wages and salaries paid in 1985, Mincer calculated that the value of employees' time invested in formal and informal training in 1985 was roughly $90 or $100 billion, if employees spent between five and six percent of their time in training.

In Mincer's analysis, the cost of employees' time in training is actually not paid by employers, even if employees are collecting wages, salaries, and benefits during the time they are in training. Instead, Mincer assumes that employees who get training on company time must pay for most or all of it by accepting a lower rate of pay per hour or per month. The empirical validity of this assumption is questionable, as discussed below. At this point, the important thing is that employees' time spent in training is estimated to be worth on the order of $100 billion a year.

Mincer also estimates the total investment by employers. His estimate is based on findings that training seems to raise individuals' productivity about twice as much as it increases their earnings. This implies that the difference between productivity and employees' compensation, which is employers' payoff from their investment in training, is approximately equal to employees' payoff on their investment. Since the payoffs are equal, the amounts invested must be equal, assuming that employers and employees both get the same rate of return on investment (a strong assumption). Therefore, Mincer's estimate of employers' investment in training is equal to the value of time invested by employees, or roughly $100 billion a year.

An estimate of $100 billion a year for employers' investment in formal and informal training combined is roughly consistent with the estimated expenditure of $50 billion on formal training alone, based on Table 2. As shown in Tables 1 and 3, employees report approximately equal amounts of participation in formal and informal training. It is plausible, therefore, that if the costs of formal training (training department budgets) run to $40 or $50 billion a year, then the cost of informal training (supervisors' and co-workers' time spent teaching trainees) would be another $40 or $50 billion.

In sum, given the limited data available, a reasonable guess is that employee training currently costs nearly $200 billion a year: close to $50 billion for direct cost of delivering formal training, another $50 billion to deliver informal training, and $100 billion for trainees' time.

Is there too much or too little investment in company-sponsored training? With such vast amounts of money spent for ongoing education and training of employees, it is understandable that employers say they wish schools could have done more of the job. Employees, for their part, see going back to school or into formal training as time-consuming, stressful, and sometimes threatening to self-esteem. Neither employers nor employees can be expected to relish paying these costs.

On the other hand, the benefits may more than justify the cost. Increases in productivity and earnings may be so large in proportion to the amount of time and money invested that the rate of return exceeds what is available from other investments. If so, the implication would be that more resources should somehow be invested in employee development.

The most authoritative estimates of rate of return to employee training and development have been calculated by Mincer (1989). Mincer relies on several recent surveys, including some of those cited in Table 3, to estimate the proportion of paid work time spent in training by employees who reported that they are or were receiving some kind of training. Mincer denotes this proportion as **k**. He uses this as an estimate of the fraction of their pay that trainees are investing in their training: "if a worker who engages in training during the year spends a fraction **k** of his work time on training, **k** is the fraction of his annual earnings invested in training." (p. 9) Multiplying trainees' annual earnings by **k** then gives the dollar value of employees' investment. The rate of return is then computed as the fraction of this investment that accrues back to the trained employees in subsequent years in the form of higher earnings (also estimated from the survey data). After correcting for depreciation, Mincer finds the various surveys imply rates of return ranging from 4.0 percent to 25.6 percent. These are rates of return for the trainees themselves. As mentioned earlier, Mincer assumes that employers get the same rate of return on their part of the investment.

Given this wide range of estimates, Mincer draws no firm conclusion about whether employees are investing too much or too little. "While the lower figures [for the estimated rate of return] do not suggest underinvestment, the higher figures do. The safe and not surprising conclusion is that overinvestment appears to be unlikely." (p. 11)

A key assumption in Mincer's analysis is that **k**, the fraction of time trainees report spending in training, is equal to the fraction of their income they invest. At first glance, this may seem odd: if employers are paying for people to spend some of their time in training, why is that not counted as an investment by employer s? The reason is that Mincer and other economists have traditionally assumed that employees who get training on the job must accept a lower rate of pay, if that training would increase their potential earnings outside the firm that trains them. (Since Becker, (1975, first edition 1964), such training has been called general, as opposed to firm-specific.) If jobs that included training did not offer a lower rate of pay than similar jobs where training was not included, an excess of qualified individuals would apply for the jobs that provided training, and market forces would bring pay rates down (Mincer, 1962; Becker, 1964; Rosen, 1972; Mincer, 1974).

However, the assumption that employees must finance their own general training can be questioned on various grounds. Feuer, Glick, and Desai (1987) argue that, to protect their employees' investment in firm-specific training, companies may also share some of the cost (and benefit) of general training. Barron, Black, and Loewenstein (1989) propose a different theoretical rationale: that on-the-job training is complementary with ability, so that more able employees, who must receive higher wages, also receive more training, both specific and general. Feuer et al. and Barron et al. both tested their predictions with data sets that include direct measures of how much training individuals received. Both tests found that employees who were receiving more training (some of which is assumed to be general) did not have to accept lower wages. Bishop (1989a), based on findings from a different pair of data sets, also concludes that employees do not appear to sacrifice earnings while they receive general training at work.

If employees sacrifice little or no pay in order to get general training, then the investment costs little or nothing to them. Since on-the-job training does yield subsequent higher earnings for employees (Lillard and Tan, 1986; Tan, 1988; Mincer, 1989; Barron, Black, and Loewenstein, 1989; Bishop, 1989a; Mangum, 1989), their rate of return would be very large -- or infinite, if their cost is literally zero. Employees' appetite for training would then be limited only by their distaste for the effort required. At the same time, paid time spent in training *would* be a cost for employers, and Mincer's assumption that employers get the same rate of return to training as employees could not be true.

A logical interpretation of existing evidence would be that employees' paid time spent in training really is a cost to employers, who also pay the direct costs of formal and informal training. In the aggregate, this adds up to the $200 billion figure derived above. But only about half of the additional output that results from this training is kept by employers; the other half is paid to employees. Since Mincer estimated that employees' rate of return would be somewhere between 4.0 and 25.6 percent if they had to absorb the cost of their own time in training ($100 billion), the rate of return to employers would be lower than that, if employers are paying for employees' time plus direct costs ($200 billion total). Employees, then, would get a very high (or infinite) rate of return on training, but the rate of return for employers would only be on the order of 2 to 12.8 percent (half of the 4 to 25.6 percent Mincer estimated for both employers and employees). This implies that employees would benefit greatly from expansion of company-sponsored training, but such expansion would not be very profitable for employers, if more training entails additional direct cost as well as additional employees' time diverted from production.

Learning-Intensive Production

Diverting employees' time from production and investing it in training is one of the ways firms arrange for employees to learn, but it is not the only way. Some firms also deliberately incorporate learning into the work process itself. When production becomes more learning-intensive, acquisition of new knowledge and skill is built into the job, and improvements in quality

and productivity depend on speed of learning. As will now be described, firms use a variety of techniques to achieve "learning-intensive production". To the extent that learning becomes an integral part of the production process, investment in training cannot be estimated in the conventional way, because it is not possible to distinguish between time spent learning and time spent working. As one manager put it, under these circumstances "training is like breathing". The important economic question about firms' investment in training is not just whether they sacrifice optimal amounts of employees' paid time for knowledge or skill development. The question is also whether enough employers have adopted a method of production that produces learning through the arrangement of work itself.

Efforts to achieve a more learning-intensive method of production entail several distinct but related kinds of change. Most directly, formal instruction can incorporate the principle of "doing by learning", and methods can be found to use slack time for learning or problem-solving. To support employees' motivation to learn, relations between employees and management must be more collaborative than conflictual, the physical size of work units may have to be reduced, new compensation systems may have to be instituted, and employees must have some security of employment. These conditions for learning-intensive production will now be described in turn.

Doing by learning. Formal training can contribute to the integration of learning and production, by bringing the work process into the classroom itself. This approach uses the class as an opportunity to produce specific ideas for improving efficiency or quality in the production process. Such a class may begin by eliciting statements from participants about problems they see in their own work situations. After the instructor presents the new conceptual material, participants divide into small groups to practice applying the new information to real problems. An immediate outcome of the class, therefore, is a set of written suggestions that can be developed further outside of class, or in some cases implemented directly. Since the classes yield practical suggestions that have economic value, this may be called "doing by learning".

For example, at one company, a class for production workers on the concept of cycle time produced the following suggestions, among others: inspect samples of parts before they are sent

out of the storeroom to the production line; make someone responsible for daily checking of prototype models (used by assemblers as guides) to ensure that they incorporate the most recent changes in engineering specifications; have downstream sections tell upstream sections if they spot defects; and start doing preventive maintenance on tools and certain equipment. These suggestions embody one of the key ideas from the class: that reducing cycle time and improving quality go hand in hand, because "doing it right the first time" saves time later in the production process. These and other suggestions from that class were compiled for use by a team consisting of production workers and supervisors, who were responsible for finding ways to reduce cycle time in their part of the factory.

At some companies, formal courses are developed and taught by production workers themselves, with training staff acting as resources and organizers. This gives classes more legitimacy for participants. It also increases the likelihood that class activities will have real payoff, both from class exercises themselves and from future applications of the skills learned. A union leader remarked that the "key to success of the training is building on practical experience." At this firm, producing ideas to improve efficiency, quality, and safety is seen as part of a production worker's job. Other companies are trying to change their culture along the same lines. Doing by learning -- eliciting new ideas from participants in formal classes -- expresses the principle that employees really are paid to think. In companies where this is not true, doing by learning is less likely to happen.

Using slack time for informal training. The real key to learning-intensive production is learning through the actual work process itself. In part, this entails using slack time for problem-solving, coaching, exchanging information, and other kinds of informal training.

I have observed this happening in a small (250 employees) insurance company. In 1984, following several years of experimentation with quality circles and work teams, approximately 30 employees from Premium Accounting, Policy Issue, and Policyholder Service were combined into a single Customer Service unit. Seventeen job titles were consolidated into one: Customer Service Representative. Within the unit, employees are organized in four teams, each responsible for

serving a particular geographic region. Customer Service teams must perform the whole range of functions previously done in Premium Accounting, Policy Issue, and Policyholder Service. Within a team any Representative may perform any function she knows how to do. (The group is entirely female.) However, since employees who came from these three separate units possessed different sets of skills, no single employee knew how to perform all the team's functions. Cross-training was necessary in order to prevent bottlenecks. Instead of providing this cross-training in formal classes, Valley Life is encouraging team members to teach each other.

To motivate Customer Service Representatives to use slack time for learning instead of pure relaxation, the company has designed and implemented a "Pay for Learning" system. The ratio of potential top to bottom pay for Customer Service Representatives is approximately two to one. To climb the pay scale, an employee must rate herself "100 percent qualified" on the range of specific tasks performed by the teams. Self-ratings must be reviewed by the team and by management, and are subject to reversal if errors in a particular procedure are later traced to an employee who has claimed competence in that procedure. The amount of additional pay awarded for mastering each task or procedure is proportional to the estimated amount of time required to achieve mastery. The entire set of skills is currently estimated to take 321 weeks to learn.

