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ABSTRACT

The subject of this report is the impact of microelectronic technology on the process of skill formation with particular reference to two industries: banking and textiles. A recent research effort sought to identify and understand how changes in the structure and nature of skills were affecting the process of skill formation and the balance of training and preparatory responsibilities between firms and the education system. Findings indicated that the relationship between new technology and flexible production was ambiguous. In textiles, modernization was underway before the industry started its current efforts to promote flexibility and quick response. In banking, microelectronics was a crucial factor in the explosion of products and services available from financial institutions. In textiles, skilled jobs required more training and higher skills. In banking, the reduction of low-level, unskilled jobs was still more striking. When the organization of production was changed, in both industries, lower-level workers had to have an aptitude for a broader set of tasks and a more abstract understanding of their jobs. Banks have reduced their long-term commitment to workers and have cut back on internal promotions. The textile industry is also having problems with internal promotion because its unskilled work force cannot acquire additional skills through informal on-the-job training. (YLB)

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## The Impact of New Technology on Skills and Skill Formation in the Banking and Textile Industries

by Thomas Bailey and Thierry Noyelle

The diffusion of computers and related micro-electronic technologies during the last twenty years has resulted in profound changes in the U.S. production system. The age of mass production, as argued in *The Second Industrial Divide* (Piore & Sabel, 1984), is coming to an end; it is being replaced by a new economy, one characterized by more competition, shorter-run production, greater diversity, and faster changes in the output of both manufacturing and service industries.

This view is consistent with those of other social scientists (Bell, 1973; Stanback et al., 1981) who believe that the era of mass production is being superseded by one of customized production, in which producers of both goods and services strive to meet the demands of increasingly splintered and segmented markets.

Micro-electronics can play a critical role both in creating the climate for customized production and segmented markets, and in helping firms adapt to these new circumstances. When linked to critical changes in traditional institutional arrangements, including those affecting the division of labor, internal firm organization, and industrial structure, this new technology--known as distributed data processing--can bring about fundamental changes in skill requirements and the skill formation process at all levels of the occupational hierarchy.

### THE IMPACT OF MICRO-ELECTRONICS ON SKILLS AND TRAINING

Most recent research on the impact of the new computer technology on skills has been driven the "de-skilling" thesis first put forth in the mid- and late 1970s

(Bell, 1973; Braverman, 1974). Although the research remains inconclusive, our reading of the literature, as well as the results of our own research in the banking, insurance, textile and apparel industries, suggests that micro-electronics in and of itself can have ambiguous effects on the skills required to carry out the tasks involved in the production of goods and services. But when it is linked to organizational and institutional changes needed to respond to the emerging demands of today's market and competitive environment, several generalizations about the effects of micro-electronics emerge:

- Micro-electronics is eliminating, rather than increasing, the lowest skilled jobs, at least in core manufacturing and services firms. To the extent that the number of these jobs is growing, they are doing so outside of the large firms, either in auxiliary industries, such as food service, or in small subcontracting firms.
- Micro-electronics broadens skill requirements for middle-level jobs; one worker now may have to perform many tasks previously fragmented and performed by several workers.
- Micro-electronics calls for a growing cadre of skilled technical and professional personnel and greater specialization of managerial personnel.

Surprisingly, the research on employment and technology has little to say about the impact of micro-electronic technology on the process of skill formation.

Neither has it sought to identify trends in training processes or the educational and training implications of the changes underway.

Our research, then, seeks to identify and understand how changes in the structure and nature of skills are affecting the process of skill formation and, in particular, the balance of training and preparatory responsibilities between firms and the education system. It does so, initially, through research in two industries: banking and textiles.

### CHANGING SKILLS AND SKILL FORMATION IN THE BANKING INDUSTRY

In banking, computerization has contributed to a proliferation of products and services, increased customization, greater emphasis on dealing with customers, sharpened competition, and rapid market shifts. Moreover, market and technological developments are causing major changes in the traditional structure of skills, and the entire process of skill formation is being reshaped as a result.

