

Debunking the Myth of a Desperate Software Labor Shortage

Testimony to the U.S. House Judiciary Committee
Subcommittee on Immigration

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1 Overview and Executive Summary

Due to an extensive public relations campaign orchestrated by an industry trade organization, the Information Technology Association of America (ITAA), a rash of newspaper articles have been appearing since early 1997, claiming desperate labor shortages in the information-technology field. Frantic employers complain that they cannot fill many open positions for computer programmers.¹

Yet readers of the articles proclaiming a shortage would be perplexed if they also knew that Microsoft only hires 2% of its applicants for software positions, and that this rate is typical in the industry. **Software employers, large or small, across the nation, concede that they receive huge numbers of re'sume's but reject most of them without even an interview.** One does not have to be a “techie” to see the contradiction here. If employers were that desperate, they would certainly not be hiring just a minuscule fraction of their job applicants.

The hidden agenda of the ITAA public relations campaign turned out to be to leverage Congress to increase the yearly quota of H-1B work visas, under which employers were importing tens of thousands of programmers to the U.S. each year. The campaign succeeded, with President Clinton signing the increase into law in October 1998. Yet in 1999 the industry has been calling for even further increases in the visa quota.

1.1 Summary: Frequently Asked Questions

I am frequently asked questions relating to various industry lobbyist claims. Following is a list of such questions and my answer. The reader is urged, though, not to simply read such a coarse summary, but instead read this document in its entirety, as this is a highly complex subject which cannot be reduced to “sound bites.”

Note: Citations for all statistics and quotes given in this subsection are available in the body of this paper.

Question: We hear so many conflicting claims about whether a high-tech labor shortage exists or does not exist. How can we possibly evaluate those claims ourselves?

Perform this simple five-minute experiment:

Just call any firm which hires programmers—a large firm, a small one, new, old, any location—and talk to the HR Department. Ask them if it is true that they reject the vast majority of their programming applicants without even an interview. After they confirm this, ask them why they do this, and they will say that the vast majority of the applicants don't have some new software skill set the employer wants, even though the applicants have years of programming experience.

Here is what you will have learned from this experiment:

- The industry lobbyists are incorrect when they claim a lack of “bodies,” i.e. a lack of people with programming experience. What they really mean (some insincerely, some sincerely) is a lack of programmers with work experience in a specific software skill, say the Java programming language.
- The industry lobbyists are incorrect when they claim the school system needs to produce more programmers. The technology changes extremely rapidly, so it will always be the case that the vast majority of programmers do not possess the newest software skills—no matter how many programmers the schools produce. (Note that it will not work for a older programmer to take a class in a

¹Our focus on computer programmers here is explained in the section “Reason for the Focus on Software.”

new skill; the employers insist on actual work experience in the skill.) Producing more programmers would just give employers more people to reject.

- The industry lobbyists are incorrect when they claim that they only want a temporary increase in the quota for foreign programmers on H-1B work visas, while the educational system works to produce more programmers. The claimed “shortage” will be permanent.

Question: The industry claims that H-1Bs are paid the fair “prevailing wage.” Is this true?

No, it is not true.

In October 1999, Susan deFife, CEO of womenConnect.com of McLean, VA, testified to the Senate in support of higher H-1B quotas. She gave the example of a new graduate she had hired in 1998 as a system administrator, a Mexican national who had just graduated from a U.S. school. Ms. deFife emphasized that she found this worker only after months of exhaustive searching. Yet a subsequent inquiry under the Freedom of Information Act (FOIA) by Robert Sanchez showed that deFife was only paying this person \$35,000 per year—when the national average for new graduates was \$45,000!

Similarly, John Harrison, CEO of Ecutel in Alexandria, Virginia, testified to the House in March 1999 in support of an H-1B increase. He issued a press release which said,

Something is wrong when you put an ad in the Washington Post for a software engineer and the only qualified applicants you receive are from non-U.S. Citizens, said John Harrison, CEO and co-founder of Ecutel, one of the nation’s most promising high-tech companies.

A FOIA request later revealed that Ecutel had hired several H-1B programmers at a salary of \$35,000, again far below average for new graduates (and these workers may not have even been new graduates).

This is outrageous. Here were two of the best examples the industry lobbyists could find in claimed support of the H-1B program, and yet both of them were in fact paying their H-1Bs salaries well below average.

And yet both deFife and Harrison wrote on their H-1B application forms that they were paying the prevailing wage. How could this happen? The answer is that the prevailing-wage provision of H-1B law is riddled with loopholes, making it extremely easy to hire cheap labor while technically complying with the law. And as immigration attorney Joel Stewart notes, “Employers who favor aliens have an arsenal of legal means to reject all U.S. workers who apply.”

As mentioned earlier, the Department of Labor found that the vast majority of H-1Bs have salaries under \$50,000, while the national median salary in this field is \$60,000. And a DOL audit found that in 19% of the cases, the employer was not even paying the wage promised in the visa application, again which often is low to begin with.

Even the highly pro-business *Wall Street Journal*, in an article (January 8, 1998) which had claimed that H-1Bs do not adversely affect job opportunities for American programmers, stated that American firms recruit abroad because “recruiting foreign talent is cheaper than hiring Americans,” quoting an American recruiter of foreign programmers as saying that he pays them \$20,000 to \$25,000 less than Americans with the same skills.

And the equally pro-business *Forbes* magazine said (May 31, 2000):

Indian programmers working in the U.S. on temporary H-1B visas typically earn 25% to 30%

less than their naturalized colleagues. Kalra, for example, will earn \$60,000 this year, while others with his experience here could easily earn \$75,000.

Sun Microsystems, which claims to scour the world for “the best and the brightest,” seems to be also interested in the cheapest. It boasted to the *Los Angeles Times* that it had employed programmers in Russia “at bargain prices.”

Note also that even if the DOL were to truly enforce the spirit of the prevailing-wage law, employers would still find younger H-1Bs more attractive than older Americans; even if an employer pays young H-1Bs the same as young Americans, that wage level is still lower than that of older Americans. The median age of the H-1Bs is 28.

See Section 9.2.5.

Question: In all this “high-tech labor shortage” talk, what kinds of workers are we discussing?

Though usually not mentioned by the lobbyists, the discussion is about computer programmers. (Note that this includes not only those with Programmer titles, but also those with titles like Software Engineer and System Analyst.) The reason the discussion is about only programmers that the H-1B work visa holders in the high-tech field work almost exclusively as programmers, not in all the other information technology (IT) jobs such as marketing, customer support, software testing and so on. And note that this is not about engineers either (though large numbers of people trained as engineers work as programmers)—among the H-1B workers, computer science graduates outnumber the electrical engineering graduates 15-to-1.

See Section 3.

Question: Is there a “desperate” IT labor shortage?

The employers claim to be desperate, but their own actions prove otherwise.

Employers only hire about 2% of their software applicants, and they admit that they reject the vast majority of their applicants without even an interview. If employers were so desperate, they could not afford to be so picky.

Both government and private data show that average wage increases for programmers have been mild, 7 or 8%, and again contradict the claims of huge shortages. The industry’s own study estimated that the claimed ‘shortage’ is only driving up salaries by 3%. If employers were desperate, they would be willing to pay much higher wage premiums.

See Section 4.

Question: Don’t low unemployment rates among programmers indicate a labor shortage?

Since people who cannot find programming work leave the field, unemployment statistics for programmers are meaningless. Twenty years after graduation from college, only 19% of computer science majors are still employed as programmers.

For example, consider the recent age discrimination lawsuit filed against Siemens. An EEOC report on the suit found that in the firm’s layoff action, the termination rate for those over 40 was 10 times higher than for those under 40. The plaintiffs in the case were now working in jobs such as truck driver. Clearly, they were “employed,” but they counted in government statistics as an employed truck drivers, not unemployed programmers.

See Section 5.6.1.

Question: The industry claims that its own study, plus a Department of Commerce report, found a massive labor software shortage. Is that true?

The methodology used by industry lobbyist ITAA in determining a massive labor “shortage” has been roundly criticized by the congressional General Accounting Office.

It is also important to note that the ITAA continues to deliberately “mix apples with oranges” as of Spring 2000, claiming 800,000 open positions in “IT,” when in fact if you read their statement more closely it shows that the biggest portion of those jobs is for technicians, not for programmers. Again, this is very important, because the H-1Bs are programmers, not technicians.

The Department of Commerce, which in 1997 published a shortage report based almost entirely on the ITAA analysis, backed off from this claim in its 1999 report. In the latter, DOC stated that it now cannot tell from available data whether there is a shortage or not. The newer DOC report also referred to low hiring rates, age discrimination and so on.

See Section 4. Also, Section 4.4 gives an overview of the major “shortage studies.”

Question: Why are the employers being so picky in their hiring?

As noted earlier, most employers admit that they reject the vast majority of their applicants. Why are they so picky?

The employers answer that most of their applicants, even though they are experienced professional programmers, do not have a very specific new software skill which the employer wants, say the Java programming language.

This skills issue is central, for both insincere and sincere employers:

- Insincere employers use the skills issue as a pretext for hiring cheap H-1B programmers and for not hiring older programmers.
- Sincere employers genuinely believe they need to hire a programmer with specific skills, but they are misinformed, because any competent veteran programmer can become productive in a new programming language in a couple of weeks on the job.

