The Outlook in 2003 for Information Technology Workers in the USA

ABSTRACT

The purpose of the IT Workforce Data Project is to identify and disseminate trustworthy statistics on information technology workers in the United States. A earlier series of reports, released in 1999, provided an overview of the IT workforce, reviewed the supply and utilization of people with appropriate academic training, examined employment of foreign-origin workers in U.S. IT jobs, and assessed the demand for talent. Now, four years later, there have been major changes in the industry:

- Employment has been declining since reaching peak levels in 2000; unemployment began to rise in 1997 and is now at unprecedented levels.
- Increased enrollments in computer science during the late 1990s have fueled a rise in the numbers of new graduates, but the demand for these new graduates is now weak.
- During the past decade, the share of foreign-born persons in the IT workforce has doubled. Use of L-1 visas for foreign employees of multinational businesses has tripled. Outsourcing IT work to foreign locations has quadrupled.

Views differ on the outlook for U.S. IT workers. The Bureau of Labor Statistics and the RAND Corporation expect strong growth in the industry, but this does not necessarily mean that all of the jobs that may be generated will go to Americans. People in the technical professions are wondering if the United States can be a cost-effective source of labor in a global employment market.

NOTE: this report updates statistics provided in the original IT Workforce Data Project series. For more information about rationales for choices of sources of data, readers may wish to consult those documents, available at www.cpst.org.

The IT Workforce Data Project

Queries about this project are welcome. The principal investigators are Richard Ellis of Ellis Research Services, Carlisle, Pennsylvania (717-218-9818 or raellis@earthlink.net) and Lindsay Lowell of the Institute for the Study of International Migration (ISIM), Georgetown University (202-687-2602 or lowellbl@georgetown.edu).

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Information technology ("IT") involves the production and application of computer hardware and software. The impacts of IT have been ubiquitous and profound, and their ends are not in sight. Already we have witnessed the automation of countless activities, personal computers everywhere, the use of microprocessors to improve the reliability and flexibility of machines like appliances and automobiles, world-wide commerce and communication over the internet, and more.

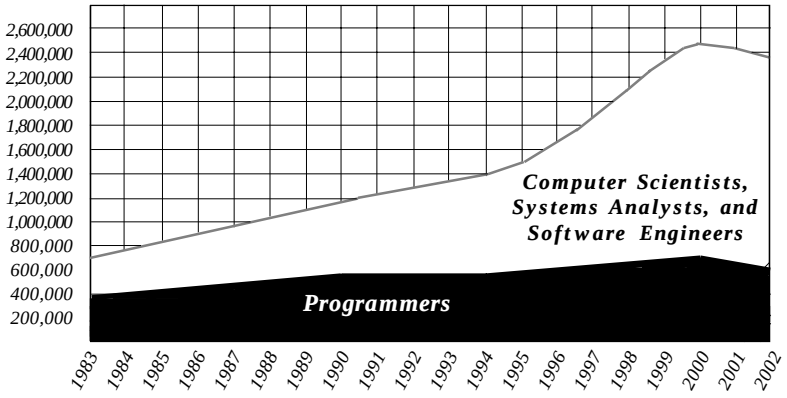
Conditions in U.S. information technology have changed a great deal since the final years of the 20th Century. An economic boom in the internet and telecommunication industries has ended. Demand for information technology specialists has swung 180 degrees and now is relatively weak. Despite these changes in economic conditions, some observers continue to maintain that the nation is not doing enough to provide an adequate IT workforce; policymakers continue to debate the merits of supplementing the supply of IT people with foreign high tech specialists brought into the country on temporary work visas; outsourcing of IT work to locations in other countries is rising rapidly; and American technical professionals are voicing increased concerns about threats to their careers.

This report provides new data and commentary on these developments, including information on:

- *Recession effects:* what has happened to IT employment since 1999?
- *Changes in the pipeline of students:* what are the recent trends for enrollments and degrees in IT fields?
- *Trends in immigration:* in a post-9/11 world, has the use of foreign technical specialists with H-1B or L-1 visas changed?
- *Trends in outsourcing:* what do new data tell us about movements of technical work to locations outside the USA?
- *Changes in demand:* what are the implications of these trends for long-range career prospects in information technology?