In addition to motivating individuals to learn, this company's system of pay for learning also reinforces the teams. All members of a team can earn up to 49 weeks credit, i.e., a raise of 15 percent over base pay, if the team as a whole achieves a set of skills that include scheduling work, selecting new team members (from a short list proposed by management), and testing new products or procedures. Thus the sociotechnical system and the compensation system both support continual learning, with a minimum of formal, off-line training. (As noted below, a growing number of companies have now adopted some kind of pay-for-knowledge system; see U.S. Department of Labor, 1988.) The result is that employees are constantly asking each other questions about how to perform certain procedures, or trading information and insights about particular cases. These conversations take place on the fly, during short lulls that would otherwise not be used productively.

Even without pay-for-knowledge, use of slack time for learning can be motivated by other considerations. I have observed this in a manufacturing company where approximately 2000 production workers are employed in the firm's one large plant. About 400 of these are Team Leaders; the rest are called Team Members. Each team is responsible for a segment of the assembly line, where it balances job duties to allow team members to work at the same pace. Members rotate jobs and do much cross-training informally. "Versatility charts" displayed near the team's work area show each member's level of proficiency in each operation, along a four-step continuum: (1) has knowledge of the job, (2) can do the job with assistance, (3) can do it without assistance, (4) can teach the job. If a team member is absent, a glance at the chart tells the team leader who is competent to fill in. Team leaders have an incentive to help team members become proficient in more operations, because if one member is absent the team leader is responsible for making sure the team still gets its work done. Team leaders therefore act as teachers and coaches, using occasional short lulls in the production process for informal training. The company does not have a pay-for-knowledge compensation plan, but team members are motivated to learn new operations by team spirit or peer pressure, since a more versatile member is more useful to the team, and also by their desire not to do the same operation all the time.

This company has a well-developed just-in-time system in operation. This means that individual operators do not build up large buffer stocks. As a result, if a problem arises in one part of the assembly process, a whole segment of the line must stop moving. At this point, workers are expected to put their heads together to help solve the immediate problem, and to figure out how to prevent such problems from happening again. Stopping the production line, and use of down time for problem solving, are important features of the just-in-time system. At this company, the line is reported to be stopped between two and five percent of the time. Other companies currently in the process of transition to just-in-time manufacturing are also expecting production workers to engage in continual learning and problem-solving during interruptions of the production process. (For examples in the apparel industry, see Bailey, 1989a, 1989c.)

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Collaborative employment practices. To motivate employees to use their time and intelligence for continual learning and problem-solving, a number of American employers in recent years have experimented with new forms of worker involvement and collaboration. Often modeled after Japanese labor-management systems, these experiments have included such innovations as greater use of work teams, quality circles, greater flexibility in the allocation of workers and in job classification, enhanced employment security, and restructuring of management rights. All involve greater amounts of management consultation with employees as well as some worker involvement in decision-making. Varied in nature, and extending across public and private sectors, manufacturing and non-manufacturing, union and non-union establishments, these experiments represent a substantial departure from traditional labor-management relationships in the U.S. In contrast to similar experiments in the 1960s and 1970s, these recent changes have not been aimed at dispelling "blue-collar blues", but at improving productive efficiency.

As Deming (1981-82) pointed out, to improve quality and efficiency it is necessary to "Drive out fear. Most people on a job, and even people in management positions, do not understand what the job is, nor what is right or wrong. Moreover, it is not clear to them how to find out. Many of them are afraid to ask questions or to report trouble. The economic loss from fear is appalling. It is necessary, for better quality and productivity, that people feel secure." (p. 20)

The "Japanese-style" management philosophy includes the belief that training is a necessary element of the system and learning is a never-ending process (Bradley and Hill, 1983; Kochan et al., 1986; Cohen-Rosenthal and Burton, 1987; Heckscher, 1988). For instance, at New United Motors Manufacturing, Inc. (NUMMI), the joint venture between General Motors and Toyota in which GM is learning Japanese-style management, production workers have been given classes in "kaizen", which means continuous improvement. One slogan repeated at NUMMI is, "If you don't have a problem, that's a problem!" The status quo can always be improved. Seeing problems as inevitable and learning how to solve them is more productive than suppressing problems or fixating on who gets the blame.

Employers are asking workers to develop skills in human relations that allow more cooperative and mutually beneficial labor-management practices. Such training is intended to advance the transition from adversarial to collaborative labor-management systems, and to increase the chances that new systems will last. Training is provided not only to production workers, but also for first-line supervisors and middle management, who are often most threatened by these changes, and for union leaders.

Workers are also being asked to be more flexible in their job assignments. Numerous automobile plants are now following the lead of NUMMI in sharply reducing the number of job classifications and implementing the "team concept". In this system, employees work as part of a team, with the team leader taking over some of the duties of the traditional supervisor. Workers are asked to monitor quality and to solve as many production problems as possible by themselves, instead of calling in specialized skilled workers and management. As one union leader said with evident pride, "Our workers are now learning engineering skills and performing some engineering duties." (Brown and Reich, 1988) Similar trends are apparent in such industries as aircraft manufacturing and telecommunications.

Although these changes in employment practices can be introduced in the absence of any new technology -- as at NUMMI -- this kind of collaboration often increases the role of employees in adopting new technology. In unionized establishments, union leaders are increasingly being asked to contribute their perspectives, and those of their members, before new technologies are introduced. This requires that union leaders and members be given more training in the nature of new technologies.

Some kind of formal employee involvement is becoming more common thoughout the economy, not only in manufacturing, but also in finance, trade, government, and other parts of the service sector. In 1982 the New York Stock Exchange surveyed a sample of U.S. corporations employing at least one hundred people, and estimated that 54 percent of employees in this group of companies were in firms that had adopted some kind of program to encourage more sharing of responsibility -- for instance, through quality circles, job rotation or participatory goal-setting.

Other indications of increased experimentation with employee involvement in the 1980s are reported by Kochan, Cutcher-Gershenfeld, and MacDuffie (1989), and by Levine and Strauss (1989). Improving the organization's ability to learn is one desired outcome of this activity.

Smaller plants. In learning-intensive workplaces, a production worker's job includes production of ideas. As Reich (1983) put it:

> "Flexible systems can adapt quickly only if information is widely shared and diffused within them. There is no hierarchy to problem solving: Solutions may come from anyone, anywhere. In flexible-system enterprises nearly everyone in the production process is responsible for recognizing problems and finding solutions" (p. 135).

Flexibility and employee involvement are easier to achieve in workplaces that are relatively small. There is evidence that, in fact, U.S. manufacturers are reducing average plant size. Based on research by Roger Schmenner, Business Week (October 22, 1984, p. 156) reported the average plant built before 1970 and still operating in 1979 employed 644 people, compared to 241 people in the average plant opened between 1970 and 1979. Business Week estimated the average plant opening in the 1980s would employ 210 people. Smaller factories enable hourly employees to become "part of the flow of ideas," have "an impact on day-to-day operations," and feel "a sense of ownership." This contributes to continued learning.

New compensation systems. Financial participation is sometimes a concomitant of employee involvement. Workers develop a "sense of ownership" more naturally if they are actual owners. Since 1974 employers have been able to receive tax credits for contributing to Employee Stock Ownership Plans (ESOPs). The National Center for Employee Ownership (NCEO) estimates that approximately 8,000 companies had taken steps to establish ESOPs as of 1984. These companies employ approximately eight percent of the workforce nationwide. The 1984 Deficit Reduction Act contained several provisions designed to spur the growth of ESOPs even further. (For recent evidence on ESOPs, see Blasi, 1989.)

ESOPs are only one form of financial participation by employees. Conventional profit-sharing is another. In addition, there are several established procedures -- Scanlon plans, Rucker

plans, Improshare -- that award extra compensation to groups of employees when they improve productivity (Bullock, 1984). These latter plans have the advantage of tying financial rewards to the group's own efforts, without being influenced by factors beyond the group's control, such as fluctuations in product demand. (For a recent review of research on such compensation systems, see Blinder, 1990.)

As illustrated in the insurance company discussed above, some firms are also experimenting with new compensation systems designed to stimulate employees' acquisition of new skills. "Skill-based pay" makes a person's current rate of pay depend on demonstrated mastery of certain skills and knowledge, not on the particular job the person is performing during the current period (Jenkins & Gupta, 1985; Lawler & Ledford, 1985; U.S. Department of Labor, 1988). Employees gain pay increments by progressing through a sequential "curriculum" of skills and knowledge used in the particular workplace. Skill-based pay epitomizes the integration of continued learning with work in participatory, learning-intensive production systems.

Employment security. While doing by learning produces an immediate payoff from training, the ultimate payoff to the company depends on how long employees remain employed there, and whether they are motivated to keep using what they have been taught in training. Granting some assurance of employment security addresses both of these concerns. Rosow and Zager (1988) argue that employment security is an essential part of a successful human resource strategy.

One way in which employment security increases the payoff from training is virtually self-evident: if employees stay, there is more time for the firm to collect the dividends from training. Avoiding even temporary layoffs helps prolong the employment relationship, because some employees -- more likely those with better alternative opportunities for employment -- quit when they are laid off, rather than waiting around to be rehired, and wondering when they might be laid off again.

Employment security also enhances workers' loyalty and commitment to the company. They can appreciate that the firm is committed to a long-term relationship and is investing in that

relationship through training. This appreciation can make employees more willing to take initiative, and to use slack time for learning and problem-solving rather than non-productive activity. Furthermore, employees can understand that, when the company follows a policy of filling new skill demands by training the existing workforce instead of dismissing them and hiring new people who possess the desired skills, it is then incumbent on existing employees to participate willingly in this training. Employment security thus fosters a reciprocal commitment that facilitates continued learning.

The complementarity of training and employment security is evident from statistical studies. Mincer (1989), using the Panel Study of Income Dynamics, found employees who said their 1976 jobs had required more OJT tended to stay longer with their 1976 employers. Tan (1988), using the Current Population Survey, found a lower incidence of company training in states where the unemployment rate is volatile or chronically high. Evidently, employment security promotes training, and training promotes employment stability, as both employers and employees try to maximize the payoff from the investments they make.

Lack of a process model for informal training. Surprisingly, despite the extent of the literature about training and skill formation in worplaces, the process itself remains a black box. Appropriate compensation plans can increase employees' motivation to learn, employment security and a culture of collaboration can create trust and further enhance motivation, new technology may provide more opportunities to learn, a small plant size may facilitate communication, and doing by learning may increase the effectiveness of formal training -- but neither researchers nor practitioners seem to have worked out any systematic account of how learning *happens* in the work process itself.