So again, for both insincere and sincere employers, the skills issue is central. Employers say they do not have enough applicants for programming jobs, but in fact they have huge numbers of applicants; what they really mean is that they do not have many applicants who possess work experience in a given skill.

An *Information Week Online* article (March 30, 1998) summarized the situation with respect to both age and specific software skills:

“Younger people with hot skills have the most options open to them,” says Tom Morgan, a VP in the Chicago office of Pencom Systems, a national IT recruiting firm.

See Sections 5, 7 and 9.2.

Question: How bad is age discrimination in this field?

Age discrimination is rampant in this field, starting even as young as 35. Consider the following:

- A study found that on average it takes three more weeks for a laid-off programmer or engineer to find a job for each year of age.
- An *InformationWeek* survey of hiring managers found that only 2% of them would prefer to hire an applicant with more than 10 years of experience.
- A *Network World* survey of hiring managers which found that the younger the manager, the less likely he/she would be to hire an older programmer.
- Twenty years after graduation from college, only 19% of computer science majors are still employed as programmers. This compares, for instance, to a figure 57% of civil engineering majors who are still working as civil engineers 20 years after leaving school.
- Most employers define a Senior Programmer title to mean just three to five years of experience.

The employers use the skills issue as a pretext for shunning the older programmers, saying, “Sorry, we cannot hire you, since you do not have the new software skills.”

Question: The industry lobbyists point to money they spend recruiting programmers, ads in newspapers, on radio, and even on highway billboards. Doesn’t that show that there is a shortage of programmers?

No. Again, this only shows that employers want to hire certain narrow categories of people, such as those with specific new software skills and younger and/or foreign programmers with lower salaries.

Question: The industry lobbyists cite astronomical sums of money the industry claims to spend on training. What about this?

Most of those sums for training are spent on secretaries and technicians, with much less being spent on programmers and engineers.

In fact, it is common for a firm to be laying off older workers while simultaneously hiring younger ones with newer skills. As one HR director of Dow Jones put it in 1998

There’s a real focus on skill sets needed right now. I recently attended a conference on retention where participants were simultaneously hiring and laying off—even in IT—all because of the need to get things involving new skill sets done fast. Training never came up as an alternative.

Computerworld reported in June 2000 that IBM, Hewlett-Packard, Ernst and Young and so on

[are laying off programmers off while] hiring people with the right skills—not teaching old dogs new tricks.

Question: Industry employers say they have to hire only programmers with specific software skills, because they have urgent needs to finish a product quickly. They don’t have time to retrain a new hire. Is this true?

By the industry’s own admission, they often leave jobs open for months until they find a programmer possessing the exact skills match they want. During this time, they could hire a generic programmer and let him/her learn the specific skills on the job, which any competent programmer can do within weeks. Refusing to hire a C-language programmer to write Java code is like a Ford dealer refusing to hire mechanics who

have only Chevy experience, and even such luminaries as Microsoft's Bill Gates have criticized industry practice in this regard.

The best way to finish a project on time is to hire smart programmers, not programmers who have some particular skill set. Studies show that there is a 10-to-1 range in productivity among programmers.

Employers are shooting themselves in the foot with their current hiring policies, actually increasing their labor costs rather than reducing them, and increasing time-to-market for their products, rather than reducing it.

See Sections 5.8, 7 and 10.

Question: Some older programmers do quite well in the field. So if an older programmer is having trouble finding programming work, isn't it his/her own fault for not keeping up with changes in the technology?

No. Employers are not willing to hire a veteran programmer who has taken a course in a new software skill. Employers insist on actual work experience in that skill. An exception to this is if the programmer does have some other hot new skill, but is lacking one other one, but otherwise employers automatically reject anyone lacking work experience in the given skill, even if they have acquired it through coursework.

If an older programmer is lucky enough that the present employer will allow him/her to work on a project which uses a new skill, then he/she can then stay alive in the field. But such cases are in the minority.

See Section 5.8.

Question: The industry dismisses concerns about older programmers by claiming that those programmers' experience is in COBOL, a language popular in the 1960s and 1970s but radically different from the languages used today. Is this true?

Virtually none of the older programmers I talk to around the nation who have trouble finding programming work are COBOL people. Their experience is in the C programming language. Java and C++, two of the hottest languages today, are extensions of the C language.

Question: Since the skills issue is central, is the solution to increase government or private training programs?

No, for two reasons:

- As mentioned above, employers are not willing to hire a veteran programmer who has taken a course in a new software skill. They want actual work experience.
- Any competent programmer can pick up a new software skill on his/her own, on the job, without formal instruction.

Retraining programs would just be a waste of money. The ones that have been tried generally input programmers and engineers but output technicians, a low-level job requiring just a high-school diploma. This does nothing to alleviate the claimed shortage of programmers, and is like "retraining" physicians as paramedics.

See Section 8.

Question: The industry says that it will need H-1B visas temporarily, as a stopgap measure until more programmers can be trained. Is this true?

No, it's false and dishonest. The employers know that this labor "shortage," in the manner they have defined it, will be **permanent**; they intend to rely heavily on H-1Bs **permanently**, as explained below.

The industry has been using this "temporary need" excuse for years, ever since the H-1B law was enacted in 1990. In the early- and mid-1990s, for example, the industry kept saying that H-1Bs wouldn't be needed after the laid-off defense programmers and engineers were retrained, but never carried out its promise. It hired those laid off in low-level jobs such as technician (which is all the retraining programs prepared them for), and hired H-1Bs for the programming and engineering work.

In late 1998, right after an H-1B increase was enacted on the strength of education being a long-term solution, an industry conference in Silicon Valley held a session on the "educational solution." There were representatives from industry and academia. Yet the industry representatives did not say a single word about education, the supposed theme of the conference session; instead, they talked about the "need" for an H-1B increase—which had already been enacted.

It is important to note that though the industry has claimed that the H-1B visa program is just a "temporary" solution to the claimed labor shortage, that claimed/perceived "shortage" will be permanent. The reason for this is that, since software technology will continue to change extremely rapidly, and since employers are not willing to hire a veteran programmer who learns a new software skill via coursework, it will always be the case that most programmers do not possess the latest software skills.

As explained next, U.S. universities are producing enough graduates to meet industry's needs, contrary to industry claims. So, producing even more graduates would simply give the industry more job applicants to reject.

Question: Are U.S. universities producing enough computer science graduates to meet industry's needs?

"Pushing the Education Button" is a tried and true method for obfuscating any issue, this case being a prime example.

The leading industry lobbying group for increasing the H-1B quota, the ITAA, claimed in its original literature in 1997 that American students had neither the interest nor the background to study computer science. But in actuality, the ITAA knew that computer science enrollment was skyrocketing, and it deliberately suppressed that fact in its report. Other industry lobbyists have continued to present highly misleading data since that time. They also continue to obfuscate the issue by talking about enrollment in engineering, even though as mentioned earlier the vast majority of high-tech H-1Bs have degrees in computer science, not engineering.

The fact is that the ratio of new computer science graduates to new programming jobs is the same today as it always was. This ratio is approximately 1-to-4; it has always been the case that about 3/4 of programmers do not have CS degrees. And new computer science enrollment has doubled nationwide in the last few years.

Moreover, these supposedly-desperate employers are ignoring most of the new graduates. If you ask a large employer about their recruiting at a typical large university, they will admit that they extend offers for programming positions—again, this is what the H-1Bs are hired for, thus the category of interest here—to only a small handful of the new graduates at that school. A small number of graduates are highly courted by employers, but most graduates cannot get programming positions, and are relegated to semitechnical jobs like customer support. To be sure, salaries are good even in those semitechnical positions, but most CS grads wish to do the "real" work, i.e. programming; instead, the employers are hiring the H-1Bs for programming positions. Moreover, once someone without job experience in programming gets a customer support position, it is quite difficult to move into development jobs.

See Section 6.

Question: In those skyrocketing computer science enrollment figures, are large numbers of them foreign students?

No. Only 6% of Bachelor's degrees in computer science are awarded to foreign students.

See Section 6.

Question: What about at the PhD level? Are they largely foreign students?

This is a red herring to begin with, since fewer than 1% of the computer-related H-1Bs have a PhD. But some other points are worth mentioning as well:

It is true that a substantial percentage of computer science PhD degrees in the U.S. are awarded to foreign students. But that is irrelevant because one does not need a graduate degree to do the work in this field. Bill Gates, founder of Microsoft, does not even have a Bachelor's degree, and similar statements hold for Larry Ellison, founder of Oracle, and Steve Jobs, founder of Apple and Pixar. A joint Stanford/RAND study found that we are overproducing PhDs in science and engineering. The domestic students know they don't need a graduate degree to work in industry, so they take the rational response, which is to stop their education at a Bachelor's.

Those who are plied by the industry's feigned interest in PhDs would be baffled by the following incident. On October 13, 1999, a team of Intel engineers recruiting for new graduates visiting my department at UC Davis. I mentioned that I had a couple of PhDs in electrical engineering I could refer to them, one a new graduate and the other a 1992 graduate. In reply one of the recruiters blurted out, "No, Intel is not very interested in PhDs; they are too expensive." The other added that she did not think a PhD would have enough to challenge him or her at Intel, except in the case of very highly specialized research areas. Keep in mind, Intel lobbyists in particular have told Congress they need H-1Bs because so few domestic students pursue a doctorate. This is shameless hypocrisy.