Figure 1

Employment in Core IT Professions, 1983-2002

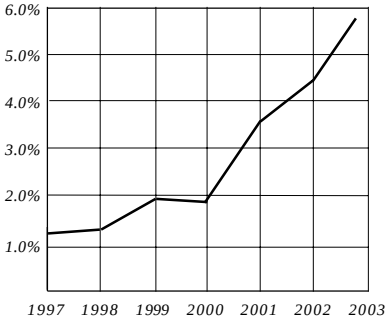


Source: annual estimates from the U.S. Bureau of Labor Statistics, based on data from the Current Population Surveys

Figure 2

Recent Unemployment Rates for Core IT Professionals

(computer scientists, systems analysts, software engineers, and programmers; annual data for 1997-2002; preliminary 2003 trends from data for first two quarters)



Source: Bureau of Labor Statistics Current Population Surveys (unpublished data)

Trends in Employment and Unemployment

In the last twenty years, the number of U.S. jobs in core IT occupations (measured by data on computer scientists, systems analysts, software engineers, and programmers) have more than tripled, from 719,000 in 1983 to 2,498,000 at the sector's peak in 2000 (see Figure 1 above). No other broad area of work in the United States has experienced such growth (and if anything, the growth has been understated; see the sidebar, below).

About 150,000 of these positions were lost in 2001 and 2002, almost two-thirds of them in programming. The occupational title of "programmer" has become ambiguous. It takes in both relatively low level coders whose work may easily be shipped overseas, and relatively high level developers of new systems, who have been hard hit by the collapse of high tech investment markets. Such conditions help explain why programming has been especially vulnerable to losses of jobs during the last two years.

As noted in our earlier series of reports, unemployment rates in the core IT professions began to rise well before the peak years of the technology bubble, going

A Large Group Now Looks Even Larger: Changes in Occupational Classification Systems, Put Into Effect in 2003, Have Increased Estimates of the Number of People in Core IT Jobs

Data are also available at this writing on employment in IT during the first two quarters of 2003, but comparisons with earlier figures are difficult. Major changes are being made in federal systems for the treatment of occupational data. Older taxonomies of job titles are being replaced with a new Standard Occupational Classification ("SOC") system. A virtue of the new approach is that it provides much better treatment of IT specialties. The old system grouped software engineers with "computer scientists and systems analysts," while hardware engineers were treated as part of electrical engineering. Programmers were treated as technicians, not as professionals. In contrast, the new SOC provides specific professional job titles for all these specialties, as well as for database, network and systems administrators; network and systems data analysts; other computer support specialists; computer hardware engineers (along with other engineering specialties); and computer and information systems managers (along with other management specialty occupations). When this new job classification system was applied to the Bureau of Labor Statistics' employment data for 2003, it seems to have led to large increases in counts of people in IT occupations. If only those specialties that closely match the job titles used in the past are counted, the numbers of core IT workers jump from 2,347,000 in 2002 to 2,939,000 in the first quarter of 2003 and 2,832,000 in the second quarter of this year. If other newly defined IT specialties such as the hardware engineers and computer and information system managers are also counted, the numbers rise again, to 3,343,000 and 3,260,000 for the two quarters, respectively. At a time when the U.S. is experiencing "the most protracted job-market turndown since the Great Depression" (Jon E. Hilsenrath, "This Recovery Feels Like Recession: Economy Expands, Payrolls Shrink," *Wall Street Journal,* May 29, 2003, page 1), these increases cannot have come from added employment. Instead, they reflect changes in the ways that data are collected and processed.

Further studies of the new occupational codes are underway at the Bureau, and will provide more detailed information about their effects on enumerations of the nation's IT workforce. In the meantime, the new estimates of IT employment in 2003 are consistent with results for the same population from a separate BLS survey, discussed in the final section of this report, of business establishments. This result lends confidence that the new numbers are trustworthy. If so, the older data may have underestimated growth in the IT professions during the latter part of the 1990s.

Figure 3

Increases in the Number of Persons with IT College Degrees, 1999-2001

Group	*Number*	*Source Data*
A. Total stock of persons with IT degrees in 1998	*861,800*	*From the IT Workforce Data Project, Report II, "The Production of U.S. Degrees in Information Technology Disciplines." Includes persons with either a computer science or a computer engineering undergraduate degree, or a non-IT undergraduate degree plus an IT graduate degree. Does not include substantial numbers of persons with degrees in business information systems, or whose undergraduate training included completion of a minor field of study in computer science.*
B. Subsequent new IT degree awards:		
1998-1999	*37,500*	*For awards in computer and information science and in computer engineering in 1998-1999 and 1999-2000, see the DIGEST OF EDUCATION STATISTICS 2001 (Washington, D.C.: National Center for Education Statistics, 2002), Tables 259 and 258. For the same data for 2000-2001, see the 2002 edition of the DIGEST (released June 2003), Table 255. In all cases, counts of people earning IT degrees were derived by adding one-third of the number of new master's degrees to the total number of new bachelor's awards. For further details and commentary on estimation procedures, see Report II in this series, cited above.*
1999-2000	*45,900*	
2000-2001	*52,900*	
C. Total stock of persons with IT degrees in 2001	*998,100*	