To illustrate what a process model of learning-through-work might consist of, Figure 2 sketches components of the process by which an employee acquires the capacity to solve a non-routine but recurrent problem. For instance, an example of such a problem would be what to do when succesive heatings of a printed circuit in the process of fabrication cause unanticipated changes in components that result in defects. Engineers may need to redesign the circuit, but it is

sometimes possible to avoid costly redesign by tweaking the production process. How can employees learn to solve such problems? Figure 2 suggests it would be worthwhile to describe carefully how such learning occurs, and to identify conditions that may facilitate learning.

Some Policy Implications

More formal training for production workers. Although rate-of-return studies are inconclusive, there is reason to believe that employers on the whole may be providing insufficient opportunities and incentives for hourly employees to continue some kind of formal training after they are hired. Some formal instruction would seem to be increasingly necessary to understand new technologies, products and procedures. Cole (in this volume) describes an extensive curriculum of formal training which, in combination with informal training, is designed to teach Japanese production workers how to use advanced "mechatronic" technology. Yet, in the U.S., surveys such as those in Table 1 indicate that hourly employees traditionally have been given little or no continued schooling or formal training after they start work. The wisdom of this practice should be re-examined. Concern about the cost of formal instruction can be addressed by making better use of "doing by learning" (bringing the work process into the classroom), or techniques of cooperative education (enabling employees to accomplish certain instructional objectives in their actual work).

More employment security. Because employment security insures and enhances the return from both formal and informal on-the-job training, it follows that firms will provide less than the optimal amount of training if they provide less than the optimal degree of employment security. Is this last premise correct? There are reasons to believe that firms do, indeed, provide less than the optimal measure of employment security. The reasons all have to do with positive externalities: if one firm offers greater employment security, it becomes less costly for other firms to do the same, but it is very costly for any firm to be among the first.

One reason for these positive externalities has to do with aggregate demand (Levine and Tyson, 1990). If some firms maintain employment security when demand for their product is low,

the wages and salaries they continue to pay contribute to demand for other firms' products. Declines in demand for the products of some firms therefore have smaller ramifications for aggregate demand. By trying to protect security of employment for their own workers, these firms also reduce the necessity of layoffs or discharges in other firms.

Firms that provide employment security may also contribute to more stable aggregate demand by avoiding some of the inflationary pressure that occurs in tight labor markets and eventually necessitates a macroeconomic policy designed to curb aggregate demand (Stern, 1982). Inflationary pressure in tight labor markets results in part from high quit rates, when employees see many tempting alternatives to their present jobs. High quit rates disrupt production and drive up unit costs. They also require employers to raise wages and salaries in an effort to retain existing employees or attract replacements; this contributes directly to inflation. However, firms with employment security policies are less susceptible to high quit rates, if employees feel loyal, or if employees expect that tight labor markets will give way to renewed high unemployment (as has always happened in the U.S.) and they want to protect their future employment security by staying where they are. Firms with employment security therefore contribute less to the inflationary pressure that engenders recession through macroeconomic policy.

Given these and other possible positive externalities, the aggregate rate of unemployment will tend to be lower on average over time, if more firms provide employment security. This creates another externality, related to the cost of hiring. Some firms routinely discharge or lay off employees as a means of maintaining discipline, reducing excess inventories of finished goods, or changing the skill mix of their labor force. Normally, new employees are hired eventually to replace those who were discharged, or who were laid off and are unavailable for recall. Recruiting and hiring new people is costly. The cost is less if there is excess supply in the labor market, as indicated by a large number of unemployed people relative to the number of job vacancies. This kind of slack labor market therefore promotes high-discharge, high-layoff policies by firms. Conversely, tight labor markets reward firms that attempt to maintain greater security of

employment and therefore avoid the cost of new hires. As labor markets grow tighter due to some firms providing employment security, there is less opportunity cost to other firms following suit.

These arguments imply that market incentives alone will not induce more firms to provide enough security of employment. It is costly to adopt such a policy when most firms do not, and ordinary market processes do not compensate firms for bearing the extra cost of being among the first. Therefore, some collective mechanism would be required to capture the positive externalities. Any collective action that promoted employment security would also, for reasons given above, promote continued training of employees. In effect, such a collective mechanism creates a benign cartel, in which employers and employees are all better off than when employers act individually. Streeck (1989) claims that collective agreements among employers in Germany, enforced by the government, have enabled that country to remain competitive by requiring more training than individual employers would otherwise provide. Similarly, Soskice (1989) sees the countries which have enjoyed the greatest economic success in the 1980s as "Coordinated Market Economies", which have enforced agreements providing for employment security and large amounts of on-the-job training, among other things. The kind of learning-intensive strategy described above would be more viable in an institutional context where all firms had to follow similar policies. It remains to be seen whether individual firms can profit from this strategy in the U.S., where this kind of benign cartel does not exist.

An example of a public program that helps employers offer greater security of employment is the Employment Training Panel in California. This program supports retraining of employees who have been laid off or are in imminent danger of being laid off. Employers have used the training funds to teach current employees how to use new technologies, instead of discharging existing employees and trying to hire new ones with the requisite skill and knowledge. Case studies of companies that have received Employment Training Panel grants indicate that the availability of such funds has helped move some firms toward a policy of treating employees as long-term assets rather than as short-term costs (Schneider, 1988).

More use of school-work hybrids for teenagers. If adults are expected to continue learning while they work, how is this capacity acquired? Cognitive psychologists have argued that all learning is "situated" in the context where it occurs. This would seem to imply that the way to acquire a generalizable capacity for learning in the workplace is to become a learner in a variety of workplaces. Cooperative education and other school-work hybrid institutions are intended to provide this kind of experience. By using the workplace as an educational setting, students can practice learning through the process of work itself.

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Table 1

SOURCES OF TRAINING TO OBTAIN JOB
OR IMPROVE SKILLS,SELECTED MANUFACTURING
OCCUPATIONS: PERCENT OF TOTAL EMPLOYMENT IN OCCUPATION

Occupation	Total	School	Formal OJT	Informal OJT
Industrial engineers				
obtain job	85	54	15	41
improve skills	51	21	23	18
Electrical and electronic technicians				
obtain job	88	48	19	39
improve skills	50	20	26	12
Industrial machinery repairers				
obtain job	63	14	18	40
improve skills	37	6	15	18
Tool and die makers				
obtain job	85	25	35	44
improve skills	40	17	10	17
Machinists				
obtain job	74	22	23	43
improve skills	33	7	10	18
Metal working and plastic working machine operators				
obtain job	46	6	7	37
improve skills	22	3	4	15
Welders and cutters				
obtain job	68	20	16	33
improve skills	25	7	5	13
Assemblers				
obtain job	24	4	4	18
improve skills	20	1	4	15

Source: U.S. Department of Labor, 1985: Tables 23 and 45

Table 2

REPORTED EXPENDITURE ON FORMAL TRAINING
PER EMPLOYEE IN VARIOUS U.S. COMPANIES

Company	Source	Year	Expenditure per employee
A.T.& T.	Eurich, 1985	1980	$1,700
IBM	Eurich, 1985	1982	$1,370
Travelers	Casner-Lotto, 1988	1986	$ 500
New England Telephone	Casner-Lotto, 1988	1984	$ 577
Pacific Bell	Casner-Lotto, 1988	1986	$ 448
Corning Glass	Casner-Lotto, 1988	1986	$ 74
Manpower Temporary Services	Casner-Lotto, 1988	1986	$ 100
Motorola	Casner-Lotto, 1988	1986	$ 430
Motorola	Business Week, 1989	1989	$ 571
BNA survey	Mangum, 1989	1984	$ 122 to 250
Delaney survey	Mangum, 1989	1986	$ 350 to 1,400
Columbia survey	Bartel, 1989	1987	$ 359 to 1,343

Table 3 Summary of Extent of Employer-Provided Training

Type of Measure	Study	Data Set	Time Interval	Specific Measure	Proportion or Average Value
Received training	Haber (1985)	1984 SIPP	Time with current employer	Employer-provided training program	8%
	Lillard & Tan (1985)	1983 CPS	Time with current employer	Company [formal] training program	12%
				Informal OJT	15%
				Other training	5%
	Hollenbeck & Willke (1985)	1983 CPS	Time with current employer	Company [formal] training program	11%
				Informal OJT	14%
	Tierney (1983b)	1981 CPS	Last year	Employer-provided training programs	5%
	Duncan & Hoffman (1978)	1975 PSID	Currently receiving	Formal training or OJT	20%
Weeks of Training	Haber (1985)	1984 SIPP	Time since 1980 with current employer	Weeks employer-paid training at work	6 weeks
	Tierney (1983a)	1978 CPS	Last year	Weeks of employer-provided training	9 weeks
	Bishop & Kang (1984)	1982 EOPP	NA	Weeks to become fully trained	7 weeks
	Duncan and Hoffman (1978)	1975 PSID	NA	Weeks to become fully trained	86 weeks
Hours of training	Tierney (1983a)	1978 CPS	NA	Hours of employer-provided training	120 hours
	Bishop & Kang (1984)	1982 EOPP	First three months on job	Hours formal training	11 hours
				Hours informal training by supervisors	51 hours
				Hours informal training by coworkers	24 hours

Source: Brown, 1989.