See Sections 6.4.2 and 9.6.

Question: The industry lobbyists claim that the H-1Bs tend to be "the best and the brightest" from around the world. Is this true?

Certainly not. We should definitely facilitate the immigration of the outstanding talents throughout the world, but only a small proportion of the H-1Bs fall into this category. The 79% of the H-1Bs earn less than \$50,000, which is below the median of \$60,000 for the field, and very far below the salaries of "geniuses," which approach or exceed \$100,000.

Though industry lobbyists often claim that most H-1Bs have a graduate degree from a U.S. university, the fact is that, as mentioned earlier, the vast majority of do Even the authors of a bill in Spring 2000 to exempt foreign graduates of U.S. schools from H-1B quotas estimate that only a small proportion of H-1Bs would be affected. Of course, as stated earlier, a graduate degree is not needed in this field anyway, and possession of a graduate degree does not indicate any special talent (the vast majority of holders of a CS Bachelor's degree would be admissible to many Master's programs.) But the point is that this is yet another instance of disinformation from the industry lobbyists.

A House Immigration Subcommittee hearing in 1999 revealed that, contrary to the industry's claim that the H-1Bs are usually of exceptionally high quality, many H-1Bs do not have the qualifications their sponsor claims for them.

See Section 9.5.

Question: The industry claims that hiring H-1Bs actually creates jobs for Americans, saying that each job held by an H-1B generates several new jobs for Americans. Is this true?

This is an obvious fallacy. The employers could fill those positions with Americans (U.S. citizens and permanent residents) instead of H-1Bs and still get the job-generating effect.

Question: What about the Asian-born entrepreneurs in Silicon Valley? Doesn't this show that the H-1B program is a net high-tech job creator for Americans?

No. On the contrary, the Saxenian study that the industry lobbyists are citing here actually shows that the Asian-immigrant programmers and engineers in Silicon Valley actually have a lower per-capita rate of entrepreneurship than do natives.

Moreover, even Saxenian (whose study was funded by the high-tech giant, Hewlett-Packard) notes that the immigrant entrepreneurs tend to hire from their own immigrant ethnic groups; those jobs are largely not open to natives. Also these firms may not employ many programmers and engineers anyway. For instance, according to Saxenian, 36% of the Chinese-owned firms are in the business of "Computer Wholesaling," meaning that they are simply assemblers of commodity PCs, with no engineering or programming work being done.

See Sections 9.8 and 9.9.

Question: The industry lobbyists say that only a tiny percentage of H-1B visas lead to complaints about underpayment of wages.

This is true but obviously meaningless. The affected parties do not dare speak out: The H-1Bs rely on the job to stay in the U.S. and also fear blacklisting, and their U.S. citizen/permanent resident co-workers at the same company fear retribution by their employers as well.

Question: Lobbyists for the large U.S. firms concede that there is abuse of H-1Bs, but that this is mainly among the "body shops" owned or run by Indo-Americans. Is this true?

No.

First of all, this focus on Indo-Americans is unwarranted scapegoating.

Second, who are the clients of those Indo-American agents? They are the large mainstream American firms, the same ones that are trying to distance themselves from the "body shops" by statements like those above.

The large American firms are just as interested in cheap labor as anyone else. Sun Microsystems, for example, has bragged in a *Los Angeles Times* interview that it hired Russian programmers (to work there) "at bargain prices." General Dynamics imported H-1Bs from England, with the appeal being, according to court documents, the "indentured" status of the foreign workers, promised by the agency to be "prepared to work here in the United States for as much as a 40% reduction in current United States salary levels."

See Section 9.3.

Question: Rather than H-1Bs being a source of cheap labor, the industry claims that legal fees make the H-1Bs actually more expensive than American workers. Is that true?

The legal paperwork needed to sponsor an H-1B costs only about \$1,000.

It does cost more to sponsor a worker for a green card, around \$10,000, but often the employers have the foreign employees pay the legal fees for green cards themselves. And even when employers foot the bill, the cost is usually less than they save in salary. If an H-1B is sponsored for a green card, he/she is in a *de*

facto sense in a state of “indentured servitude” for a period of about five years. The worker will often get no raises during that time, so that the employer might save \$50,000 in salary. (An organization of H-1Bs from India, the Immigrant Support Network, www.isn.org, has arisen to lobby Congress to remedy the H-1Bs *de facto* indentured status.)

Note also that an employer who rents an H-1B from an agency avoids the fee a recruiter would charge in a regular hire, which is considerably more than \$10,000.

The indentured-servitude nature of the H-1Bs is extremely attractive to employers. Not only might they accrue large savings in salary, but also the H-1B cannot leave their projects in the lurch by jumping to a competitor. It is no wonder that the industry did not support legislation in 1998 which would have greatly reduced the time it takes for an H-1B to get a green card. Even immigration attorneys have publicly pitched this “loyalty” of the H-1B workers.

See Sections 9.3 and 9.2.8.

Question: The industry claims that if it cannot bring H-1B workers to the U.S., it will be forced to move software operations to where the workers are overseas. Is this true?

This is a bogus threat, demonstrably so: If the industry found it cost effective to send major portions of their work overseas, they would already be doing so, which they are not.

The fact is that, although a small amount of work is done abroad, this will not escalate to become the major mode of operation of the industry. The misunderstandings caused by long-distance communication, the problems of highly-disparate time zones and so on result in major headaches, unmet deadlines and a general loss of productivity.

Just look at Silicon Valley. This is the most “wired” place in the world, yet those massive Silicon Valley freeway traffic jams arise because very few programmers telecommute. They know that face-to-face interaction is crucial to the success of a software project.

See Section 9.4.

Question: The industry says H-1Bs comprise only a small percentage of their workers. If that is true, why is there such a controversy?

The Department of Commerce, in their report *Digital Economy 2000* (June 5, 2000), found that H-1Bs now account for 28% of all information technology industry hires requiring at least a Bachelor’s degree.

Moreover, many of the large employers claiming that only a small proportion of “their” work forces consists of H-1Bs are hiding behind the fact that they “rent” many H-1B workers from agencies.

Question: How was the industry able to get Congress to pass the H-1B increase in 1998, given that a Harris Poll had shown that 82% of Americans opposed the increase?

The high-tech industry wields enormous, unstoppable clout on Capitol Hill and in the White House, and even in academia.

In Spring 2000, a major supporter of pending legislation which would increase the H-1B quota, Rep. Tom Davis (R-Va.), had the gall to say, “This is not a popular bill with the public. It’s popular with the CEOs...This is a very important issue for the high-tech executives who give the money.” Rep. Davis is chair of the Republican Congressional Campaign Committee.

Extensive details are given in Sections 2.3 and 2.2.

Question: Does this discussion really boil down to whether one should protect the natives? Shouldn't the industry be allowed to hire outstanding talents from overseas?

First of all, this is not a “natives vs. immigrants” issue. Many immigrant American programmers are negatively impacted as well. Thus when we refer to “Americans,” we mean U.S. citizens (native or naturalized) and legal permanent residents (greencard holders). The employers’ access to the H-1B labor pool makes it easy to shun American programmers, both native and immigrant; immigrant computer programmers encounter the same age discrimination when they reach age 35 or 40 that natives do. As pointed out by Shankar Lakhavani, chairman of the workforce committee for the the Institute of Electrical and Electronic Engineers (IEEE) and a Pakistani immigrant, “There are many immigrants like me who are American citizens, and they would like a crack at these jobs [which are going to H-1Bs].”

We should definitely encourage “the best and the brightest” programmers and engineers around the globe to come to the U.S. But as discussed above, the vast majority of H-1Bs are not in that category.

2 Motivations in Industry, Academia and Politicians for Claiming a Software Labor Shortage and Advocating a Higher H-1B Visa Quota

2.1 Industry: Desires for Cheap Labor and “Indentured Servitude”

In early 1997, the ITAA industry lobbying group began its massive national public relations campaign to develop an image of a software labor shortage in the public consciousness. Many critics speculated at the time that access to cheap labor—mainly in the form of foreign nationals and but also in an expanded supply of new college graduates—was the “hidden agenda” behind the ITAA’s campaign. Though ITAA’s Harris Miller originally denied this in the case of foreign nationals (*Electronic Engineering Times*, December 8, 1997), another ITAA official blurted out around the same time that its “number one priority” in 1998 would be to push Congress to increase the yearly quota of H-1B work visas (*San Jose Mercury News*, November 21, 1997), which turned out to be the case.

Similarly, savings in salary costs seem to be the motivation behind ITAA’s false claim that university computer science enrollment is currently on the decline. That enrollment does in fact respond to market demands and has been skyrocketing in recent years, but since the industry has been focusing its hiring on the cheaper new and recent graduates, employers feel the larger that pool is, the better.