from 1.2 to 1.9 percent between 1997 and 1999. Levels of joblessness in IT hovered at just under two percent during the following year, and then shot up to 3.6 percent in 2001, 4.3 percent in 2002, and an average of 5.9 percent for the first two quarters of 2003 (see Figure 2).

The overall size of the sector remains impressive, although employment in IT has certainly declined and is probably continuing to do so. Job markets are reported to be especially poor in locations that were centers for dot-com and other speculative ventures. Other kinds of IT jobs entail more prosaic applications of IT in more traditional industries, and those kinds of positions have been less vulnerable.

The Educational Pipeline

The second report in the original IT Workforce Data Project series, "The Production of U.S. Degrees in Information Technology Disciplines," included points about IT training that are worth repeating here. A majority of those employed in IT jobs were trained for other professions, typically engineering or other scientific fields. In addition, the possession of appropriate academic credentials does not guarantee that a person will be working in an appropriate job. In 1999, more than a third of those with degrees in core IT disciplines were not working in core IT positions. To be sure, some of those people may have been working in closely related jobs (for example, computer or information systems managers).

The Computing Research Association (CRA) tracks enrollment and degree trends in computer science and computer engineering. The association is mainly interested in doctoral degrees, but it also tracks trends at the bachelor's and master's degree levels at the schools it surveys.

The high tech boom of the late 1990s encouraged young people to pursue studies in computer science and related disciplines. In the CRA report on trends for the 1995-1996 academic year, its author exclaimed:

> To put it succinctly: enrollments are up... Most dramatically, the number of new bachelor's students is up from 10,099 to 14,239, a 40% increase on top of last year's 5% rise![1]

This explosion in undergraduate computer science enrollments continued in 1996-1997, and more modest levels of growth were recorded after that point, peaking in 1999-2000. In the meantime, the students in the pipeline have begun to graduate, leading to record numbers of new degrees in IT disciplines through the 2001-2002 academic year, according to CRA. More comprehensive data from the National Center for Education Statistics confirm that a steep rise in the production of newly trained IT specialists has lasted through at least 2000-2001 (see Figure 3, above). Unfortunately, this rise in the supply of qualified people occurs at a time when demand for their skills has diminished. Noting that the number of new undergraduate students in computer science programs dropped slightly in the fall of 2002, the most recent CRA report says "Perhaps the decline in the technology industry is making computer science and engineering less alluring..."[2]

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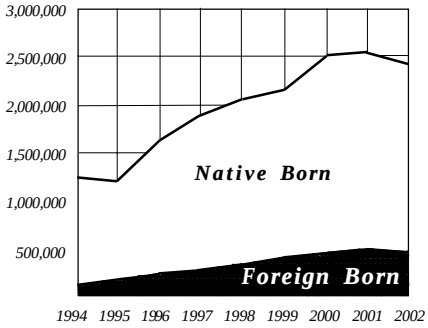
[1] Gregory R. Andrews, "1996 CRA Taulbee Survey: Grad, Undergrad Student Enrollments Up," *Computing Research News* (Computing Research Association, March, 1997), pp. 1-5.

[2] Moshe Y. Vardi *et al.*, "2001-2002 Taulbee Survey: Survey Results Show Better Balance in Supply and Demand," *Computing Research News* (Computing Research Association, March, 2003), pp. 6-13.