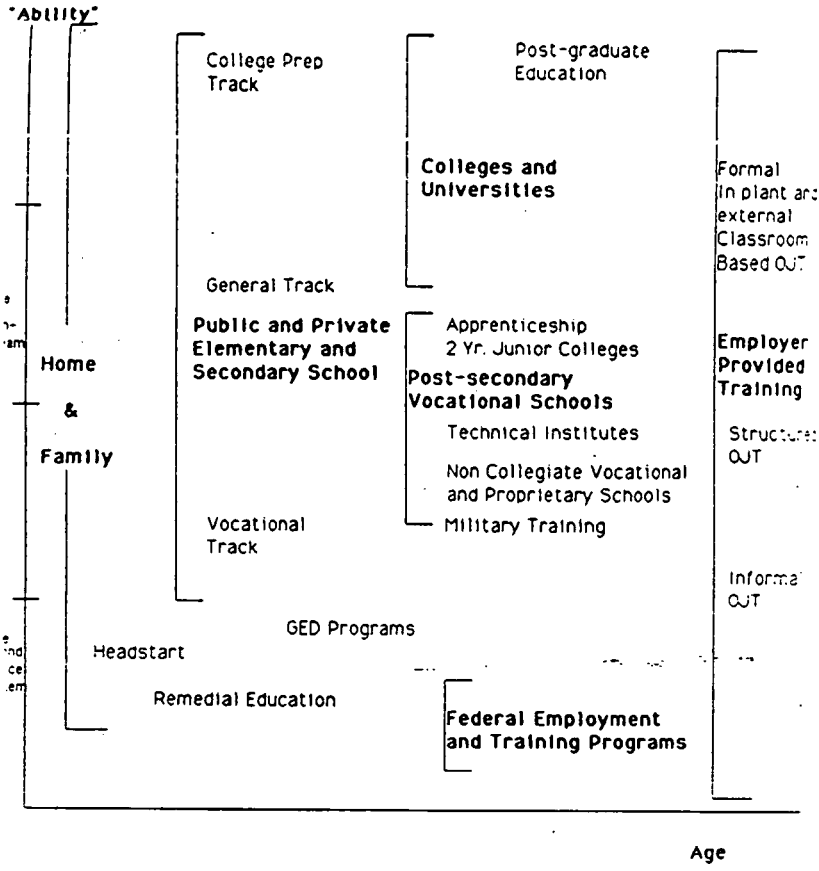
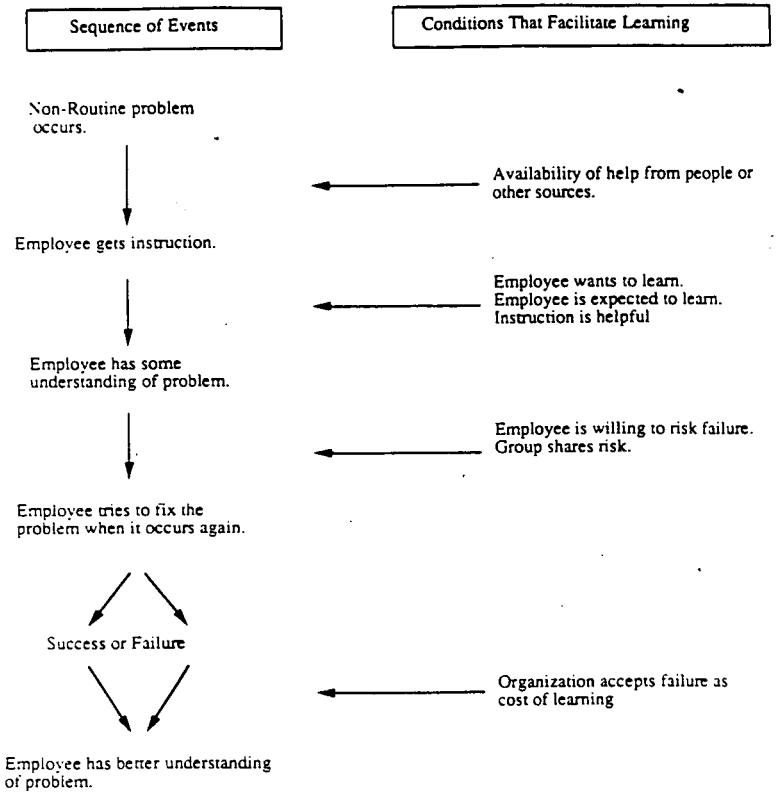


Figure 1 Institutions of Employability Development

Source: Mangum, 1989.

Figure 2

Process Model: Learning To Solve Non-routine Problems



Representative HAMILTON. Mr. Tornatzky, please proceed.

STATEMENT OF LOUIS G. TORNATZKY, SCIENTIFIC FELLOW, INDUSTRIAL TECHNOLOGY INSTITUTE, ANN ARBOR, MI

Mr. TORNATZKY. It is a privilege to appear today and describe what the Industrial Technology Institute, ITI, has learned about issues of worker training in manufacturing industry.

My main message concerns not the often-studied skill needs and training responses of large manufacturers, but the less visible, but more important needs of the 120,000 American manufacturers with 20 to 500 employees.

It is these firms that produce half of manufacturing value added, that contribute more to the cost of American products than the large companies that buy their output, and whose quality, delivery, cost, and engineering performance gates their customers' success in the world market.

My argument today is simple: In large firms, ample resources exist to address gaps between employees' skills and the requirements of the new technologies and manufacturing practices; in foundation firms there is a clear market failure.

If mobilization of an infrastructure to address the skilling needs of America's foundation firms can cut in half their current 30 percent productivity shortfall, and I repeat, 30 percent productivity shortfall relative to large firms, it will bear immense fruits in higher worker incomes, higher U.S. productivity growth, reduced product cost, improved quality, and improved U.S. trade performance.

As members of the committee are well aware, the last decade has largely been a disaster for U.S. manufacturing. In our experience, part of U.S. manufacturing's poor performance reflects its refusal to adopt, and its problems in using, certain key manufacturing practices and technologies generally falling into two categories, the practices and tools of quality and quality management and the engineering and production application of computerized automation.

However, the difficulties that are encountered in adopting and using these technologies express themselves differently in large versus small firms. In large companies, the problem has often been the technologies are installed, but not used to their intended capacity and thus yielding inefficiencies of capital utilization. In smaller firms, the building block technologies often are not even present.

Where in West Germany or Sweden, large firms are about twice as likely as small firms to be users of computer-assisted design and computer-assisted manufacturing, in the United States they are 3½ times more likely.

In the 1988 Census Bureau study of manufacturing it was found that 56 percent of U.S. metalworking firms with 20 to 99 employees not only did not have CNC machines, computer numerical control, but also expressed no intention of acquiring any in the next 5 years.

Even among larger firms more than half had no plans to acquire the capability to use CAD to control manufacturing machines. Yet our research has found that in the tooling firms that dominate the non-electrical-machinery sector, it is this technology exactly which

is associated with significant enough cost reductions to affect industry competitiveness.

Why haven't U.S. firms—especially smaller ones—adopted these technologies and approaches and used them to advantage? There are many reasons, but a critical one is that foundation firms have a distinctive set of needs that are not being addressed by the training infrastructure. They generally pay lower and it makes it harder for them to attract and keep skilled workers. They are less likely to be unionized and therefore they do not have access to established formal apprenticeship programs.

Finally, because they are small, individually they lack the clout to influence the substance of training curriculums and, as a result, most of the input that defines training comes from larger firms.

What are the new training demands? The conventional training experience teaches individuals to operate a particular piece of equipment. But the new technologies place a greater demand on workers to understand the concepts that underlie a particular piece of equipment, and how it is linked with other pieces of equipment in a manufacturing system.

To derive a benefit from using computer-assisted design, the student needs to understand how to create part libraries, to iterate designs stored in those libraries, and to download files to shop-floor machines elsewhere in the plant. He or she needs to understand principles as well as operational procedures.

The training response by U.S. companies to these new realities has been quite uneven, and largely contingent upon where a company sits in the industrial structure. Major industrial corporations have generally been quite responsive in upgrading their training function. According to one estimate, while fewer than half of all U.S. manufacturing firms provide formal job training, about 80 percent of firms with 500 or more employees provide it. The larger firms also make more effective use of the newer technologies, such as computer-assisted instruction, interactive video, hypertext, and so on.

The situation with smaller firms is quite different, and frankly much worse. Firms with fewer than 500 employees on average hire somewhat less educated entrants, so the magnitude of their training task is greater to begin with. They generally have few, if any, in-house training staff. They make only limited use of advanced training technologies, and they are heavily reliant on equipment vendors for training which usually gets packaged with their procurements.

However, this vendor provided training is often minimal in scope, often because the procurement agent in a small company is ill-advised about his company's true training needs. Training also tends to be focused on the specific equipment in hand and doesn't provide the more general, principle-based instruction that I have referred to earlier.

There is some evidence that the major companies which constitute a prime market for smaller firms are beginning to assist their suppliers via various qualification programs, but supplier improvement programs in most industries have had only a limited direct impact in the training area.

One result has been that smaller firms have become heavily reliant on public sector training resources, particularly local community colleges. The provision of contract, often customized, training services has become a growth market for these institutions.

Let me end with some conclusions.

Our research does not suggest that the large-firm sector requires significant further support or subsidy from the public sector. Where a clear case of market failure seems to exist is in the failure of small manufacturers to get a concurrent response from the various elements of the training infrastructure. The lack of such a response makes foundation firms unduly dependent on technology vendors themselves for their work force training.

Moreover, foundation firms have not received much help from their major industrial customers in the training domain.

We feel there are simply fundamental flaws in the way public policy treats technology and human resource issues. As one example, that goes beyond the scope of our discussions today, many of the Federal institutions that promote technology development and research in advanced topics are largely unconnected to the institutions that promote technology deployment such as training institutions.

The problem isn't just with the technologists. The education-and-training infrastructure remains largely uninformed about the economy, its structure of skill needs, and where it is headed, and in their rush to be responsive to business, they tend to think locally and act locally and ignore the larger picture.

To conclude, technology, properly and broadly used, can be an important element of a national strategy to improve productivity and living standards. The segment most in need of help are the foundation firm manufacturers with 20 to 500 employees. These firms need a better-funded, more responsive infrastructure that develops curriculums based on smaller manufacturers' aggregated needs. This is not an opportunity that the country can pass up.

Thank you.

[The prepared statement of Mr. Tornatzky follows:]

PREPARED STATEMENT OF LOUIS G. TORNATZKY

NEW MANUFACTURING REALITIES AND WORKER TRAINING

Testimony presented to the
Joint Economic Committee,
U.S. Congress,
May 17, 1990

By
Louis G. Tornatzky, Ph.D,[1]
Industrial Technology Institute
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[1]James Jacobs, Daniel Luria, Rocco DePietro, and Mitchell Fleischer, senior technical staff at ITI, assisted in preparation of this testimony.

Introduction

It is a privilege to appear today and describe what the Industrial Technology Institute (ITI) has learned about issues of worker training in manufacturing industry. ITI is a not-for-profit R&D organization which has been working in the area of industrial automation and its human implications since 1980. Like many other "think tanks," we have conducted major studies of the skill needs of American manufacturers, and the ways in which those needs are being changed by the increasing use of new kinds of technology.

While I will discuss some of our conclusions in that regard, my main message today concerns not the oft-studied skill needs and training responses of large manufacturers, but the less visible but, if anything, more important needs of the 120,000 American manufacturers with 20-500 employees. It is these firms that produce half of manufacturing value added, that contribute more to the cost of American products than the large companies that buy their output, and whose quality, delivery, cost, and engineering performance gates their customers' success in the world market. ITI has a unique window on those 20-500-employee shops. We have an active, long-term partnership with the Michigan Modernization Service, a state agency that has worked directly with more than 600 of these so-called "foundation firms." Based on that experience, ITI has organized a unit focused on "base modernization" -- the improved performance of foundation firms -- across the nation; ITI has base modernization clients in Minnesota, Pennsylvania, Massachusetts, New York, Illinois, Kentucky, and Maryland, among others.

My argument today is simple: in large firms, ample resources exist to address gaps between employees' skills and the requirements of the new technologies and manufacturing practices; in foundation firms there is a clear market failure. Because these companies are small, their needs are less visible; and because the U.S., unlike many of our competitors, lacks an infrastructure linking small manufacturers, trade associations, educational institutions, and technology vendors, these needs are seldom aggregated to the point that market providers of training services can efficiently respond. That market failure provides, I think, a clear justification for public action. If mobilization of an infrastructure to address the skilling needs of America's foundation firms can cut in half their current 30% productivity shortfall relative to large firms, it

will bear immense fruits in higher worker incomes, higher U.S. productivity growth, reduced product cost, improved quality, and improved U.S. trade performance.