Amazingly, the prominent computer-industry business magazine, the *Red Herring*, admitted in its July 1998 editorial that the charges I make in this report are correct, and even more amazingly, actually endorsed the idea of hiring H-1Bs as a means to accessing cheap labor. The *Red Herring* put it this way:

The congressional General Accounting Office found “serious analytical and methodological weaknesses” in the [ITAA/Dept. of Commerce] reports. The American Engineering Association criticized common IT hiring practices that eliminate more than 95 percent of applicants. A University of California at Davis professor decried “rampant” age discrimination by the industry and suggested that technology companies prefer to hire young, cheap, foreign programmers who are willing to work 80-hour weeks.

Though factually correct, these criticisms are, we feel, ingenuous. Companies have a fiduciary responsibility to keep labor costs low. If U.S. technology companies cannot find highly trained, highly motivated American employees at a competitive cost, then a shortage does exist. And

if companies say they want to hire more skilled foreign workers because those workers are cheaper, we should believe them—and increase the number of visas issued.

Equally important as cheap labor as an attraction to industry is the *de facto* “indentured servitude” of the H-1B workers whose employers are sponsoring them for green cards. As explained in Section 9.3, such workers are essentially immobile for a period of five years or more. This means a programmer cannot suddenly leave the employer in the lurch on an important project by leaving for another company. It also enables the employers to give them smaller raises, work them more hours and so on.

This point in particular demonstrates the insincerity of the industry’s claim to legitimately need the H-1Bs. The industry did not support legislation in 1998 which would have greatly reduced the time it takes for an H-1B to get a green card, thus solving the indentured-servitude problem. Clearly, the industry finds indentured servitude quite appealing.

The H-1Bs are well aware of this, and many express quite bitter feelings about it in Internet discussions. A good description of this appeared in *Tech Week*, January 10, 2000:

Rajeev calls himself a high-tech indentured servant.

An H-1B visa holder from India, he arrived here nearly five years ago to design chips for a semiconductor firm. Rajeev (not his real name) expected to get a green card within a few years and pursue his dream of doing challenging tech work in Silicon Valley. Instead, immigration rules and bureaucratic delays have kept him at the same firm, which is now failing. All the talented engineers have fled to greener pastures, he says, while he and other H-1B visa holders are stuck, mopping up the mess and praying to get their green cards in the mail.

“It’s total exploitation,” he says. “It’s just Indians and Chinese who are doing all the work because they have to”...

Mistreatment of H-1B workers is not surprising to guest workers in Silicon Valley. Recently, a group of five Indian H-1B technology professionals met with TechWeek to discuss problems with the system. All asked to remain anonymous for fear of reprisal from their firms, and several felt betrayed by bosses who shunted them into grunt-work duties. Much of the guest workers’ frustration with the high-tech industry, however, stemmed from their perception that firms were purposefully ignoring the immigration dilemma. To them, it seems Silicon Valley firms favor a revolving door system of H-1B workers who are easy to exploit.

“The tech industry could help us by lobbying the INS,” Rajeev says. “But they choose not to, because they’re getting H-1Bs.”

An organization of H-1Bs from India, the Immigrant Support Network, www.isn.org, has arisen to lobby Congress to remedy the H-1Bs *de facto* indentured status. As of June 2000, the organization had 15,000 members nationwide.

Ironically, the worst victims of current hiring policies are the employers themselves. This is detailed in a later section, titled “Employers Are Shooting Themselves in the Foot with Their Hiring Policies.”

2.2 Motivations in Academia

Universities and colleges have extremely strong incentives to support the claims by industry lobbyists of a desperate software labor shortage and the “need” for a higher H-1B quota:

- Public university/college administrators use the shortage claims as leverage to demand increased funding from state governments.
Many also have started special computer-related courses aimed at the nonstudent public, which, by charging higher fees than those of their mainstream courses, become “profit centers.”
- Universities and colleges depend heavily on industry donations of equipment, research funds and even entire buildings.
- As discussed in a later section in this paper, titled “Education,” we are overproducing Ph.D.’s in science and engineering. Yet universities use Ph.D. production to obtain lucrative federal research grants. Since domestic high-tech students correctly perceive that they do not need a Ph.D. to work in this industry, most of them, including most of the top students, forego graduate work and instead go straight to industrial work after finishing their undergraduate degree. To make up for this “deficit,” universities admit large numbers of foreign students to their Ph.D. programs. The latter use their U.S. degrees as steppingstones to H-1B visas and eventually green cards. In short, if there were no H-1B program, the foreign students would not come to the U.S. for graduate study; universities would find their graduate programs depopulated and they would lose their grant monies.
- Universities themselves hire H-1B workers for research projects, and actually have pressed Congress to exempt them from the law (widely flouted in industry anyway) requiring H-1Bs to be paid at least the level of “prevailing wages.”

One of the most prominent academic supporters of the H-1B program has been Professor Ed Lazowska of Department of Computer Science at the University of Washington. A glance at his department’s Web page (as of March 16, 2000) shows just how financially beholden they are to industry:

The home page includes a place to click on “Information for Industry,” and after clicking there, one of the items in the next page is “Corporate Support.” And there you have it: \$1.5 million from Ford Motor Co. in research funds; “several million dollars” in equipment from Intel; \$500,000 from Boeing for an endowed faculty chair; another \$500,000 chair from Microsoft; another one from Boeing; some miscellaneous items; and finally, \$3 million from the Bill and Melinda Gates Foundation for two endowed chairs (soon to be filled).

Those who might have thought of academia as a center of integrity must keep in mind that universities are exceedingly political entities, with money playing a central role in all activities. Industry lobbyists know that they can count on academia to produce seemingly “unbiased” studies which in fact are designed from the outset to produce results supportive of industry’s position. In an impressive moment of candor, prominent immigration attorney Austin Fragomen, who has lobbied Congress in favor of liberal H-1B visa policies, wrote in *Workforce Magazine*, March 1996. He reports that when the Senate was considering scaling back the H-1B program in that year,

...The business community mobilized, forming American Business for Legal Immigration (ABLI), a Washington, D.C.-based lobbying group that represents a number of associations and employers, and **commissions academic studies to support its position.**

(Emphasis added.)

2.3 Politicians and Lobbyists

2.3.1 Amazing Candor from the Chair of the Republican Congressional Campaign Committee

In Spring 2000, a major supporter of pending legislation which would increase the H-1B quota, Rep. Tom Davis (R-Va.), had the gall to say, “This is not a popular bill with the public. It’s popular with the CEOs...This is a very important issue for the high-tech executives who give the money.” (*National Journal*, May 5, 2000 and *New York Daily News*, May 3, 2000.) Rep. Davis is chair of the Republican Congressional Campaign Committee.

In the last few years, both major political parties have been making tremendous efforts to curry favor with the high-tech industry. (*The New Republic*, June 8, 1998; *Newsbytes*, April 27, 1999; *Washington Post*, June 13, 1999.) The *Dallas Morning News* described it most succinctly, in a June 29, 1999 article:

“The presidential candidates are tripping all over themselves to be seen as having the computer industry seal of approval,” said Larry Makinson of the Center for Responsive Politics, a Washington group that monitors campaign spending.

“Both Democrats and Republicans are coming away from Silicon Valley with bagfuls of money,” he said. “It’s probably the single most-sought-after industry there is. It’s the turn-of-the-millennium equivalent of Hollywood.”

2.3.2 Whatever the Industry Wants, It Gets

Whatever the industry wants, they get. After President Clinton initially sided with the American Trial Lawyers Association (a close ally) on the issue of stockholder lawsuits against high-tech firms, Clinton switched his stance after heavy pressure from the industry. Even though another traditional Democratic ally, the AFL-CIO, opposed increasing the H-1B quota, Clinton signed the increase into law (and then immediately went on a fundraising tour of Silicon Valley). In 1999, the industry wanted to limit their legal liability on the Year 2000 bug problem, and Congress/Clinton approved this too.

The industry lobbyists have made major efforts during Clinton’s presidency to get a “direct line” to him. For example, during the 1996 expose’ of “coffees” held in the White House for donors to meet Clinton, one of the attendees on June 19, 1996 was reported to be Dr. Howard Rubin (*Mother Jones* magazine Web page, www.mother-jones.com), a Hunter College computer science professor who is paid by the industry and who has been a prominent ally of the ITAA industry lobbying group.

Eventually, in 1997, Clinton wrote a memo to his Department of Commerce (DOC), asking them to cooperate with the ITAA. The Department of Education was also brought in, as the ITAA’s theme was that education was the long-term solution to the claimed labor “shortage,” but that in the meantime an increase would be needed in the H-1B visa quota.² On the other hand, the Department of Labor was largely shunted out to the margins, as the industry lobbyists viewed DOL as the “enemy.” The DOC issued its own report in September 1997, a virtual carbon copy of the ITAA report, with no input having been sought from opposing voices. (Later, after pressure from the American Engineering Association and a congressional staffer, DOC did establish ties with those who disagreed with the “shortage” claims, and produced a more balanced report

²This argument, used in 1997 and 1998, is a common industry tactic, which they used in 1995 as well. At that time the theme was, “As soon as we get the laid-off defense engineers and programmers retrained, we won’t need H-1Bs.” This, of course, never materialized.

in June 1999, *The Digital Workforce: Building Infotech Skills at the Speed of Innovation*, by Carol Ann Meares and John Sargent, Jr.)