Figure 4

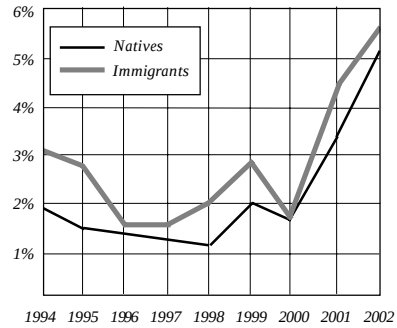
The Information Technology Workforce by Nativity, 1994-2002



Source: Current Population Survey microdata

Figure 5

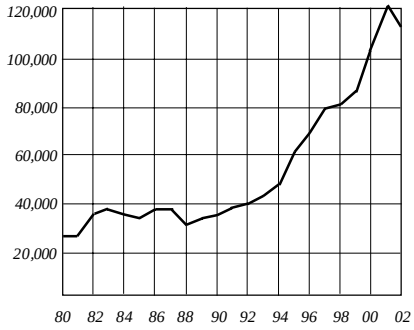
Unemployment Rates of IT Workers by Nativity, 1994-2002



Source: Current Population Survey microdata

Figure 6

L Visas Issued, FY 1980-FY 2002



Source: Wasem, op. cit, from the Report of the Visa Office, Office of Consular Affairs, U.S. Department of State

Trends in Immigration

Foreign-born persons account for a growing share of all core IT workers in the U.S., doubling from about a tenth of this labor force in 1994 to over a fifth of it in 2001. The number of immigrants in IT did not drop as much between 2001 and 2002 as did the number of natives, so the immigrant share of IT jobs continued to rise during the recent recession (see Figure 4).

Microdata from Current Population Surveys, combined in a year-long dataset known as the Merged Outgoing Rotation Group (MORG), show how immigration contributes to changes in the ethnic makeup of the IT workforce. As recently as 1996, 74.3 percent of those in core IT occupations were native-born whites. By 2002, this share had declined to 66.9 percent. Asians now account for 15.1 percent of all IT workers, and 85.3 percent of those Asians are immigrants. Nearly a third of all these Asian IT immigrants are from India. Another 5.1 percent of the IT workforce is Latino; of those, 31.4 percent are immigrants. White immigrants account for 5.4 percent of the IT labor force. The remaining 7.5 percent of the core IT workforce consists of native-born blacks and a small number of people with "other" ethnic backgrounds.

The same data show that immigrants in the IT workforce are both younger and better educated than their native counterparts. In 2002, 53.3 percent of the immigrants with core IT jobs were under the age of 35, compared to just 41.0 percent of the natives. 41.1 percent of the immigrants had graduate degrees, compared to 16.2 percent of the natives. Despite their relative youth and advanced educations, immigrants tend to be more likely than natives to be unemployed (see Figure 5).

Other characteristics of immigrant IT workers, noted in our earlier reports, continue to apply, notably their geographic concentration in a few states. In 2002, 11.4 percent of all native IT workers were located in California; nearly a third (31.1 percent) of the foreign-born IT specialists were in this state. Similarly, New Jersey accounted for only 2.7 percent of the native IT workers, but 10 percent of the foreign-born workers.

The increase between 1994 and 2002 in foreign participation in U.S. IT labor markets was facilitated by legislation that expanded the annual number of allowable admissions of persons with H-1B temporary worker's visas. These higher ceilings on admissions are due to expire this Fall; if no further actions are taken, the caps will revert to lower levels, from 195,000 in Fiscal Years (FY) 2001, 2002 and 2003, to 65,000 in FY 2004. Many persons with these visas have been reaching allowable six-year limits on their stays. Renewals of these temporary visas for workers who are already here are allowed if an application is made within three years, and the numbers of these renewals have increased. Other persons who have worked in the U.S. under H-1B visa arrangements may extend their stays by finding new employers.

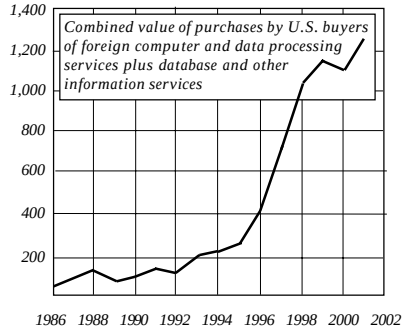
Other kinds of visas for temporary workers from abroad are contributing to increased reliance on foreign-origin IT workers. NAFTA and other trade agreements authorize TN visas that can be used by IT professionals. L-1 visas are intended to help multinational businesses by supporting transfers of executives and managers to locations in the U.S. for up to seven years, and transfers of "specialized knowledge" workers for up to five years. A recent Congressional Research Service report[3] acknowledges that firms may be using these visas to transfer

[3] Ruth Ellen Wasem, "Immigration Policy for Intra-company Transfers (L Visas): Issues and Legislation," Congressional Research Service, June 12, 2003.

