

Policies, Recommendations, and Conclusions

The Changing Context for Technology-Based Work

Demand for computer and information technology professionals skyrocketed in the 1980s. From tools largely associated with large businesses, defense agencies, and scientific research, the advent of personal computing put the data handling, computation, production, and analysis functions of computers within easy reach of every economic sector. Productivity gains by American workers were attributed by many economists to incorporation of technology into the workplace, whereas others remained skeptical about technology's impact largely because of the difficulties associated with measurement.

As technology permeated every sector of the economy, the demand for computer scientists and IT professionals increased. With growing demand came growing supply as workers sought skills to give them access to high-paying jobs and almost certain employment. Bachelor's degrees in these fields were not the only ticket to IT/CS jobs; many people migrated from other subject areas, learned computing, and/or gained credentials through certificate programs.

The introduction of technology created new job classifications, but also began to change the nature of work in familiar jobs. A study by the National Research Council, for example, sought to address the effects of technology on women's employment, especially in job categories where women dominated. The findings, documented in *Computer Chips and Paper Clips: Technology and Women's Employment*, painted a mixed picture.¹ There was a net loss of low-skill jobs associated with technology, including positions such as data entry and other "back office" work largely filled by women. But there was a gain in the category "administrative assistant," for example, with an upgrading of the

support functions associated with office work. With this shift, there were, as always, "winners" and "losers." New entrants into these job categories, often women of color, tended to lose, since they had often used low-end data entry positions as stepping stones to higher-end administrative support jobs. Those with greater access and skills added computing functions (e.g., database development, spreadsheets, etc.) and enhanced their employment positions. Low-end jobs were also most ripe for export, as data entry was often moved offshore.

The diffusion of the Internet placed even greater value on those with computing and IT skills. In 1998, business and industry lobbied for an increase in the number of H1-B visas, from 65,000 to 195,000 over a five-year period, fueled largely by difficulties in hiring Americans to populate the highest skill ranks of computer professionals. Many within the computer fields have argued that no shortage really existed in the supply of IT professionals, but instead, that the push was motivated by industry's desire to recruit foreign nationals who would command lower salaries.

An alternative supply source has existed throughout this period, i.e., increasing participation by women and minorities in computer science and information technology. But, in fact, there was a significant decline in women's proportion of computer science bachelor's degrees from its high in the mid-1980s over the decade of the 1990s. In light of the ease of identifying talent in IT/CS fields from sources such as India and Ireland, many programs made little or no effort to tap into the underused American base.

With the dawn of the 21st century, concerns about adequate numbers of American IT and computing professionals have multiplied. These concerns have been fueled largely by the following:

- Continued expansion of computing and IT functions in all sectors of the economy
- Evolving job functions with the integration of computing
- Decreasing opportunities for/increasing difficulties in importing talent in a post-9/11 environment
- Enhanced demand for U.S. citizen IT/CS professionals in security and defense fields for related agencies and departments and their private sector contractors

This study sought to reveal policies, practices, and targets of opportunity for increasing output and use in IT/CS fields by underparticipating groups—namely, women and minorities. The study focused on a region with strong demand (Washington, DC, Virginia, and Maryland) that is also well known for robust preparation programs.

As noted in previous chapters, represented among the leading producers of IT/CS degrees for women and minorities are a number of proprietary institutions. Yet the major federal program investments flow to an entirely different set of universities and colleges. Because students in these varying types of institutions have access to different resources and experiences, it is likely that they do not have equivalent degree programs. Students are likely attracted to the more client-centered approach of proprietary schools, especially because many of these students appear to be pursuing degrees while serving full-time in the workforce.

Recommendations on Nontraditional Pathways

1. Developing and articulating standards

Professional societies, employers, and representatives of institutions should work together to articulate voluntary program standards, such as ABET accreditation standards for engineering and those in chemistry issued by the American Chemical Society. The availability of such guidance would provide students with key information about the quality, structure, and reputation of programs—criteria that do appear to affect their employment futures.

These standards for programs should offer guidance for both proprietary and other providers to help them reach some common agreement of what

should be learned and how the resulting skills can be measured. Such accountability would satisfy students, accreditors, and employers alike.

2. “Traditional providers,” i.e., those offering full-time study opportunities, should consider expanding their client-centered options, including remote-learning coursework, to attract nontraditional students who may work full-time and/or do not seek a four-year degree.

Federal sponsors, especially the National Science Foundation, U.S. Department of Education, and the Department of Labor, should support expansion of program options described in recommendations 1 and 2 above.

3. Public and private sponsors should reexamine their support of two-year colleges and HBCUs/HSIs.

The disproportionate contribution of these institutional types to the education of minority and women students and to those seeking nontraditional educational pathways warrant increased investment. Market-sensitive sponsors need to direct their resources to where the students are who are most likely to prepare for the jobs in their industries. Nontraditional students represent a surging pool too talented and geared to market opportunities to ignore.

Who Pays?