The ITAA, out to attain the government's imprimatur for their "shortage" claim, got DOC approval to lend the Commerce name to a January 1998 Convocation held in the San Francisco Bay Area. (In reality, though, the ITAA ran the show.) Keynote speakers were Secretary of Commerce William Daley and Secretary of Education Richard Riley. The Executive Branch's lack of integrity in this matter was illustrated when Riley pointed to a recent *Wall Street Journal* article (January 8, 1998) which had claimed that H-1Bs do not adversely affect job opportunities for American programmers. Riley avoided mentioning that that same article had also stated that American firms recruit abroad because "recruiting foreign talent is cheaper than hiring Americans," quoting an American recruiter of foreign programmers as saying that he pays them \$20,000 to \$25,000 less than Americans with the same skills.

Immediately after Clinton signed into law the large H-1B quota increase in 1998, he went on a major fundraising tour of Silicon Valley and some other high-tech regions.

And even though some officials in the Department of Labor have been critical of the H-1B program (and thus the DOL was excluded in the collaboration between the ITAA and the Departments of Commerce and Education), the DOL has limited itself to addressing only egregious individual violations of H-1B law, rather than modifying regulations in a way that would have broad impact. In particular, the DOL could, entirely within its legal mandate, rewrite its prevailing-wage regulations so that a job's specific software skills requirements (e.g. the Java programming language) must be factored in to calculation of prevailing wage. (See Section 9.2.5.) Yet they have refused to do so.

The *Baltimore Sun* reported on February 21, 2000:

The industry groups and the companies employing H-1B workers have a powerful ally in the American Immigration Lawyers Association. AILA members have thrown their financial muscle and support behind the congressmen who play a key role in determining the fate of the program.

Sen. Spencer Abraham, chairman of the Senate Immigration Committee, has been a speaker at AILA's national conferences and held a series of fund-raisers in tandem with AILA events.

When AILA met last summer in Seattle, the Michigan Republican held a \$500-a-plate breakfast at the hotel where most of the conventioners were staying. He held a similar fund-raiser during an earlier AILA conference.

2.3.3 H-1B and Immigration Policy Is Set by a Small Group of DC Insider Lobbyists

The ITAA's focus on immigration, so vehemently denied throughout 1997 by ITAA president Harris Miller, is illustrated by the fact that Miller is a former immigration lobbyist. Moreover, prior to Miller's lobbying career, he was a congressional staffer who specialized in immigration legislation, and thus who had the perfect Capitol Hill connections on which to base his subsequent immigration-lobbying business.

What we have, then, is a classic example of people writing laws and then taking lucrative jobs in the private sector which benefit from those laws. As *The New Republic*, October 19, 1987 reported, Miller is unapologetic about this:

"I believe in interest groups and the right of interest groups to be represented, and if I can represent them on the Hill, well, I will do it," says Harris Miller, a former aide to Kentucky

Democrat Romano Mazzoli's House Judiciary subcommittee on immigration who now has his own lobbying firm. Miller's first big client was the National Council of Agricultural Employers, a group of large growers who use migrant and illegal alien workers.

Interestingly, Miller used many of the same arguments for farm workers then as he is doing now in the case of H-1B visas for the high-tech workers.

These lobbyists know very well how to play the political game. They know, for example, that politicians like to use academic "studies" for cover. We have seen earlier immigration attorney/lobbyist Fragomen open admission that industry commissions academic studies with the understanding that the outcome of the studies will be in industry's favor. Miller, who used to work for Fragomen, has used the same tactic.

Miller's case illustrates the fact that, H-1B policy is similar to immigration policy in general, which is set by a small group of Washington insiders who are unknown to the general public but who pop up repeatedly in different key roles over the years. These people who often profit from their insider status, through jobs, contracts and so on.

A February 20, 2000 article in the *Baltimore Sun*, for example, reported that former congressman Bruce Morrison opened an investment-visa business which exploited a bill he had authored while serving as chair of the House Immigration Subcommittee in 1990. Paul Donnelly, Morrison's former press secretary from Congress, established a similar business in Maryland.³

Morrison's bill also established the H-1B visa program (which modified its predecessor program, called H-1), and also mandated the establishment of a bipartisan Congressional Commission on Immigration Reform. In 1995, Morrison himself was appointed to the commission, and Donnelly was hired as a commission staffer.

The kingpin of the "immigration legislation insiders" is lobbyist Rick Swartz. The *New Republic* tells the story (December 23, 1996; see also *Wired* magazine, August 1996) about what happened when the Commission on Immigration Reform recommended a thorough overhaul to address major problems with U.S. immigration policy, including the H-1B visa program:

[immigration] lobbyists, alerted by the friendly reception that the commission's recommendations received, began organizing. Central to this effort was Rick Swartz, who runs a public relations business out of his Washington home. Swartz introduces himself as a former civil rights lawyer and liberal, but he is funded primarily by the political right. His main patrons are Wall Street financier Richard Gilder and his Political Club for Growth, a conservative funding group that helped launch Newt Gingrich's gopac and subsidizes a variety of efforts, from the Cato Institute to Empower America.

Swartz got seed money to work on immigration from Gilder and was hired to advise two computer companies, Microsoft and Intel, which feared that Congress, heeding the commission and

³The "small group of insiders" nature of immigration legislation is illustrated by the case of a partner of Morrison's in the investment-visa business, Maria Hsia. Hsia was later indicted for her alleged role in the "Buddhist temple scandal" involving illegal campaign donations to Vice President Gore in 1996. Hsia worked closely with John Huang, who was the center focal point of the influence-peddling scandal involving Gore and President Clinton in 1996. Huang was the one who got Clinton to do a sudden flip-flop on then-pending legislation to eliminate the so-called Fourth Preference immigration category. (*Boston Globe*, January 16, 1997.) Clinton had earlier reached an agreement with Congress to eliminate the category (following a recommendation by the Commission on Immigration Reform), then suddenly, within a one-week period, flip-flopped in response to Huang's urging. Huang had successfully retained the Fourth Preference provision during the drafting of the 1990 bill, a fact which a lobbying group noted (ironically dovetailing with our "small group" theme here) "Most people outside of a handful do not know that [Huang] was intimately involved in the Immigration Act in 1990."

the Department of Labor, would seek to regulate the hiring of skilled immigrants and temporary workers. (Emissaries from the Jordan Commission had tried to explain to Microsoft that its proposals to replace labor certification with a fee would save it time without costing more money, but the company was dead set against any change.)

One of those “emissaries” was Donnelly. The commission’s proposal was that the labor certification process for employer-sponsored green cards be replaced by a fee. This would save the employer time and effort by eliminating the multi-year legal process needed to secure a green card for the foreign worker. The proposal would also be of tremendous help to the foreign workers, who would get “instant green cards,” and thus not have to wait in limbo on H-1B visas during the lengthy processing time for green cards. The fact that Microsoft refused illustrates just how much industry likes the *de facto* “indentured-servant” nature of the H-1B visa.

In 1999, the engineering professional organization IEEE-USA, which had been opposed to importation of foreign engineers and programmers in 1998, had come under enormous pressure from corporate and academic interests in the parent organization IEEE to moderate its position. IEEE-USA then hired Donnelly as a consultant, whose job was “to help wean the organization from its outright opposition to immigration.” (*The New Republic*, June 19, 2000.)

Donnelly then convinced IEEE-USA to support his proposal—similar to one formulated by Congressional Commission on Immigration Reform as mentioned above—under which industry could bring in foreign engineers and programmers on an expedited basis, giving them “instant green cards” and bypassing the H-1B stage. This new stance on IEEE-USA’s part was counter to its previous view that industry should hire/retrain American programmers and engineers, but apparently the organization felt that its new position would relieve the pressure brought to bear on it by the parent organization.

However, Donnelly was up against his rival, Swartz, and up against Swartz’s allies representing the computer industry, who wanted to retain the “indentured servant” nature of the H-1B workers. Those lobbyists dismissed Donnelly as “anti-immigrant,” in spite of his work as a consultant to immigrants and as an advocate for relieving the greencard backlog for the spouses and children of immigrants. (*Wired News*, May 15, 2000.)

Meanwhile, one of Swartz’s clients was the Immigrant Support Network (www.isn.org), an organization of H-1Bs who were hoping to get Congress to alleviate the “indentured servitude” problem. (According to a message broadcast by ISN on October 21, 1999, Swartz would charge the organization approximately \$100,000 for 9-10 months of work on the project. Later, Carrie Kirby, a reporter for the *San Francisco Chronicle*, told me that Swartz had started on a *pro bono* basis but began paid work for ISN in May 2000.) Swartz’s representation of both ISN and his corporate clients would seem to be a conflict of interest, which is apparently why he chose a middle ground: He lobbied Congress to limit the duration of the indentured servitude to four years. At the time, the typical waiting period for a green card for H-1Bs was five years, so it would be a small but significant gain for the H-1Bs, while still giving the employers four years of immobility for each H-1B.

Donnelly and Morrison still tried to get Microsoft to support the “instant greencard” proposal. However, Microsoft’s counsel and lobbyist, Ira Rubinstein, simply stalled, saying that he may support the proposal in the future but now wished to concentrate on H-1Bs. Later Rubinstein tried other stall tactics as well. (Personal communication with Paul Donnelly, June 17, 2000.)