The developments that took place at two medium-size banks--Bank A, a bank in a major regional market center with a well-developed branch system, and Bank B, a wholesale institution that serves corporate clients--illustrate changes in skill requirements and formation in this industry.

**Bank A.** At Bank A, middle-level jobs were significantly altered by the introduction of new technology and the proliferation and diversification of consumer services--themselves the products of new technology. These developments were particularly evident in the branch system, where just under one-third of the bank's employees were employed.

In the early 1980s, when competition intensified, products multiplied, automation facilitated product delivery, and consumer sophistication increased, the bank began to shift from an emphasis on "order taking" to a new emphasis on "selling." Selling the new products required a different type of employee than the local high-school-educated worker previously employed by the branch banks. Initially, the bank split ten or twelve full-time jobs in each branch into part-time jobs to reflect its peak hours, and advertised for college-educated people to fill them.

The bank also needed branch employees who could play a key role in both managing the bank's ongoing relationship with customers and selling the bank's products.

Today, bank management considers a two-year college education to be a minimum requirement for carrying out the problem-definition and problem-solving functions that are now an

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essential part of the job. The bank provides additional training for product knowledge (the number of products has leaped from five or six to several dozen in only ten years), customer service, and sales skills. At the same time, there has been a shift away from lesser educated clerks who worked primarily on specialized form-handling tasks. The total of these changes is a sharp rise in both entry-level educational prerequisites and in-house training.

**Bank B.** At Bank B, the impact of new technology has rested more heavily on upper-level employees. Wholesale banks, such as Bank B, offer corporations a broad array of transactional services and thus have traditionally had many small departments and a high ratio of managers and professionals to clerks. Nearly 40 percent of the employees are officers, and there is a substantial share of technical personnel just below the officer level.

Previously, most employees were hired just out of high school, entered in clerical positions, and learned the business as they moved up the ladder. Today, wholesale banks offer corporations a great many new, typically computer-based services; to develop and sell the new products, specialists and experts are needed such as system engineers, system analysts, actuarial specialists, and security traders. The old "generalist" managers at Bank B did not have the requisite skills to fill these positions, nor did they have the expertise to develop an in-house system and to recruit specialists in the outside market: system analysts and programmers, securities traders, and human resources managers to refocus the whole human resource strategy of the bank. Thus, for example, the bank has had to purchase a corporate cash management system from an outside vendor.

At present, the bank is recruiting MBAs for positions as loan officers and credit analysts, supplementing their training by sending them to graduate-level finance courses, and putting them through an 18-month job-rotation program within the bank. Software development projects are staffed with in-house personnel and

outside specialists hired on a project basis.

**Lessons.** Several lessons have emerged from our banking industry study:

- The industry is undergoing a fundamental reshuffling of skills and training, which puts enormous pressure on banks to hire, train, or otherwise develop a very different kind of labor force, at very different levels of the occupational structure than they did ten years ago.
- The impact of computers on the development of new banking services and markets has been at least as important as their impact on the reorganization of traditional functions, such as checking and savings accounts.
- There are differences in the impact of technology on various occupational levels. The development of an enormous number of number-crunching activities has eliminated the need for most *low-skilled jobs* (file clerks, messengers, and low-level statistical clerks).
- Enhanced communication and information processing has led to a broadening of skills for middle-level personnel. Many responsibilities associated with customer interaction are filtering down from the upper-tier to middle-tier personnel.
- *Upper-level* personnel are increasingly expected to be specialists--accountants, system designers, marketers, product developers, bond traders, and so forth--rather than generalists trained primarily to manage the clerks who deliver the banking service.
- The industry now relies more on outside education, although there has also been an increase in product training and certain kinds of behavioral training that are not provided adequately by the traditional education system.
- Institutional factors have acted to constrain the process of adjustment. A corporate

tradition of internal promotions and a corporate culture that emphasizes firm loyalty created a tremendous strain on the firms' ability to change.