Let me begin to elaborate that argument by posing three questions:

- What are the new manufacturing practices and technologies whose use is generating new skill needs?
- How are the resultant demands for training being met -- or not met -- by manufacturers, and particularly by small- and medium-sized firms?
- What are the limitations of the current training infrastructure?

What are the New Manufacturing Practices and Technologies?

As members of the Committee are well aware, the last decade has been a disaster for U.S. manufacturing. In nearly every major sector, large chunks of the domestic market have been lost, or ceded, to foreign-based producers. Properly measured, manufacturing productivity growth rates are low, relative both to past U.S. performance and to those of our major trading partners. Real earnings are below the levels of the late 1960s.

In our experience, and in the opinion of many observers, part of U.S. manufacturing's poor performance reflects its refusal to adopt, and its problems in using, certain key manufacturing practices and technologies. These generally fall into two categories: (1) the practices and tools of quality; and (2) the engineering and production application of computerized automation. However, the difficulties in adopting and using these new approaches tends to express itself differently in larger vs. smaller firms.

In large manufacturers, the problem has often been that technologies are installed, but not used to their intended capacity, thus yielding inefficencies of capital utilization. For example, flexible manufacturing systems, "cells" that use material handling automation to link computer-controlled machine tools and assign work to those tools according to software instructions, are adopted but not used for flexibility (Jaikumar, 1986).

In smaller firms, the building block technologies -- production planning and inventory control software (such as MRP II), computer numerical control (CNC) machines, computer-aided design (CAD), and their linkage through CAD-CAM software -- are often not even present. For example, where in West Germany and Sweden, large firms are less than twice as likely as small firms to be CAD-CAM users, in the U.S. they are three and a half times more likely (*TechnEcon 1:1*). Perhaps most disturbing, the 1988 Census Bureau study ("Manufacturing Technology 1988") found that 56% of U.S.

metalworking firms with 20-99 employees not only do not have CNC machines, *but also express no intention of acquiring any in the next 5 years.* Even among firms with 100-499 employees, more than half have no plans to acquire the capability to use CAD output to control manufacturing machines. Yet ITI research for the Economic Development Administration (McAllinden, 1989) found that in the tooling firms that dominate the non-electrical machinery sector, it is this CAD-linked CNC approach which alone is associated with significant enough cost reductions to affect industry competitiveness.

All firms, large and small, have organizational and "cultural" difficulties in implementing quality management techniques, despite the level of training received. For example, we recently visited a stamping plant which supplies the auto industry. The plant's quality manager had an active in-house program to train workers in SPC. All line workers and supervisors were trained. However, the quality manager acknowledged the SPC was having little effect on product quality because the plant department was under such heavy pressures to produce that workers were not given time to investigate process problems revealed by the SPC charting. The unused training was soon forgotten. The training continued because major customers (Big 3 auto makers) require their suppliers to provide workers with SPC training.

Why haven't U.S. firms -- especially smaller ones -- adopted these technologies and approaches and used them to advantage? There are many reasons, but a critical one is that these foundation firms have a distinctive set of needs that are not being addressed by the training infrastructure. Their lower pay (partly a reflection of their lower productivity, itself partly a reflection of their lower rate of use of automation) makes it hard for them to attract and keep skilled workers. Yet their role in the value-added chain generally means they are more likely to be batch rather than mass producers, and that means more equipment setup and a higher *average* level of required workforce skill than in most large firms. Because they are less likely to be unionized, they do not have access to established formal apprenticeship programs. Finally, because they are small, individually they lack clout in influencing the substance of training curricula.

As a result, most of the business input to traditional training comes from large firms. Many programs assume the existence of job classifications that seldom exist in foundation firms. The smaller firms' crying need for good technical generalists (Jacobs, 1987) is not addressed in the burgeoning number of education programs that produce individuals trained on specific types of equipment.

What are the New Training Demands?

The conventional training experience teaches individuals to operate a particular piece of equipment. But the new technologies place a greater demand on workers to understand the concepts that underly a particular piece of equipment, and how it is linked with other pieces of equipment in a manufacturing system (Tornatzky and DePietro, 1987). Many community colleges, for example, teach students to be CAD operators able to perform 2-dimensional drawings. But to derive a benefit from using CAD -- and hence to convince a banker that CAD is a justifiable investment -- the student needs to understand how to use it to create part libraries, to iterate designs stored in those libraries, and how to download files to shop-floor machines. The student thus must understand how CAD fits into the firm's production strategy, how it's been decided which machines will process which parts for which orders, and so on. In short, the operator needs to grasp principles as well as operational procedures.

CAD and the other new technologies for discrete parts processing call for more attention to be paid to the use of skills to compute, communicate, and reason out answers to problems. While concerns about basic skills have been widely voiced, much less attention has been paid to the context in which those skills get imparted to people who will have to solve production problems. Mathematics instruction is typically segregated from vocational education programs, for example. People learn math and people learn factory skills, but they don't learn how to use math in the factory. Yet that's precisely what workers need to know how to do. Smaller firms cannot afford to go out and hire highly paid specialists (e.g., programmers). They need an efficient way to develop flexibly trained and skilled workers.

How Are the New Training Needs Being Met By Companies?

The training response by U.S. companies to these new realities has been quite uneven, and largely contingent upon where a company sits in the industrial structure. Major industrial corporations have generally been quite responsive in upgrading their training operations. According to one estimate (Johnston, 1989), while fewer than half of all U.S. manufacturing firms provide formal job training, *about 80%* of firms with 500 or more employees provide it. Larger firms are making effective use of the newer training technologies, such as computer-assisted-instruction (CAI), interactive video, hypertext, and allied approaches.

This generally positive situation with large firms needs to be qualified in one important way. Despite having made great strides in enhancing training delivery, training is still

not an integral part of the business strategy of most major manufacturers. It is often the first item cut in a budget crunch. Recently, a major automotive company put all of its training activities virtually on hold after a disappointing quarterly report. Human resources are still not seen as a critical investment.

The situation with smaller firms is quite different, and much worse. Firms with fewer than 500 employees on average hire somewhat less educated entrants (Vaughan and Berryman, 1989), so the magnitude of their task is larger to begin with. They generally have few if any in-house training staff, make only limited use of advanced training technologies, and are heavily reliant on their equipment vendors for training which gets "packaged" with their procurement actions. However, this training is often minimal in scope (often because the small company purchasers are ill-advised about their true training needs), focused on the specific equipment at hand, and fails to provide the more general, "principle-based" instruction that is needed.

There is some evidence that the major companies who constitute a prime market for smaller, foundation firms are beginning to assist their suppliers via various qualification and improvement programs. However, supplier improvement programs in most industries have had only a limited impact in the training area (Tornatzky, et al, 1989). Typically, major corporations might provide their small firm suppliers with training materials (e.g., videotapes), but this is usually confined to quality-related issues (SPC training, for example), and can in no way be considered as comprehensive training support.

The result has been that smaller firms have become heavily reliant on public sector training resources, particularly local community colleges. In fact, the provision of contract (often customized) training services has become a growth market for community colleges, and many of them have developed highly innovative approaches. For example, Lansing Community College (in Lansing, Michigan) has developed an approach to training and implementation assistance for MRP-II systems. A faculty member is assigned to a company for upwards of a year to provide a variety of training experiences, as well as technical assistance.

What Isn't the Infrastructure Doing?: Some Conclusions

Our research does not suggest that the large-firm sector requires significant further support or subsidy from the public sector. While large firms, and the rest of society, would clearly benefit from improved literacy and numeracy among new labor force

entrants, reform of K-12 education is not our subject today.

Where a clear case of market failure seems to exist is in the failure of smaller manufacturers to get a coherent response from the various elements of the training infrastructure. The lack of such a response makes foundation firms unduly dependent on technology vendors for their workforce training. For obvious reasons, vendor training tends to be highly specific to the equipment being purchased and lacking in the more "general principles" orientation mentioned previously.

Moreover, foundation firms have not received much help from their major industrial customers in the training domain. Large firms have been more interested in winnowing down their number of direct suppliers than in helping suppliers improve their performance.

While the issues and problems that I have described are serious, the committee should be somewhat comforted by efforts underway at the state level to remedy them. Several states are attempting to make their publicly-supported educational systems more responsive to contemporary industrial realities.

Nonetheless, there are fundamental flaws in the way public policy treats technology and human resource issues. As one example, that goes beyond the scope of our discussions today, the Federal institutions that promote *technology development* are unconnected to the institutions that promote *technology deployment*. In the next 10 years we can expect a major revolution in manufacturing as some of the more exotic advanced materials (ceramics, composites, engineered materials) reach more widespread development. Yet those Federal agencies which are supporting major R&D in this area are spending virtually nothing to study and plan for the human resource and deployment implications of these technologies.

The problem isn't just with the technologists. The education-and-training infrastructure remains largely uninformed about the economy, its structure of skill needs, and where it is headed. In the rush to be "responsive" to business, it tends to "think locally *and* act locally." Thus there is an explosion of customized training courses, but still no real increase in the supply of technology generalists.

To conclude, let me again thank the Committee for this opportunity to present some of the conclusions we've drawn from our work at ITI. Technology, properly *and broadly* used, can be an important element of a national strategy to improve productivity and

living standards. The segment most in need of help -- and whose upgrading will have the most dramatic impact on those outcomes -- are the "foundation firm" manufacturers with 20-499 employees. These firms need a better-funded, more responsive infrastructure -- with our community colleges playing a lead role -- that develops curricula based on smaller manufacturers' *aggregated* needs. As we approach the 21st Century, we have the opportunity to turn loose the talents of a new kind of technology generalist. This is not an opportunity we should pass up.

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Representative HAMILTON. Thank you very much for your testimony this morning.

I guess the question that kind of runs through my mind that I want to focus on at least initially after hearing each one of you is just what it is that you think we ought to be doing about all of this?

Of course those of us up here are Federal legislators; what you've identified for us it seems to me in your statements and identified very well is, as one of you put it, I think you Mr. Tornatzky, that we have a market failure here and we are not adapting as quickly as we ought to adapt and that has very adverse consequences on the blue-collar worker, as you say, Ms. Flynn.

I suppose it always has been true, that we have been slow to adapt, but maybe it's coming more to the front because we're in a more competitive world, but what is it you think we need to be doing? I know you have suggested a few things here, but I want to get those a little more focused. What needs to be done at the State level, what needs to be done at the Federal level, and I'm speaking now of government, in dealing with the kinds of problems you've identified, or doesn't very much need to be done at all?

Mr. TORNATZKY. I think a couple of things need to be done. One, I think we need to focus our activities. I have made the argument that we need to focus on the smaller manufacturing sector, and many of the comments in the training literature at large talk about training in general without understanding the industry structure implications of how training services are really distributed.