Personally I do not support the Donnelly proposal, because although it would fix the problem of H-1B “indentured servitude,” a worthy goal, it would not address the problems of age discrimination and so

on which are being fueled by the influx of foreign programmers. Nevertheless, the industry's continuing rejection of the Donnelly proposal, which would bring in the workers they say are needed and would reduce paperwork and trouble for the employers, shows that they do indeed wish to retain the indentured-servant nature of the H-1B program. And the personal attacks on Donnelly are uncalled for.

3 Focus on Software Developers

3.1 Reason for This Focus

In an attempt to obfuscate the issues, industry lobbyists who pushed Congress to increase the H-1B work visa quota in 1998 talked about shortages of “information technology” (IT) workers, running the entire gamut of all jobs having any connection to computers, including nontechnical jobs such as marketing. **Yet the vast majority of H-1Bs hired for computer-related work are programmers, meaning software developers having titles such as Programmer and Software Engineer.**

This focus on software is especially important to keep in mind in the H-1B setting. The overwhelming majority of H-1Bs are in the computer science area, not electrical engineering. Department of Labor data show that the computer science H-1Bs outnumber the electrical engineering ones by nearly a 15-to-1 ratio. (*Dallas Morning News*, April 19, 1998. Also see a similar figures in *Characteristics of Specialty Occupation Workers (H-1B)*, U.S. Immigration and Naturalization Service, February 2000; the number of H-1Bs in “occupations in systems analysis and programming” is 10.9 times the number in “electrical/electronic engineering occupations.”) Though the boundaries between the two fields as viewed as undergraduate majors is not crisp—in fact, many, probably most, electrical engineering graduates eventually end up doing software—the key point is that **the vast majority of high-tech H-1Bs are working on software, not hardware.** For this reason, our report here focuses mainly on software, though we do also mention hardware/electrical engineering examples at some points.

Similarly we use the word *industry* to mean all employers of software developers, not just those in the high-tech field. This means that we include not only software publishers, such as Microsoft, but also employers such as banks, insurance companies and so on who develop software only for their own internal use.

3.2 Need for Care Regarding Job Titles

It is very important to note that titles such as Programmer and Software Engineer are interchangeable. The choice of title depends on the employer, not on the type of work done. Many programmers may instead have titles such as System Analyst, Computer Engineer.

In his 1999 guide to programming careers, consultant and author Jesse Liberty warns readers not to read anything into a job title in the software development field: “Some companies distinguish between programmers, analysts, architects...Others call all these people software engineers.” Actually, the Programmer title is rather archaic in today's job market.

John Miano of the American Programmers Guild noted (e-mail, May 21, 1999):

For all practical purposes the titles Programmer, Programmer/Analyst, System Analyst, Software Engineer, Software Specialist, Systems Architect etc. are functionally equivalent. The difference in titles is representative of the type of industry rather than the job function.

For example, a bank would most like call an employee a "Programmer/Analyst" where the person doing the same job in a software development company would be called a "Software Engineer."

The amount of vertical division in programmer functions has virtually disappeared over the years. In the olden days of batch processing you had the Analysts who looked at problems and drew flow charts, the Programmers took the flow charts and converted them to code, the Data Entry people would convert the code sheets to punch cards. Operators took the punch cards and ran them as batch jobs. (A Programmer Analyst was an intermediate level between Analyst and Programmer.)

With the advent of timesharing and later PCs, you can just type in the code, compile it, and have the results back in seconds. As a result even the most senior developer codes these days, while in the past coding (i.e. being a Programmer rather than an Analyst) was considered low skill work. Even Dave Cutler, the head of NT development at Microsoft codes.

A major failure of many studies of the IT workforce has been that they artificially separate these titles, leading to many false conclusions. For example, the Programmer title tends to be used more for older, mainframe-based jobs. Some researchers have expressed puzzlement about some oscillations in numbers of Programmer jobs and their salaries, without realizing that these seeming anomalies are explainable by two opposing forces: (a) The general decline in the use of mainframe usage, and (b) a temporary resurgence, starting around 1997, due to increasing attention paid to the Year 2000 bug.

4 There Is No Desperate Shortage of Computer Programmers

Even former Intel CEO Andy Grove has said (*Washington Post*, April 24, 1998), "I don't buy into the hyperventilated description of the technology worker shortage."⁴ But even nontechies can see that there is no shortage, simply from the facts that (a) employers hire only a small fraction of their applicants for software positions, and (b) programmer wages are showing only a very moderate rate of increase.

4.1 Employers Are Flooded with Re'sume's, But Are Extremely Picky

Any policymaker or journalist interested in the IT hiring issue should treat an article, "Why Are Employers So Picky?" in the November 22, 1999 edition of *Infoworld* as required reading. This article should be read, and regularly re-read, because it so succinctly describes the state of hiring in the industry. Industry employers claim a "desperate" labor shortage, but in fact their extreme pickiness in hiring shows they are not desperate at all.

The subtitle of a March 22, 1999 article in *Computerworld* says it all: "**Stream of Applicants Belies Labor Shortage.**" Early in the article is a related quote (emphasis added):

"We are inundated with resumes," said Kathy McLean, human resources information systems manager at the Eden Prairie, Minn., company [Best Buy, Inc.].

⁴Equally significant is that fact that Grove went on to remark, concerning the congressional proposal to increase the quota of H-1B visas for foreign high-tech workers, that all industry needed was access to the foreign students studying at U.S. graduate schools, about 3,000 of whom graduate per year—far less than the 65,000 quota in place at the time. In other words, the quota should be reduced, not increased.

Industry lobbyists exhort Congress and the press to “Look at all those Sunday newspaper ads for IT positions.” What they do not say, though, is that employers are not willing to fill those jobs with most programmers who apply for them, as can be seen from the extremely low percentages of applicants whom they actually hire, such as:

American Management Systems	2%
Broderbund Software	1%
Cisco	5%
Cohesive	2%
Datascan	5%
Deltanet	4%
ECbridges	2%
Flashpoint Technology	2 to 5%
R.D. Raab	1%
H.L. Yoh	4%
Inktomi	less than 5%
Microsoft	2%
Net Perceptions	2%
New England firm	1%
Qualcomm	4.5%
Radiant Systems	under 1%
Red Hat Linux	under 1%
Tangis	under 1%

Table 1: Percent of software applicants hired

[Microsoft (Redmond, Washington): Associated Press (*Tacoma News Tribune*), May 13, 1997; Deltanet (San Francisco): Patrick Schmidt, interview by the author, November 5, 1997; ECbridges (San Francisco Bay Area): Raymond Lim, interview with the author, November 7, 1997; Flashpoint (San Francisco Bay Area), Francine Beanan, interview with the author, October 31, 1997; Broderbund (San Francisco Bay Area): Mary Bjornstad, interview with the author, October 31, 1997; American Management Systems (Fairfax, Virginia): *Washington Post*, November 30, 1997; Inktomi (San Francisco Bay Area): Amy Hanlon, interview with the author, February 26, 1998; Qualcomm (San Diego): *San Diego Union Tribune*, March 7, 1998; Cohesive (San Francisco Bay Area): Ned Roberts, interview with the author, July 21, 1998; H.L. Yoh (Minnesota): John Sturgesleski, interview with the author, June 16, 1999 (Sturgesleski said “I will submit 10-15 applications to our clients per week; 1-2 will get interviews, and the numbers go down a lot from there”; I am assuming a 30% offer rate to interviewees, as seen below); “New England firm” (New England): interview with Director of Software Development, June 17, 1999; Net Perceptions (Minnesota): Ann Reishus, interview with the author, June 25, 1999; Red Hat (Durham, North Carolina): *Business Week*, June 30, 1999; Radiant Systems (Alpharetta, Georgia): Heather Arnold, interview with the author, August 1, 1999 (she said 300 re’sume’s are received per week for software development positions, and they hire approximately 35 developers per year); DataScan (Alpharetta, Georgia): Karen (surname not stated), interview with the author, July 30, 1999 (said hired 70 last year out of “thousands” of re’sume’s; I am using the conservative figure of 1,500 here for the latter); R.D. Raab: *Computerworld*, December 6, 1999; Cisco: *San Francisco Chronicle*, May 19, 2000; Tangis: interview of Randy Sheets with the author, June 19, 2000.]

Industry lobbyists have attempted to “spin” the above data in various ways, but they do not seem to communicate with their industry clients: **The employers admit that they are extremely picky in their hiring,**

and that they reject the vast majority of their applicants without even an interview. Indeed, when asked about the author's citing of a low 2% hiring rate, Microsoft admitted that it is "very, very selective." (*Boston Globe*, March 8, 1998.)

And it is important to note that it is not just Microsoft that is hiring only a tiny proportion of the applicants. The above companies comprise a broad range of employers, from giants to the tiny five-programmer startups, from the software vendors to the applications firms that write software for their own internal use, and so on.

In fact, I have served as an invited panelist on IT workforce issues at various conferences in which the audience consisted primarily of HR people and hiring managers from the IT industry (ITAA/DOC Convocation, January 1998; MEPTECH II, November 1998; *San Jose Business Journal* Power Breakfast, June 1998; etc.), and none of these people has ever challenged my point that hiring rates are down in the 2% range.