Figure 7

Imports of IT Services, 1986-2001

(in millions of dollars)



Source: Private Services Trade by Type, 1986-2001, Bureau of Economic Analysis, U.S. Department of Commerce (TAB02 at http://www.bea.gov/bea/di/1001serv/ntlserv.htm)

rank-and-file employees. Some companies are reported to use employees with L-1 visas to staff service contracts with other companies. Other firms may be turning from H-1B to L-1 visas because the latter have no caps and no requirement to match local prevailing wages. The number of L visas has tripled in the last decade (see Figure 6). Indian citizens are the largest users by far, accounting for a quarter of all these visas in FY 2002. Legislation addressing these issues has been introduced in the current session of the Congress.

Offshore Outsourcing

In addition to competition from foreign temporary workers, IT professionals in the United States are threatened by a growing tendency for firms to ship technical work overseas. A measure of the trend is provided by data from the U.S. Department of Commerce on imports of IT services. These transactions have grown from under $300 million in 1995 to over $1.2 billion in 2001 (see Figure 7). A report in *EE Times*[4] cites a McKinsey & Co. estimate that "projected software and service exports to the U.S. in 2003-04 are expected to come in at $8.5 billion" from just India alone.

Outsourcing white-collar jobs has become a general business trend, and includes transfers of work in law, architecture, financial services and insurance, management, and many other sectors as well as information technology. A widely cited Forrester Research report released in November 2002 predicted that 3.3 million white-collar jobs, worth $136 billion in U.S. wages, will be shifted out of the nation by the end of 2015. This forecast includes 473,000 IT positions, over and above those already lost to earlier movements of this kind. More recent estimates dwarf the Forrester numbers. Gartner, Inc., a Connecticut consulting firm that specializes in advice on outsourcing business arrangements, claimed on July 15, 2003 that 10 percent of all U.S. professional jobs in IT services firms would be transferred overseas by the end of 2004, along with five percent of the IT positions in other types of organizations.[5] According to Gartner, offshore outsourcing has become the fastest growing IT industry segment. Certainly many IT employers are engaging in such shifts. In addition to earlier announcements from such companies as Apple and Motorola, new reports describe plans for major transfers of IT activities at EDS, IBM, Hewlett Packard, Microsoft, Oracle, Sun Microsystems, and many others.

Demand and the Outlook for Careers in IT

For more than half a century, the Bureau of Labor Statistics' *Occupational Outlook Handbook* has been the nation's basic guide for career planning. Forecasts are essential for this project. BLS is careful to state assumptions that underlie its predictions, to make their limitations clear, and to revisit previous projections to see where they may have erred.[6] The current (2002-2003) edition of the *Handbook* relies on work done before the terrorist attacks of September 11, 2001 and the dot-com/telecommunication bust that became evident late that year,[7] and so it may reflect an era of optimism about prospects for careers in the IT professions. Data from the Bureau's ongoing survey of business establishments (which, as noted above, used the new SOC occupational titles) yield an estimated 3,276,000 IT jobs for the baseline year of 2000. Projected 2010 employment for the same set of occupations is 5,432,000, a figure that if reached will preserve IT's status as both the fastest growing employment sector in the nation and also one of the largest occupational groups.

BLS's outlook is "benign" in the sense that it assumes a steady continuation of long-term trends. A different "benign" view of IT is offered by a recent report from the RAND Corporation.[8] More akin to a futurist scenario than a statistical forecast, RAND's study predicts continued strong growth for information technology and continued North American domination of the field. The authors state that "A period of IT consolidation, in response to the 'dot-com crash' and the implosion of the telecom industry, is both likely and healthy. This consolidation should

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[4] K. C. Kirshnadas, "India's tech industry defends H-1B, outsource roles," *EE Times*, July 10, 2003.

[5] *Economic Times of India* (U.S. edition), "Outsourcing to cut 10% IT jobs in US: Gartner," July 16, 2003.

[6] For example, see "Assumptions and Methods Used in Preparing Employment Projections," at http://stats.bls.gov/oco/oco2006.htm.

[7] "The BLS projections were completed prior to the tragic events of September 11. While there have been numerous immediate economic impacts, the nature and severity of longer-term impacts remains unclear." See http://stats.bls.gov/emp/emppak1.htm.

[8] Richard O. Hundley *et al.*, *The Global Course of the Information Revolution: Recurring Themes and Regional Variations* (Santa Monica: RAND, 2003).

lead to a stronger foundation for substantial and sustainable IT growth in the coming decades."