If we focus our activities, whatever they may be on that sector, that's part of the issue.

Representative HAMILTON. In other words, the big firm adjusts and the little firm doesn't adjust. Is that basically correct?

Mr. TORNATZKY. Exactly, correct.

Representative HAMILTON. So we need to focus, as you put it, on the small firm?

Mr. TORNATZKY. The larger firm in the United States is in effect on a parity with larger firms in competitor nations in terms of the use of technology.

Representative HAMILTON. Do you agree with that, Mr. Stern and Ms. Flynn, to focus on the smaller firms?

Mr. STERN. To a large extent, yes. I think the big firms can still stand improvement in some respects, but I think the more pressing need is with the smaller firms. I would agree with that.

Ms. FLYNN. I would also say the small firms have special concerns regarding training and their ability to retain skilled workers. However, I would not write off the larger firms quite yet. I think the larger firms, particularly with respect to adopting new technologies, are considerably behind other countries in terms of utilization in the workplace.

Representative HAMILTON. What do we do once we focus on these smaller firms? What do we do? What kinds of things ought we to try to correct? How can we help?

Mr. STERN. Well, one set of policies might try to create new options within the unemployment insurance system. There have been

some initiatives that I'm aware of in California, and one I mentioned, which——

Representative HAMILTON. Shared layoffs?

Mr. STERN. Shared layoffs. Another that was enacted at approximately the same time allows some moneys from the unemployment insurance fund to be used in a preventative way for training, that is when employees are faced with imminent layoff having to do with either decline in demand or, more importantly, introduction of new technology, the employment training panel, as it is called, can allocate funds to firms for providing the kind of training to employees that will enable them to use the new technology.

Representative HAMILTON. There would be a lot of resistance to this idea of shared layoffs, wouldn't there?

Mr. STERN. The shared layoffs idea, yes, there has been some resistance mainly on the part of more senior employees who would ordinarily be protected against full-time layoff, and I think more importantly on the part of employers who are reluctant to keep paying the fixed-benefit costs that still have to be paid even when somebody is on the payroll part time.

Representative HAMILTON. How would you change present Federal programs in this area to make them more effective?

Mr. TORNATZKY. I don't think Federal programs generally recognize the supplier chains that exist in manufacturing industry. In most areas of the country there is a regional economy where there is a linked set of small company suppliers that provide inputs to one or more large manufacturers.

I think there is an opportunity, one, to recognize that some sort of regional supplier structure exists wherever there is an anchor OEM company, and try and move Federal action toward creative private-public partnerships that address a supplier network in key industries. Maybe the delivery mechanism could be community colleges, or it could be supplier development programs in major corporations suitably incentivized, but we need to craft programs that really respond to existing industry structure.

Representative HAMILTON. And your suggestion in your statement is that we have to localize the problem much more; is that correct?

Mr. TORNATZKY. Regionalize. For example, if you take GE Jet Engines in Cincinnati, they have several hundred suppliers within a hundred miles, that cover three States perhaps, but that is a supplier network for that corporation.

Representative HAMILTON. Are we getting better or worse at adopting to the pace of modernization and change in worker upgrading and training? Do you see improvement today compared to say 5 years ago or 10 years ago, or is it worse?

Mr. STERN. My impression is it's a mixed picture. There are some companies that are moving fast, and the aggregate productivity figures have been encouraging in manufacturing, although the downside to that, as Congressman Wylie mentioned at the outset, is that we've been shedding labor from manufacturing. So that the improvement has come in a sense at the expense of the blue-collar workers who are the subject of this hearing.

Ms. FLYNN. I would just like to add to this point that there is the whole corporate downsizing trend and restructuring. There is also

an increased use of the contingent work force. More and more part-time workers are being used and consultants not on the payroll. This gets back to the employment security issue. If employers, workers, and managers are not comfortable and feel secure, then it impacts both training and adoption.

Representative HAMILTON. Mr. Tornatzky.

Mr. TORNATZKY. I think we are getting better as a country, but the target has moved.

Representative HAMILTON. What do you mean by that?

Mr. TORNATZKY. Again focusing back on small manufacturing companies: If you look at our counterparts in Germany or Japan, they are much further advanced than they were 5 years ago. So the ante keeps being raised.

I also think how good we are doing depends upon what part of the country or what State one is talking about. There is great diversity in how States are addressing these kinds of training issues.

Representative HAMILTON. Which States in your mind stand out as doing a good job?

Mr. TORNATZKY. Clearly Michigan. [Laughter.]

There has been, I also think, some very innovative imaginative programs in some of the major industrial States such as Ohio and Pennsylvania.

Representative HAMILTON. Which ones are doing a very poor job?

Mr. TORNATZKY. It would be real difficult for me——

Representative HAMILTON. You're too much of a diplomat; is that it?

Mr. TORNATZKY. Too much of a diplomat. We have a business we have to maintain here.

Representative HAMILTON. Before going to Congressman Wylie, is it your impression that our major economic competitors do a much better job than we do in utilizing the skills and capabilities of the blue-collar worker?

Mr. STERN. Oh, absolutely. This is well documented, as I mentioned in my statement, especially in Japan.

Representative HAMILTON. And do they do the same kind of a job with the small firms as they do with the big ones?

Mr. STERN. That's an open question.

Representative HAMILTON. How much is government involved in their activities?

Mr. STERN. Heavily, particularly in West Germany.

Representative HAMILTON. The Government takes a lot of responsibility for the training and retraining and the adaptation necessary for the blue-collar worker to use the new technologies?

Mr. TORNATZKY. Yes.

Mr. STERN. Yes.

Representative HAMILTON. Is that true in Japan as well?

Mr. STERN. Yes, sir. For instance, when Drexel Burnham had to close its office in Tokyo, I was told that they were not allowed to close that office until they had made suitable arrangements for the employment of people who were going to lose their jobs in that office. There is a structure of law in these countries that protects and promotes employment security.

Representative HAMILTON. Is it your impression that the foreign firms that locate in the United States continue to do a better job of worker training and adaptation than the domestic U.S. firms?

Mr. STERN. Yes, some of them do. The Japanese transplants have brought some of their human resource practices with them and have achieved stunning effects in some cases.

Representative HAMILTON. Yes.

Mr. TORNATZKY. I would like to partially disagree with that because one of the things the transplants have been able to do is really select a work force and really operate from a clean slate, which makes it a much easier issue of training a work force, when you can select them using whatever criteria you intend to use from the beginning.

For example, I think the Saturn facility in Tennessee, which also had the same opportunity, is on a par with the best Japanese transplant in terms of worker training.

Mr. STERN. Yes. Saturn is comparable to New United Motors in Fremont. This was the joint venture between GM and Toyota in which 80 percent of the blue-collar workers in that plant were originally employed by GM. So it's quite possible to do it with the existing work force.

Ms. FLYNN. I think case studies consistently show that, especially in the Japanese firms, the practice is to create jobs that have more breadth and more depth. There is much more training involved, the labor classifications are broader and it's just a much more flexible environment. It is also true that they don't have to worry so much about labor turnover, which again contributes to the notion that it's safer to train and not worry about losing your skilled workers after you've trained them.

Representative HAMILTON. The Japanese managers complain here frequently about the tendency of American workers to quit, don't they?

Ms. FLYNN. Yes.

Representative HAMILTON. Congressman Wylie.

Representative WYLIE. Thank you very much, Mr. Chairman.

I appreciate the testimony. Your excellent presentations demonstrate your obvious talent and expertise. I'm glad to hear that Ohio is doing a good job. The Midwest is on the rise again.

I want to follow up on a question of the chairman which I think is key as I perceive it, and that is referenced also, Mr. Tornatzky, in your testimony where you point out that market failure is contributing to the problem of not best using blue-collar workers.

To rephrase it, could government failure also play a role here, and I want you talk with specific references to the job that our public education system might be doing in this area as far as preparing future workers for technological change?

Mr. TORNATZKY. I think there are two potential areas of failure. One is in failing to aggregate resources and programming, say at the community college level. In other words, basically every community college is into the training business.

So what you often see in some States is a failure to get critical mass and critical quality in programs, and perhaps a wiser course of action would be to focus on a few centers of training excellence—teaching factories is a common metaphor—and activities.

Another obvious source of failure is what has happened in K to 12 education, which could be the topic of a whole other hearing or a series of hearings.

Those are, I think, the primary areas of failure.

Representative WYLIE. Would either one of you care to comment on that?

Ms. FLYNN. It seems historically in the U.S. education and training policy has focused on the schools as the major source of job skills. It seems that it's time to really integrate a lot more of the nonschool providers, be they the military or firms or apprenticeship programs. We really haven't focused on those other very large producers of job skills and integrated them into public policy.

Mr. STERN. I would like to amplify that, if I may. I agree with that very strongly. There is growing recognition or rediscovery of what is a very commonsense idea, that the best place to learn something is where it is going to be applied, and if we are talking about work-related training, the natural place for that kind of training to occur is in the workplace.

There is some evidence—continuing the idea of market failure—that the rate of return to company provided training is quite high, which suggests that companies are underinvesting in employee training, and I think this gets back again to the idea that I keep harping on of employment security. There is simply a reluctance on the part of employers to take the view that employees are long-term assets.

Representative WYLIE. To sort of follow up on that, Japan is often put forth as a model of economic success insofar as it includes the area of labor management relations, and I want to inquire as to whether American workers would really be comfortable in the kind of environment that we see in Japan, and I want to relate a personal story.

A friend of mine has a Toyota dealership, and he said he went over to watch Toyota cars being made, and if one of the persons on the assembly line is up to his ears in hub caps, the people who are on the wheel assembly line will come over and help him, and that's not possible in most of the contractual arrangements that we have here in this country.

I asked a labor union leader about that, and he said well, that might be true, but they develop more skills and are less likely to have injuries and so forth in our plants, and we have a different kind of environment.

Would you care to comment on that, Mr. Stern?

Mr. STERN. Yes, sir. Again, the joint venture between UAW with Toyota and General Motors in Fremont was a test of this idea, and the test is being extended in the new GM division at Saturn, which is a very different kind of industrial relations system, much more collaborative, much more emphasis on flexibility and broad assignments and few job classifications. So I think the UAW, in particular, and some other unions are definitely becoming more receptive to this style of labor relations.

Representative WYLIE. Our economy and culture for the most part in the past hasn't been committed to a so-called lifetime employment contract, which has been alluded to as a part of the Japanese culture. Is that going to be difficult for American firms to

honor? I think that's what we're talking about here in our discussions this morning, some incentive so employers don't move around in an employer-employee relationship.

Ms. Flynn, I think you mentioned that.

Ms. FLYNN. The lack of employment security certainly raises problems. Although employers in some sense don't want employees to stay forever. If the firm has to downsize, managers would certainly like some workers to voluntarily leave. So they are caught in a bind there. But I do think we are seeing a movement away from job security to employment security. You see that in some of these innovative labor management contracts where they are focusing on providing training, counseling and relocation assistance or helping the worker find another job even if it's at a different plant.