The situation is typified by the fussy John Otroba (*Washington Post*, November 30, 1997, emphasis added), who

...**has no shortage of incoming re'sume's.** When he logs onto his office computer every day, he has at least 50 in his electronic mailbox...But only about one in 12 re'sume's leads him to pick up the telephone to call the job seeker. Some don't pass that screening step. Of those who come in for an interview, fewer than a quarter are offered jobs [making an overall rate hiring rate of under 2%].

In other words, there is no shortage of "bodies," i.e. there is no shortage of experienced computer programmers. The problem is that employers are not willing to hire them. Employers are only willing to hire from three narrow categories of programmers:

- New or recent (within a few years of graduation) college graduates, who have cheaper salaries. Note, though, that even among new computer science graduates, fewer than half are hired as programmers.
- Foreign nationals on work visas, who have cheaper salaries.
- A relatively small number of programmers who have experience in certain highly-specialized software technologies.

It should be emphasized that tiny hiring rates seen above are for programming positions, not for, say, marketing jobs. In conducting my own interviews, for instance, I am very specific in asking for rates for programming jobs.

The companies' re'sume'-scanning machines search for key words corresponding to currently-"hot" skills desired by the employer. Any re'sume' lacking these words is rejected, untouched by human hands.⁵ The same is true for the employment Web sites set up by most companies in the industry, which filter responses based on skill sets and reject any applicant who lacks the given skills.

⁵A June 26, 1998 *Wall Street Journal* article on the problems of middle-aged professionals in the job market reported that "[one] man phoned a prospective employer to ask why he didn't land a job interview, only to learn that his resume had been prescanned electronically for 'action verbs' that failed to turn up. 'I've had the privilege of being rejected by a computer,' he said." It is interesting that the *Journal* should take such a view of this practice, since the very companies the WSJ has supported in their demands for H-1Bs give thousands of applicants this same "privilege" of being rejected by a computer.

Moreover, the industry claims of a labor shortage are even more strongly contradicted by the fact that **even among applicants who have the skills demanded by “picky” employers, less than half are made offers.** Patrick Schmidt of Deltanet notes that the programmer employment agencies he uses will only refer an applicant to an employer if the applicant is an exact match to the skill set defined by the employer—and yet even then Schmidt says he hires well under 10% of such applicants, due to the large number of agencies which send him applicants.

This was illustrated quite well in an article in *IT Recruiter* in October 1999:

Connaissance’s HR director, Martin, who says his organization is constantly trying to find top talent but has difficulty doing it, would rather take another route. “On-the-job learning] is certainly a consideration,” he says. “But if you find someone who’s already been trained, why do you need to train someone?”

In other words, the reason Martin’s firm does not need to retrain older programmers in new skills is that he is able to hire people who do have those newer skills. So where is the “shortage”?

In this light, it is very instructive to look at offer rates, meaning the proportion of those made offers among those who are interviewed (in person, not just on the telephone). Those who are interviewed have already been prescreened for skills criteria; the employer will have chosen the applicant’s re’sume’ because of specific skills listed, and will have typically performed a mini-interview with the applicant by telephone, in order to verify that the person does indeed have the skills. Here are offer rates:

American Management Systems	under 25%
Aspect Technologies	20%
Broderbund	30%
City of San Jose (civil service)	10%
Cohesive	20%
DataScan	12%
Deltanet	possibly as much as 40%
ECbridges	20%
ESP	10%
Flashpoint Technology	25 to 30%
high-tech job fairs	as few as 6%
Inktomi	50%
Madison, WI recruiter	20%
Mensch, Tim	5%
Microsoft	25%
Net Perceptions	50%
New England firm	25 to 30%
Quintet	under 5%
Radiant Systems	under 15%

Table 2: Percent of interviewees made offers

[Microsoft (Redmond, Washington): Microsoft recruiting head David Pritchard, ABC Nightline, January 1, 1998; Deltanet (San Francisco): Patrick Schmidt, interview with the author, February 26, 1998; Flashpoint (San Francisco Bay Area): Francine Beanan, interview with the author, February 26, 1998; AMS and job

fairs (Fairfax, Virginia and greater DC area): *Washington Post*, November 30, 1997; Inktomi (San Francisco Bay Area): Amy Hamlin, interview with the author, February 26, 1998; Quintet (San Francisco Bay Area): Ali Moussi, interview with the author, February 26, 1998; Broderbund (San Francisco Bay Area): Jennifer Ranghiasi, interview with the author, February 26, 1998; City of San Jose: Debi McIntyre, interview with the author, March 5, 1998; ECbridges (San Francisco Bay Area): Raymond Lim, interview with the author, March 5, 1998; Cohesive (San Francisco Bay Area): Ned Roberts, interview with the author, July 21, 1998; Aspect Technologies (San Jose): *San Jose Mercury News*, July 19, 1998; “New England firm”: Director of Software Development, interview with the author, June 17, 1999; ESP, Sean Sweeney, interview with the author, June 18, 1999; Madison, WI recruiter: interview with the author, June 22, 1999; Net Perceptions (Minnesota): Ann Reishus, interview with the author, June 25, 1999; Tim Mensch, startup founder, Oakland, CA: *Tech Week* letters to the editor, July 12, 1999; Radiant Systems (Alpharetta, Georgia): Heather Arnold, interview with the author, August 1, 1999 (she said 1 out of 7 or 8); DataScan (Alpharetta, Georgia): Karen (surname not stated), interview with the author, July 30, 1999.]

Note that these low rates are for offers, not hires. Thus the low rates cannot be explained away, for instance, by postulating that an applicant gets multiple offers but can only accept one, or by suggesting that many re’sume’s are casually submitted via e-mail by programmers who may not really be in the job market but are merely “testing the waters.” So we do indeed see that employers are very picky in their hiring. Again, note that Microsoft admitted this, and indeed any industry employer, large or small, will admit this when asked.

Instead, it is clear that even if one grants the employers’ claim that they must hire someone with a given skill set (which I strongly disagree with), they still are being very selective in their hiring—contradicting their claims to be “desperate” to hire.

Employers also admit that when an applicant for a programming job interviews, typically six or eight of the firm’s programmers will meet with the applicant, and each of those programmers has “veto power”—if just one of them is negative or lukewarm about the applicant, then the person is usually not hired, no matter how strongly positive the assessments of the others are. Again, this is quite counter to the employers’ claim to be desperate to hire.

Occasionally industry people will even admit that they are not “desperate.” Note for instance the following, from *Computerworld’s* publication, *College Careers Spring 1999*:

Although there may be a shortage of programming talent in the Seattle area, employers aren’t so desperate that they’ll take just anyone, says Bob Stange, a vice president at Staffing Options, a Lynwood, Wash.-based executive recruiting firm. “It’s not enough just to be a good programmer,” Stange says. “My clients want people who are going to be able to understand what it is they do in the marketplace.”

4.2 Salary and Nonsalary Compensation

In some very narrow segments of the programmer labor market, some salaries have indeed risen substantially. (*America’s New Deficit: The Shortage of Information Technology Workers*, Dept. of Commerce, Fall, 1997.) As stated earlier, employers are overdefining job requirements, with ads like “Must have experience writing C++ code for TCP/IP applications on SPARC platforms.” The pool of programmers satisfying such conditions is of course small, thus raising salaries for those within that narrow pool.

However, outside of these subsegments, programmer salaries are not rising rapidly. Bureau of Labor Statistics data show that salaries of programmers overall—i.e. combining the ones who have currently-“hot” skills and the “ordinary” programmers—rose about 7% in 1997. Again, this overall 7% figure includes the programmers who are commanding a high salary because they know a new language like Java; so we can see that the salaries of “ordinary” programmers are not rising much, if at all. And though this 7% figure is a few percentage points above inflation, it is still very mild. **If employers were desperate to hire, as they claim, they would certainly be willing to pay a premium of more than 7%.** By contrast, surveyors and dieticians saw their salaries increase far more than programmers, beating inflation by 20% and 17%, respectively (*Business Week*, June 29, 1998).

Urban Institute/American University economist Robert Lerman, in his testimony before the Senate Judiciary Committee on February 25, 1998 (Dr. Lerman’s testimony is available at

<http://www.urban.org/TESTIMON/lerman2-25-98.html>

) also pointed to wages, whose mild rate of increase does not indicate a massive labor shortage.⁶

A 1998 UC Berkeley study (“The Perceived Shortage of High-Tech Workers,” Clair Brown, Ben Campbell, and Greg Pinsonneault, Dept. of Economics, UC Berkeley) found that

To determine if there is currently a shortage of high-tech workers, we looked at their wage growth in the economy. If there is indeed a labor shortage, we would expect to see earnings of high-tech workers increase more rapidly than earnings of other workers. This did not happen. Although average earnings for engineers have increased over the last ten years, we find that the increased earnings for engineers have not been transmitted fully to the more experienced workers. In addition, we find that high-tech engineers and managers have experienced lower wage growth than their counterparts. This is strong evidence against the existence of a labor shortage...

In the entire economy, a professional with 20 years of experience in 1985 earns 48% more than a professional with no experience, and by 1995 this increases to 73%. In the high-tech industries, an engineer or professional with 20 years of experience earned 55% more than a new-hire in 1985 but only 59% more in 1995.