### CHANGING SKILLS AND SKILL FORMATION IN THE TEXTILE INDUSTRY

The broad changes affecting the economy in the last decade have had profound effects on the U.S. textile industry. Imports have continued to grow, and the industry has needed to produce an increasing number of styles and fashions. Although the training needs of the industry are changing, its efforts and the education system's to work together have met with only sporadic success.

The system of education institutions and firm-based training that prepares the industry's work force has been hit by two interrelated yet separate shocks: (1) workers must be trained to operate, maintain, and repair new sophisticated equipment, and (2) the shift in focus to service, quality of product, and flexible manufacturing processes requires production workers to have new skills and abilities.

There are many studies of the textile industry and textile technology, yet none focuses on the interaction between technology and industry training. The information provided here was developed in extensive interviews--in six firms in 1985 and six in 1987, three of them repeated from the earlier interviews, and in interviews with faculty at several education institutions. The smallest firm had just over 1,000 employees and the largest had over 50,000; all were engaged in technological or educational innovations.

Since the 1970s, the textile industry has been experiencing a revolution in production technologies, demand for the industry's products, and competition, especially from abroad. Its use of low-skilled labor and the widespread diffusion of the basic textile production process has made the industry especially vulnerable to competition from cheap foreign labor. Many marginal firms have closed and the survivors have

carried out major modernization and automation programs.

Historically, U.S. textile firms have preferred to concentrate on large production runs of standardized items for a mass market (Toyne et al., 1984, ch. 8). However, the greater segmentation of markets, faster changing of styles, and faster-changing fashion seasons have shrunk the market for large production runs of identical fabric.

Thus, the textile industry had to become more responsive to an increasingly volatile and varied market. But there remains a conflict between cost and flexibility that technological progress has been slow in resolving. New management practices and new ways of organizing production within the same technological setting can also resolve the conflict, and these innovations as much as the technology itself have profound implications for recruiting and training workers.

Many firms are experimenting with innovative methods of production organization, management, and training of their employees, but these steps are still tentative and only beginning to take hold in the largest firms. Moreover, experiments often include only one department or, in a multiplant firm, one mill. Nevertheless, managers who have experimented with changes in the division of labor believe that improvements in efficiency throughout the plant can be made by switching from a narrow, task-oriented conception of the worker's role to one in which teams of employees work together to accomplish a joint project. The central question for purposes of this study is how the education system needs to adjust so that it can most effectively prepare a work force for a modern and flexible production process.

**Changing Skills.** In the textile industry, skill needs are rising, and the ratio of operators and laborers to more skilled workers is falling. At one time, many jobs in textiles simply involved moving material from one place to another; many of these jobs have been eliminated by automation. At the same time, the increased sophistication of the machines has reduced the number

of operators relative to more skilled maintenance and repair personnel.

Even though the number of operators has been reduced, many operators' jobs are actually more demanding. First, because modern machinery is more expensive and errors more costly, operators must have a broader understanding of the production process. Second, because of the increase in the number of styles produced by each mill, many operators are likely to be engaged in a greater variety of activities. As a result, some firms are experimenting with broader job definitions and teamwork strategies.

Most machines now have microprocessors and other electronic components as well as sophisticated sensors and yarn splicers and knotters. Thus, skilled technicians must be able to follow complicated manuals and updates provided by the manufacturers. Obviously, literacy is much more important. Also, the increasing demands as a result of greater style changes, more involvement with product development, and practical innovations are changing technicians' work even more than operators'.

**Skills Formation.** The traditional employment structure in the textile industry called for the internal promotion of employees from unskilled, entry-level jobs to progressively more complex operator jobs. Those with aptitude and interest were then trained as fixers or supervisors, and sometimes even plant managers. With the exception of generic occupations, such as air conditioning mechanic, skilled textile workers had no specialized training and usually were not high school graduates.

One implication of this system is that there is not much of a role for a junior college or vocational education system in the training of skilled workers for the basic textile jobs. For example, in North Carolina, the state with the greatest number of textile jobs, there is little interaction between the industry and the community colleges.