I think that workers would feel comfortable with that if they didn't have to move quite a distance. It does not necessarily mean that workers insist on keeping the particular job they have. It's employment security that is more important. So maybe there is some room here for firms to work with other firms in an area and not necessarily have to commit to a particular job within a company.

Representative WYLIE. One of the potential problems of workers changing jobs several times in a career is the loss of so-called vested pension at retirement coming at it from the other direction. In the Federal Civil Service there is portability in pension plans from one Federal agency to another. None of you have mentioned this particular aspect of employment opportunity. Is this a major issue or something that we should consider as a major issue?

Mr. Tornatzky.

Mr. TORNATZKY. I have no particular expertise in this area. So I will defer to my colleagues.

Mr. STERN. I'm not a pension expert either. Currently under ERISA, as I understand it, the pensions vest at 7 years, I'm not sure that's correct, but it may be that an earlier vesting might be warranted.

Ms. FLYNN. I'm not a pension expert either. However, it seems to me what we are trying to do is encourage flexibility and mobility, and one of the best ways to do that is to have vested pensions, and health care that goes from one job to the next job.

Also with all these dual-career families it seems to me that we have to have some relocation assistance for spouses as well. It's getting much more difficult with two people working in a family and this really hasn't been looked at in much detail yet.

Representative WYLIE. We have been talking about international comparisons here, and I would suggest that our economy has created more jobs since 1982 than all of the other advanced industrial nations combined. So while there are problems, let's not forget that there are in some respects evidences of us doing a pretty good job as far as our employment standards are concerned. Is that a fair observation?

Ms. Flynn.

Ms. FLYNN. I think there are jobs. Today we are focusing on blue-collar workers, and the problem is that a lot of the jobs that are being created are in the service sector or outside of manufacturing, and this really causes problems for displaced blue-collar workers.

The evidence shows that the vast majority of blue-collar workers who are displaced choose to go back into manufacturing and declining industries rather than move into the growth sectors.

They are finding it very difficult to move into the growth areas because of education and skill gaps. Those that have moved into the growth sectors have suffered both with respect to pay and status. So even if those jobs are growing, that isn't going to help a large portion of the blue-collar workers that we have in firms today unless we do something about skills and training.

Representative WYLIE. I want to raise a question which Chairman Hamilton asked a little earlier, and that is who is best qualified to determine what training programs are needed to improve productivity at the manufacturing level, the individual company, and someone said training at the workplace is perhaps as good a place as any to start, State or local government or the Federal Government?

Mr. STERN. Well, I would say there ought to be a collaborative meeting of minds on this, and especially getting back to Mr. Tornatzky's point about the small firms, that what you find around the community colleges, for example, and in some cases quite effectively growing up is an advisory group mechanism, but more than just advisory, one that has real clout representing local employers and specifying the content of training that will be useful to a number of employers within the same industry in a given local labor market. I think that has proven to be a viable mechanism and ought to be reinforced.

Mr. TORNATZKY. I would agree with Mr. Stern on that point, but add to it that one other stakeholder would be those producers of capital goods that serve those markets.

Representative WYLIE. OK. But you all would agree perhaps, if I'm reading you right, that the best effort the Federal Government could make would be to provide a setting for better educational opportunity?

Ms. FLYNN. Well, I think there are other roles for the Federal level as well. It seems to me that an awful lot is going on at local and State levels that other localities and States don't know anything about. We are constantly recreating the wheel it seems. The Federal Government should put money into research and development, it should disseminate examples of best practice as well as worse practice. We often learn best from what went wrong in other States or in other local areas. Also, there has been next to nothing done on evaluation of these new types of programs. This is something that should be done at the Federal level rather than having efforts replicated across 50 States.

So while I agree with the other two witnesses that the content of the individual training programs really belongs at the local level, there clearly seems to be a role for the Federal Government as well.

Representative WYLIE. Mr. Tornatzky.

Mr. TORNATZKY. I wonder if I could tag on that a bit. I share many of Ms. Flynn's observations. In particular I think it would be useful to understand this so-called infrastructure a little bit better because it's a highly diffuse system that really is a nonsystem, and for the user, either the company or the individual worker, it's very

difficult to find a map of what is offered and what is available and how do you get services.

Mr. STERN. If I might add to that, there is an interesting initiative undertaken by Pacific Bell in trying to organize, to broker in effect courses that exist in various 2- and 4-year colleges in the area. It's very hard for an individual who is employed to go out and find a coherent sequence of courses or training experiences. I'm amplifying what Mr. Tornatzky just said. In this case a company has taken the initiative to try to make a coherent sequence of courses available to its employees by bringing them on company premises. This is an interesting innovation, but I think it's the kind of thing that would be beneficial in many settings.

Representative WYLIE. Well, we have to explore adjustments in this area from many different viewpoints apparently.

Thank you very much, Mr. Chairman.

Representative HAMILTON. Thank you, Congressman Wylie.

I am informed that California, Mr. Stern, has some kind of a funding program for training. Do you know what that program is?

Mr. STERN. Yes, sir. I was briefly referring to it before. It's the employment training panel. Several years ago there was miraculously a surplus in the unemployment fund, and the decision was to use some of that surplus to pay for training that would be preventative in nature, that would prevent unemployment, and that's the skill upgrading.

Representative HAMILTON. How long has that program been in effect?

Mr. STERN. My recollection is that it started in 1978.

Representative HAMILTON. Is it working reasonably well?

Mr. STERN. It's regarded as very effective, yes, sir. It has received very good reviews.

Representative HAMILTON. Who qualifies for it?

Mr. STERN. Well, the initiative has to be taken by employers.

Representative HAMILTON. They apply for money from the State for training?

Mr. STERN. Yes, in effect. It's usually done through some intermediary, and the training is performance funded. That is, the training money does not flow until a person has been placed for at least 90 days in a job after having completed the training.

Representative HAMILTON. Is there any evidence that that program simply pays for training that the firms would have paid for anyway themselves?

Mr. STERN. Well, that has been my concern about the programs, and I have had some exchanges with the people in charge of that program about this. But I think they are trying more carefully now to target the training so that there can be some impact either on job creation, net job creation within the State helping to attract new employers or preventing existing employers from leaving or accomplishing some kind of change in the company's human resources policy toward again this idea of viewing their employees as assets.

Representative HAMILTON. Does Michigan have anything like that?

Mr. TORNATZKY. We have analogous programs. Often these are tied to modernization activities as well. For example, we have an

agency called the Michigan Modernization Service, and I think you've had prior testimony on this program. It provides diagnostic services and suggestions for modernizing technology in a plant. They come up with a modernization plan and in parallel with that apply for training moneys from State agencies.

Representative HAMILTON. Is that a large program?

Mr. TORNATZKY. That's a significant program.

Representative HAMILTON. How many firms in Michigan would be taking advantage of that?

Mr. TORNATZKY. Oh, I don't have those numbers in front of me right now.

Representative HAMILTON. Twenty or 500?

Mr. TORNATZKY. It's in the hundreds.

Representative HAMILTON. In the hundreds.

Mr. TORNATZKY. Yes.

Mr. STERN. In California it's $55 million a year that is allocated from this program.

Representative HAMILTON. Do you have any idea how many firms use it?

Mr. STERN. Again, it's in the hundreds.

Representative HAMILTON. Does Massachusetts have anything like that, Ms. Flynn?

Ms. FLYNN. Well, we have several programs to help mature industries and get workers to move between firms. We have centers for excellence. I'm not that familiar with them myself in terms of the numbers.

Representative HAMILTON. You're not aware of any training money that is provided by the State for firms?

Ms. FLYNN. We have training money, and we also have technical assistance funding for especially the smaller firms that were referred to earlier.

Representative HAMILTON. Now in your list of things that you thought the Federal Government could do you did not include training programs by the Federal Government if I heard you correctly.

Ms. FLYNN. Do you mean actually providing the training or providing the funds?

Representative HAMILTON. Well, either. I didn't hear either one of them.

Ms. FLYNN. Well, basically I personally believe that the Federal Government could have some venture capital funding for experimental types of programs.

Representative HAMILTON. Now I'm focusing on training here.

Ms. FLYNN. I'm referring to training. Earlier I mentioned that in the skill training life cycle, the firms usually start providing the training when there is a new skill involved and then the schools pick it up. There is a problem with getting the schools to pick up the training and the Federal Government, it seems to me, could have funding for experimental programs for training to be provided.

Representative HAMILTON. We don't do anything like that now?

Ms. FLYNN. Occasionally that is done. For instance, with high technology it was done.

Representative HAMILTON. With Federal money?

Ms. FLYNN. With Federal funds, yes.

Representative HAMILTON. Mr. Tornatzky, you were kind of shaking your head there. Do you see a role for the Federal Government in providing funding for training programs?

Mr. TORNATZKY. Yes. I think we have to modernize the manufacturing base and if there are resource limitations I think there is a significant role the Federal Government can play to redress those resource limitations.

Representative HAMILTON. But of course we have a few resource limitations on the Federal Government as well.

Mr. TORNATZKY. Understood. [Laughter.]

Representative HAMILTON. How much of our production problem in these plants is simply a matter of work ethic?

Mr. TORNATZKY. I believe that suitably trained and suitably motivated and suitably managed the American worker is the equal of any in the world, and I think one of the things that the Federal Government can do, this committee and other entities, would be to celebrate that fact.

Representative HAMILTON. You don't see any decline in the work ethic?

Mr. TORNATZKY. No, sir.

Representative HAMILTON. Is that a common view among you, Mr. Stern and Ms. Flynn?

Mr. STERN. I think Mr. Tornatzky stated it very eloquently and I would agree with that. I think to the extent that there is a problem with the work ethic, it has to do with failures of management.

Ms. FLYNN. I also find no problem with the work ethic. There are clear cases where worker support is very important for change at the workplace. If you have worker support and supervisor support, then it seems that you can do almost anything at the workplace no matter how large the changes, no matter what the technology is, and no matter what kind of retraining is involved.

If you have a workplace where either the supervisor is concerned about loss of responsibility or job or the workers are concerned about their jobs, then very minor changes—very simple change that you think could be implemented overnight—get bogged down. There are worker support questions, but I wouldn't attribute it to questions of the work ethic.

Representative HAMILTON. Mr. Stern made an interesting comment there. He puts the responsibility here on management, if I understood you correctly.

Mr. STERN. Yes, sir.

Representative HAMILTON. Do the other panelists agree with that? The problems that you're talking about here in general about the utilization of the blue-collar worker, you basically hold American management responsible for these problems; is that correct?

Mr. STERN. Yes.

Mr. TORNATZKY. Yes.