RAND's report is about the IT *industry;* it pays little or no heed to the IT *workforce.* Indeed, IT could be dominated by North American multinational businesses without becoming particularly dependent on North American technical talent.

A different view of the outlook for IT workers may be inferred from a more general assessment of prospects for the entire scientific and engineering ("S&E") workforce, currently being circulated as a draft by the National Science Board (NSB).[9] Excerpts from the introduction convey the message of this report:

> Science and technology have been and will continue to be engines of US economic growth and national security... Current trends of supply and demand for S&E skills in the workforce indicate problems that may seriously threaten our long-term prosperity, national security, and quality of life... The Federal Government and its agencies must step forward to ensure the adequacy of the US science and engineering workforce. All stakeholders must mobilize and initiate efforts that increase the number of US citizens pursuing science and engineering studies and careers.

Recommendations call for substantial increases in support for scholarships, university research, graduate stipends, etc. Similar arguments have been advanced in the past. A major problem is that many serious observers of U.S. scientific and engineering labor markets simply do not accept the premises on which the NSB's draft report depends. It is not at all certain that the supply of high tech talent in the U.S. is inadequate, nor is it clear that there will actually be future demand for a much larger S&E workforce in the United States. However, the NSB may be right to raise questions about what happens to U.S. technical prowess and national security if the U.S. depends on foreign talent, and to remind us that if Americans cannot compete with world-class technical people, they are not likely to be able to obtain work in science, engineering, or fields like information technology that are blends of both.

IT professionals have different concerns about the prospects for careers in the field. Where some academic and industry spokesmen see shortages of talent and a lack of adequate capacity, IT workers tend to see surpluses of qualified people and an inability to make good use of the existing pool of labor. A recent series on "The Disposable IT Worker" which appeared on the iSeries Network's web site is representative of the views of IT professionals.[10] It looks at rises in the numbers of foreign temporary workers with L-1 visas and at trends in outsourcing, and concludes that the boom days of the late 1990s are not likely to return.

Paul Kostek, a past president of IEEE-USA (the American branch of the international Institute of Electrical and Electronics Engineers) and the 2003 chair of the American Association of Engineering Societies, speaks for many technical professionals in the United States when he writes:

> *Business Week* magazine recently reported that for $650 a month you can employ an aerospace engineer in Russia with a master's degree in math or aeronautics. His U.S. counterpart makes about $6,000 a month. So how do U.S. engineers compete in this new global marketplace? ...[They] won't be able to compete on price by accepting salaries that are below U.S. poverty levels... I have to ask myself if an overseas competitor in Belarus, Beijing or Bangalore possesses the same skills that I do, and if proximity isn't important, and if they'll work for $800 a month, then why hire me at $8,000 a month? It's a question that is increasingly hard to answer. For the next generation considering a career in engineering, it will be even harder.[11]

Kostek's question is indeed hard to answer. It raises all kinds of additional issues, matters which go far beyond the capacities of a report like this one. For example, are the costs of outsourced jobs balanced by trade benefits for high tech exports and low cost goods for American consumers? Can the U.S. continue to be a prime market for the rest of the world if it is a stronghold for neither manufacturing nor technical services? What are the long-run implications of these trends for American standards of living?

Still other questions arise. If global labor markets are posing problems for American workers, just how rapidly will these problems continue to grow, and how far will their ultimate impact reach? Disinterested, authoritative information about such matters has not been easy to find, but on August 5, 2003, the U.S. General Accounting Office announced that it would study some of these questions. That initiative is a welcome beginning.

The job market for domestic IT professionals has weakened, but that market is still very large. For the near run, normal turnover alone will generate opportunities for people who are determined to work in the field. The long-run outlook is more problematic. The United States does not lack, either now or in the foreseeable future, sufficient numbers of capable people who would like to work in IT. But those people may not be willing to conclude that long-run demands for their services will be good enough to support IT as a sensible career choice.

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[9] *Draft report, Task Force on National Workforce Policies for Science and Engineering,* NSB, May 2003. Available at http://www.nsf.gov/nsb/documents/2003/nsb0369/sb0369_drft.doc.

[10] Mary Lou Roberts, "The Disposable IT Worker" (three-part series; iSeries Network, May-June 2003); archived at http://www.iseriesnetwork.com.

[11] Paul Kostek, "Competing with the $800 a Month (or less) Engineer" (Washington: IEEE-USA, June 14, 2003).