Nontraditional students challenge us to reconsider the provision of funding assistance for education in IT/CS fields. There are at least three reasons for weighing the cost of such training: advancement, evolution of existing jobs, and overall expansion of the talent pool. Each relates to different ways to pay—student supported, employer supported, and grantor supported. Students in our study were seen to require many different forms of support for their education.²

If IT/CS is a growth segment of both the higher education universe and the global economy, then educators and employers share the responsibility for the development of talent in this area. This is especially so if the federal government and industry deem IT a “national need.” Arguably, for the last decade, this has been the case.

The rising overall cost of education and shrinking contributions by the states to public higher education has increased pressures on students and their families. Forward-looking governors in states such as New Jersey and North Carolina effectively tied the fortunes of higher education institutions to economic development strategies. Traditional students benefit from such visionary policies, but the effects on nontraditional students are harder to discern. Rising tuitions without federal student aid relief, notably the stagnant dollar value of Pell Grants, forced more would-be full-time students into part-time study. Hence, the ranks of nontraditional students swelled.

4. Public and private sponsors should develop a new collaborative aid program, administered as a competitive block grant to institutions, to allow U.S. IT students to study part-time in areas defined as “national need.” Individual or consortia of companies could target institutions that are proven suppliers of talent to their industry.

Structure of Academic Programs

Faculty knowledge (or lack of knowledge, in the case of observations about traditional institutions) of workplace needs and faculty attitudes about women and minority students are in dire need of updating and repair. For too many, stereotypes abound. Training graduates for a global workplace is a murky concept. Translating knowledge into skills is a lofty concept lacking a pedagogy.

5. The value and need for internships, co-op, and other workplace experiences is a proven antidote to the parochialism of many faculty. Invigorating traditional degree programs by augmenting both the faculty and the curriculum is essential. Such changes are likely to yield higher retention of minority and women students. Combined with financial aid, they are also likely to convert more part-time students into full-time enrollees.

It is not clear how the lack of diversity among IT/CS faculty interacts with expressed negative attitudes, for example, about minority students. The small numbers of women and minorities among advanced-degree recipients decrease their avail-

ability to diversify the pool of faculty in traditional institutions. In 2001, foreign nationals received almost half of all master’s degrees in computer science, whereas over 50 percent of doctorates were awarded to non-U.S. citizens. Whereas the advanced degree pool was not the focus of this study, the interplay between faculty composition and attitudes towards minority students can only be addressed by interactions within a more diverse faculty.

A corollary curriculum need is to emphasize the applicant’s problem-solving IT/CS skills in the admissions process rather than his or her programming experience alone. Gauging current knowledge and skills upon entry is necessary but not sufficient. Estimating potential for growth and versatility, which colleges and universities do unevenly at best, is also needed. A corollary student need is the provision of career guidance to students as well as information regarding employer perceptions, expectations, and opportunities. Market surveys on program alumni outcomes afford new students a realistic sense of where IT/CS coursework may lead and how that aligns with one’s career aspirations.

Needs of Different Employers

The federal government plays a dual role in the IT workforce. It is a critical employment sector, with concerns about remaining competitive, as well as a regulator/accountability agent for other sectors that employ IT professionals.

6. Enforcement of employment discrimination laws through the Equal Employment Opportunity Commission should be strengthened.

Glass ceilings, gender disparities in pay and promotion, and separation experiences of minorities remain workplace realities. How are they resolved, how long does it take, how are whistleblowers protected, etc.? In addition, this study found differences in the treatment by human resources departments, if not line managers, of students who have reached the workplace via a nontraditional educational pathway. This, too, is a form of discrimination totally unrelated to performance and merit-based work appraisal.

Providing a supportive work environment, of course, is the principal way of attracting and

retaining talent. Organizations such as Catalyst and magazines such as *DiversityInc* rate corporations on workforce climate by surveying women and minority employees. Similarly, Fortune 500 companies are evaluated on their receptivity to diversity and the mentoring of their senior executives. *Government Executive* does such a review for federal departments and agencies. Nevertheless, discrimination persists. If nontraditional students become a new workplace “caste,” U.S. higher education will have failed the “supply” test in response to the demand for a different, technically, and culturally competent 21st century worker.

Conclusion

The current system of preparation of “line” IT/CS professionals appears to be structured to accommodate 18-year-olds who come to colleges or universities directly out of high school. The presumption seems to be that their attendance is supported by parents, perhaps augmented by student loans. This picture is narrow and outmoded, especially for women and minorities who pursue IT/CS degrees. If one imagines that a much larger pool of talent lies beyond the vision embodied within the system currently in place, it is essential to provide multiple viable pathways for program structure, support of education, and accommodation to workplace needs.

References

1. National Research Council. 1987. *Computer Chips and Paper Clips: Technology and Women's Employment*. Washington, DC: National Academy Press.
2. Bhattacharjee, Y. 2004. “Undergraduate Education: Tweaks to High-Tech Visas Revive NSF Scholarships.” *Science* 306 (December 10): 1976.