Ms. FLYNN. It is management that is usually the source of deciding what technologies to adopt and when to adopt. Management usually is the source of the allocation of tasks among jobs as well. There might be some restrictions with union contracts, but those are relatively few.

Mr. TORNATZKY. Let me amplify my yes a little bit. One of the more significant needed changes in American manufacturing is the use of various quality management techniques, statistical process control and various kinds of philosophies of that sort.

One of the major obstacles to effectively using those approaches is getting management behind the efforts. For it to really work in a company, there has to be a top to bottom commitment with significant leadership by management, and often that is what gets in the way.

Representative HAMILTON. How do you describe the role that the community college system or the technical colleges should play in all of this?

Mr. TORNATZKY. They are doing a couple of things. There are degree programs in various technical domains or certificate programs, and they are also doing customized training. The latter tends to be focused around a particular system or a piece of equipment that is being implemented.

I think one of the things they are not doing very well, or at least not consistently well, is the training of manufacturing generalists: the worker who can operate an array of new equipment, but also understands some of the principles and issues and concepts that really underlie advanced manufacturing technologies and practices.

Representative HAMILTON. The community colleges and the technical colleges are too specific, is that it, and too focused on particular kinds of training?

Mr. TORNATZKY. I think they are by and large doing an excellent job, but because of a lot of market considerations, what small companies will pay for and what State agencies will pay for, they tend to fall just a bit short. I think of all the public or quasi-public entities, they are probably doing the best job.

Mr. STERN. I think that they deserve very high marks for being entrepreneurial and responsive, and given proper incentives I think they can be a very flexible instrument for policy. An example of that is a national program that General Motors has organized using community colleges to prepare mechanics for auto dealers, and this is a national program but it operates locally. So that a person comes into the program, spends some time both working in a dealership and taking courses at the community college and ending up at the end as a trained GM auto mechanic.

Representative HAMILTON. And GM picks up the bill on that?

Mr. STERN. I do believe they provide some kinds of support. I'm not sure if they pick up the tuition bill.

Mr. TORNATZKY. This is a good example of aggregating demand. An individual auto dealer or even group of auto dealers could not afford to bankroll this program's development. On the other hand, since the skill needs are similar across a wide swath of users that is geographically separated, you could aggregate demand and create a first-rate program and deliver the needed skills.

Representative HAMILTON. Who pays for it?

Mr. TORNATZKY. Well, in this case GM has been farsighted. In other cases there may be a need for public intervention.

Representative HAMILTON. Is GM training mechanics for Chrysler and Ford?

Mr. TORNATZKY. I doubt that.

Representative HAMILTON. I would, too. But the way you described the program makes me think they are.

Mr. STERN. They are running some risk of doing that. There may well be some graduates of the GM program that go to work for other dealers, and that has been a traditional disincentive for this kind of training by industry. That is what I think underlies the market failure that I mentioned before.

Representative HAMILTON. Congressman Wylie.

Representative WYLIE. Thank you, Mr. Chairman.

I think the chairman and I may be emphasizing the same concerns in a little different way by rephrasing the question. I asked could the Federal Government be doing a better job in education, and the chairman asked could we be doing a better job in vocational education or could we do a better job in training.

That leads me to this question, does our educational system for higher education pay enough attention to vocational training? I would say that in Ohio we have a very good system of vocational education and maybe it has been helpful to us.

Are we putting too much emphasis at the college level on training so-called white-collar workers? That's what my father used to like to refer to us as. He always wanted me to be a white-collar worker, and he was a blue-collar worker. Are we putting too much emphasis at the college level on the training of white-collar workers, when the distinction between white-collar workers and blue-collar workers may be disappearing if I read your testimony correctly this morning, Mr. Tornatzky?

Mr. TORNATZKY. I think yes. Those institutions of higher education that are addressing the training issue tend to be 2-year level community colleges. Universities and colleges by and large are not. Major universities are not. The National Science Foundation is not. They fund programs in science education, but you will look far to find a program focusing on technical education and training, although it's just as important for the whole technology life cycle. And if you look in colleges of education, by and large research intervention on training activities tends to be in a few isolated centers of excellence.

Mr. STERN. I would simply add from an economic point of view that the recent evidence is that the earnings advantage from a 4-year college degree have increased in the past 8 or 10 years or so. There was a dip during the mid-1970's, but now it seems that the return to a 4-year liberal arts kind of college education seems to be at an all-time high. So from a narrow economic point of view, I guess that says that we are not overinvesting in that kind of education.

Ms. FLYNN. At least when you're talking about 4-year colleges, I don't think we overemphasize liberal learning. It seems to me that over and over again we hear employers asking for people who are ready to learn. In many respects they want generalists who are willing to become specialists over and over again within the firm and be flexible.

So I think it's important to keep in mind that technological change and all these changes really requires workers who are willing to be flexible and pick up new skills as the skill needs change at the workplace.

Representative WYLIE. And yet, Mr. Stern, to follow up on that, you say we need to emphasize the training in the workplace more than we have, that that's really key to this transition. You say in your testimony what is new is not the concept that nonsalaried workers have useful ideas, but the recognition that this is a key to competitiveness. How does that phase in with what you've been telling us?

Mr. STERN. Well, in this country it seems that we do have generally a two-track system. Now, I'm not saying I like this tracking idea, but it seems to be what exists, that if you want to go into management, you go for the 4-year degree, and the economic indicators, as I mentioned, seem to suggest that that is paying off rather well these days for people who do that.

If you are going to take a nonsalaried kind of job, then you generally don't get a 4-year degree, and that is where I was suggesting that the workplace itself is a site where more systematic attention to learning would be very appropriate.

Furthermore, I think that some of the powerful and effective kinds of learning take place when schools and workplaces are joined together as in the General Motors program that I mentioned, or as in traditonal programs of cooperative education. This is another thing that exists at the community colleges: programs of cooperative education where people can combine paid employment with formal classroom study, and I think that is a viable approach.

Representative WYLIE. You mentioned something, Ms. Flynn, about the Government providing venture capital as seed money in this process of transition, and I'm not sure I understood what you meant by that.

Ms. FLYNN. Well, a few years ago when everyone was talking about high technology and training for high technology, it seems that most schools though that you had to start producing computer programmers and technicians and that was how to prepare for high technology.

Under the Vocational Education bill there was money set aside for demonstration programs for high-technology skills training, and there were funds that States could apply for to start new programs. It had to be a new program and closely monitored. The Federal Government would review these and then discuss them as models for other States.

So it was venture capital money in the sense that it was experimental. It wasn't a lot of money, but it was in brand new fields and in areas in which such programs did not exist.

Representative WYLIE. But the results would be closely watched in how the money would be used. So from that standpoint it's not high risk of venture capital that we're talking about, although when you talk in terms of venture capital usually you're thinking in terms of high risk.

Ms. FLYNN. It could still be high risk. However, with venture capital, especially in these types of programs, if you monitor it and it doesn't work out, as I mentioned before, we can still learn an awful lot. These funds also encourage States to be experimental. If you found out something didn't work, then that was information in and of itself, and then you would try some new alternatives.

Representative WYLIE. You understand where I'm coming from, from the standpoint of putting Federal Government money into something. We don't want to talk in terms of too much riskiness, I'll tell you that.

Mr. Tornatzky.

Mr. TORNATZKY. I guess now that I understand what you meant, I would strongly agree with Ms. Flynn, who is really advocating in effect a programmatic experiment or series of experiments. One of the problems with the so-called training infrastructure is the people who run training programs never gather data on them, and the people who gather data on the training problems never run programs. So there is really a disparity of experience which doesn't help us much.

Representative WYLIE. OK. I think I have pinned that question down. Thank you.

Representative HAMILTON. I just have one other question, and that is the unions. Where do they fit into all this?

Mr. STERN. I was wanting to bring that up myself, Mr. Chairman.

Representative HAMILTON. I'm glad I got to it.

Mr. STERN. The unions have had a longstanding commitment to training efforts in many cases. Of course, there are the traditional apprenticeship programs and in many cases the industrial unions have negotiated substantial training programs for their own members. I think there is considerable interest on the part of members of the labor movement to involve the unions more widely in an across-the-board skill upgrading effort on the part of nonsalaried workers.

Representative HAMILTON. Do you have the general impression that the unions in the country are meeting their responsibilities in this area?

Mr. STERN. I think that they have been staunch supporters of training and skill upgrading for their members.

Representative HAMILTON. These training programs that you're talking about are training programs the union pays for and manages and puts on, or are they programs done in conjunction with management?

Mr. STERN. There is a range of practice. The payment usually comes from the collective bargaining settlements. So it's in a sense in lieu of wages, and often there is a kind of joint governance of the program. Sometimes there is more control by the union and sometimes it's a joint effort. A conspicuous well-known example is the UAW again which negotiated joint training programs with the big three auto companies.

Representative HAMILTON. In summary then I think you all see the talents of the blue-collar worker as a source of considerable strength in the U.S. economy and one that we probably are not utilizing fully because we are not managing it as effectively as we should. Is that a fair summary of your views?

Ms. FLYNN. Yes, it is.

Mr. STERN. Yes, sir.

Mr. TORNATZKY. Yes.

Representative WYLIE. Mr. Chairman, could I just ask one more question?

Representative HAMILTON. Sure.

Representative WYLIE. You got into something about labor's role in this, and I tried to allude to it a little while ago by the structured role of labor relations in our economy vis-a-vis the way we find it in some other countries like Japan, but does the adversarial relationship, using the words advisedly, between labor management in our country detract from the transitional training programs which might otherwise be put in place?

Mr. STERN. It might. Controversy can arise, for example, over the issue of whether literacy education should be mandatory or voluntary, and if this kind of thing gets embroiled in an adversarial process, I think it's highly counterproductive.

Representative WYLIE. Am I wrong in my concept that there is an adversarial relationship as far as our economy is concerned?

Mr. TORNATZKY. I would argue that the bad old days are over by and large, although there are exceptions in some industries and in some of the unions.

I would also point out if you take the case of West Germany, organized labor has in many ways a much more powerful role in how corporations operate, and those kinds of situations have worked extremely well.

Ms. FLYNN. I would argue that to some extent some degree of adversarial relationship is healthy. But beyond that there is a trend toward growing cooperation with the unions such as the examples that have been cited earlier at Ford or at AT&T. There are several instances lately of broadening job classifications, of giving up traditional rights to jobs in exchange for more flexibility and in exchange for employment security. So there has definitely been a shift within the unions to more cooperative arrangements partially brought on by the concern of so many layoffs in the manufacturing sector of late.

Mr. STERN. But without surrendering what has to be an adversarial role with regard to wages and compensation.

Representative WYLIE. Thank you.

Thank you, Mr. Chairman.

Representative HAMILTON. Well, thank you all for your participation and your statements and your responses. We appreciate it very much and the Joint Committee stands adjourned.

[Whereupon, at 11:35 a.m., the committee adjourned, subject to the call of the Chair.]

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