However, the old system of internal promotion is increasingly problematic. Employers are having difficulty in promoting their unskilled and semi-skilled employees. As a

result, three trends are beginning to emerge:

- An increasing concern for the quality of secondary school education;
- An increase in training by the textile firms and equipment manufacturers;
- A small increase in the use of the community college system to upgrade current employees.

There is no trend toward hiring community college graduates with no textile experience directly into skilled production-level jobs. Instead, the industry is trying to incorporate the additional educational demands into the traditional internal promotion system, either through internal training or through using the community colleges for upgrading.

**Implications for the Future of Textile Education.** *Education Content.* An analysis of the textile industry's education needs in relation to the industry's markets and technology reveals that:

- The industry needs a work force with better basic literacy and technical skills. Thus, it has a large stake in the quality of the local secondary education system.
- Since workers at all levels are expected to operate in a more uncertain and less well-defined environment, they need to have a more abstract understanding of their various roles. Educators need to develop an understanding of how they can better prepare students at all levels for such an environment.
- As work moves from a mass production focus to one that emphasizes flexibility, group interaction and social skills become more important for skilled and less-skilled workers alike. Students' abilities to work cooperatively need to be strengthened.

*Internal and External Education and Training.* Rather than focusing on the hiring of skilled workers from the outside labor market, the long-run interests of the textile industry would be better served by

strengthening the basic preparation of the industry's work force and developing appropriate measures to promote internal upgrading.

*The Role of the Community Colleges.* The internal training strategy appears to leave little role for the community college or vocational education system since the industry would still take entry workers without post-secondary education and subsequently upgrade them. Nevertheless, these institutions could become sources of educational extension and mid-career upgrading.

### CONCLUSIONS

The technological and market changes that are the focus of this report have had profound effects throughout the economy. The main conclusions, drawn from case studies of the banking and textile industries and other research on technology and skills, are discussed below.

*Technology, Flexibility, and Work Organization.* The relationship between new technology and flexible production is ambiguous. In *textiles*, modernization was underway before the industry started its current efforts to promote flexibility and quick response. In *banking*, micro-electronics has been a crucial factor in the explosion of products and services available from financial institutions. In both industries, technology alone was unable to produce sufficient flexibility without organizational change.

*Skill Changes.* The effect of new technology on the nature of required skills continues to generate controversy. Many analysts argue that modern micro-electronic technology is generally used to lower skill requirements--to de-skill jobs.

In *textiles*, skilled jobs require more training and higher skills. While there has been no proliferation of low-skill jobs, some such jobs still exist, and they may require even fewer skills than previously. In *banking*, the reduction of low-level, unskilled jobs is still more striking.

When there are changes in the organization of production, in both the banking and textile industries, lower-level workers must have an aptitude for a broader set of tasks

and a more abstract understanding of their job in general.

*Preparing the Skilled Work Force.* Over the last five years, banks have been reducing their long-term commitments to workers, reducing internal promotions, and increasing the number of ports of entry to which access is determined by educational credentials. They have also been relying more on short-term and part-time workers at lower levels and specialized professionals at more skilled levels.

The textile industry is also having problems with internal promotion because its unskilled work force can't acquire additional skills through informal on-the-job training. One option would be for textile employers to shift away from internal promotion, separate lower-level employees from skilled workers and supervisors, and create a new port of entry at the level of the technician or skilled worker. Thus, the skilled workers would be hired directly from vocational schools or community colleges, and it would no longer be necessary to hire promotable workers at the lowest levels.

However, there is no discernible trend in this direction, for several reasons: (1) it is difficult to hire community college graduates because students generally go to the colleges to find jobs outside of the mills. Substantial wage increases might solve the problem, but employers wish to keep costs down; and (2) community colleges cannot make the capital expenditures necessary to keep their equipment up-to-date.

Thus, the textile case seems to contrast with the evidence from other industries. Indeed, by increasing emphasis on internal training to facilitate promotion of their unskilled work force, this industry appears to be strengthening rather than weakening its internal labor market.

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