A Bureau of Labor Statistics paper by Carol Veneri, “Can Occupational Labor Shortages Be Identified Using Available Data?” (<http://stats.bls.gov/opub/mlr/1999/03/art2full.pdf>), also states that the data do not support the industry’s claim of a labor shortage:

...the labor market conditions for this period [1992-1997] indicate that neither the occupational group consisting of computer systems analysts, engineers, and scientists nor the computer programmer occupation has exhibited both higher than average employment growth and higher than average growth in wages.

The ITAA criticizes the BLS data as being inaccurate, yet outspoken advocate of higher H-1B quotas TJ

⁶By contrast, the June 23, 1998 issue of the *Wall Street Journal* reported on a butter shortage in the U.S., with prices for Grade AA butter rising 73% in the past year.

Rodgers, CEO of Cypress Semiconductor, stated⁷ he is raising salaries by 6%, quite in line with the BLS figures.⁸

Comparisons of 1996 and 1997 salaries in Silicon Valley by the employment agency Heuristics Search Inc., were presented in *Tech Week*, March 9, 1998. Salaries were tabulated for five areas of skill sets (software engineers, client/server, communications, database and graphical user interfaces), over four levels of experience (0-2 years, 3-8, 8-9, 10 or more). Once again, the differentials between 1996 and 1997 were in most cases in the 6-9% range.

Similar figures were found for other regions of the country in the Datamasters survey, cited in the same article (and the Datamasters Web page also shows similar figures comparing 1997 to 1998). This survey also features detailed salary information yearly from 1990-1998, extremely useful. It is available at

<http://www.datamasters.com/dm/survey.html>.

House Report 657, on House bill HR 3736, 1998, <http://rs9.loc.gov/cgi-bin/cpquery/z?cp105:hr657:>, quotes Prof. Lerman further:

[The data cited in the ITAA report] are inconsistent with other private surveys as well [as] with public data sources. A survey conducted by Deloitte and Touche Consulting Group revealed that salaries for computer network professionals rose an average of 7.4% between 1996 and 1997. Coopers and Lybrand found average salary increases at 500 software companies were 7.7% in 1995 and almost 8% in 1996.

Even the industry-sponsored *Silicon Valley Joint Workforce Initiative Study* (A.T. Kearney Co., May 18, 1999), in claiming that a labor “shortage” was costing employers \$5,000 to \$6,000 per employee in various ways, allotted only 3.0% for its Salary Premium factor due to the alleged shortage. Again, if employers were desperate to hire people, which they claim, they surely would be willing to pay a premium of more than 3.0% to get someone.

Salaries for new college graduates in computer science rose 3.9% during 1996-1997.⁹ Qualcomm, another firm which insists there is a high-tech labor shortage, admits that its starting salaries have only be rising about 4% per year. (*San Diego Union-Tribune*, March 7, 1998.) Starting wages for new computer science graduates of UC Berkeley have been rising at the rate of 5.5% yearly.¹⁰ And in spite of wild newspaper stories about new Bachelor’s graduates getting salaries approaching six figures, the going rate is in the \$40,000 range.¹¹

The ITAA industry lobbying group says that salaries are less relevant because of nonsalary compensation such as bonuses and stock options. **Yet the ITAA made no claims that total compensation (i.e. salary plus bonuses, stock options and so on) is rising at more than the 7 or 8% rate we see in salaries. On**

⁷Marketplace, NPR, February 25, 1998

⁸Rodgers also stated he had to include a new car as a signing bonus for one Stanford Ph.D. he hired recently, but that is not news. This is for a Ph.D., not a Bachelor’s degree, and it is Stanford—the top Stanford Ph.D.s, MBA, doctors and lawyers have always tended to be *prima donnas* in negotiating compensation.

⁹*Software Workers for the New Millennium*, National Software Alliance, Arlington, VA, January 1998.

¹⁰Letter to the editor to the *San Francisco Chronicle*, April 4, 1998, by Professor Randy Katz, chair of the UCB CS Dept.

¹¹*Computerworld*, March 30, 1998; *San Diego Union-Tribune*, March 7, 1998; Forum, KQED-FM, San Francisco, March 6, 1998; TJ Rodgers, Cypress Semiconductor, Reuters, February 25, 1998.

the contrary, the median value of stock options only rose \$2,900 between 1996 and 1998,¹² certainly not enough to support ITAA's claims of dramatic increases in overall compensation.

The key point is not whether there exist nonsalary forms of compensation—this has always been true in this industry, since 1980 or earlier—but rather whether the amount of such compensation has been rising. If overall compensation, both salary and nonsalary, is rising only at a mild rate like 7%, then employers are obviously not desperate to hire.

Except for a few cases of “miracle” companies, the profit made through stock options in established firms is on average also a small portion of salary, typically about 1%.¹³ In columns in trade magazines which advise programmers on how to negotiate compensation on a new job, stock options are rarely mentioned; they are also given only the briefest of mentions on, for example, in the benefits section of Sun Microsystems' employment Web page, at

http://www.sun.com/corp_emp/working/benefits.html

Of particular interest is a special kind of bonus, the “bounty” paid to an employee who introduces a friend to the firm who is then hired. At Oracle, for instance, the size of this bonus is currently \$1,000 for a job paying more than \$40,000, and \$500 for one paying less than that. The size of this bonus has been constant at Oracle for several years; in fact, the figure (\$1,000) was common in the industry even in the 1980s. **So we once again do not see evidence of escalating levels of desperation among employers. If employers were that desperate, they would certainly raise the finder's bounty to encourage people to bring in more leads.**

4.3 Criticism of the ITAA/VPI/DOC “Shortage” Survey Methodology

Much has been made of dizzying claims of numbers of open positions made by the ITAA and its partners (Dept. of Commerce and the Virginia Polytechnic Institute, VPI). The methodology underlying these claims has been strongly criticized by the General Accounting Office (*Washington Post*, March 23, 1998) and the Bureau of Labor Statistics.

The GAO cites a number of flaws in the ITAA/VPI study, and other flaws have been pointed out by others as well. For example, the ITAA/VPI survey counts a position as “open” even if it is currently filled by outside consultants. The fact that many programmers now prefer to work as consultants (“contractors”) instead of as salaried employees does not mean we have a shortage of programmers.

The ITAA/VPI has also been strongly criticized for the fact that its survey simply asked how many openings a firm had overall, not in the U.S. In other words, the survey's counts include all the jobs U.S. multinationals have open in foreign countries.

Interestingly, the ITAA/VPI study's author, Linda Leffel, noted in a side comment in the study that “even if 346,000 qualified applicants ...appeared today, in all probability immediate positions would not be available—to translate this number to an absolute would be misleading.” For example, many jobs are open just to “test

¹²IT Workforce Data Project: Report IV, *Assessing the Demand for Information Technology Workers*, November 1999.

¹³The ITAA has cited an Associated Press story (*Tacoma News Tribune*, May 13, 1997) in which Bret Bertolin of the Office of the Forecast Council of the State of Washington notes that a large number of programmers in Washington cashed in on stock options in 1995, bringing their overall compensation to over \$100,000. But Bertolin, in an interview with me on May 12, 1998, said, “That's misleading. This is mainly Microsoft employees cashing in on options they received six years earlier. A new employee cannot walk into Microsoft today and count on a windfall six years from now.”

the waters”: There may be, say, four job ads placed when the firm intends only to hire two workers. The four jobs may be under four different managers, who are “competing” with each other for two job slots.

It should be noted that Leffel and VPI have strong incentives to find that there is a labor shortage, because VPI formed a new program, aimed at the nonstudent public, conferring a computer studies degree. The tuition for this program is higher than for the university’s mainstream courses, and thus has become a “profit center.” Leffel, as Director of Continuing Education for VPI, is in charge of the program.

In any case, as the economist Robert Lerman cited earlier pointed out in his testimony before the Senate Judiciary Committee, **the size of the demand for labor is irrelevant anyway; what matters is the difference between the supply and demand, and these studies do not address that question.** Dr. Lerman noted that industry lobbyists used their vacancy statistics in an attempt “to bowl over people by saying that a worker shortage is obvious...The mere existence of vacancies does not demonstrate a shortage.” (*Sacramento Bee*, March 14, 1998.)

Similarly, the ITAA claims a 10% vacancy rate for IT positions—but does not mention that the industry always has had high vacancy rates. ECbridges’ Raymond Lim even considers 10% low, saying that rates of 20% were typical a few years ago. (Interview with the author, March 5, 1998.)

4.4 Comments on Other Studies of a Possible IT Labor Shortage

Here are some brief remarks about some other studies:

- The second Dept. of Commerce (DOC) study, *The Digital Workforce: Building Infotech Skills at the Speed of Innovation*, by Carol Ann Meares and John Sargent, Jr., June 1999. DOC has conceded that it regards industry as its “constituents,” and I have earlier in this paper chronicled the relation of DOC to ITAA, but of all the studies commissioned or requested by industry, this one is by far the fairest, though it does have a number of problems.

The study dares to discuss the age discrimination issue and cites significant problems in this area. It zeroes in on one of the most important problems, the employers’ refusal to hire older programmers who do not match a given skills list, though unfortunately the study seems to justify this by the short time-to-market for many software products (an argument I refute later in this paper).

The report’s coverage of the issue of “retraining” for older programmers is rather self-contradictory. On the one hand, the report is to be greatly commended for stating that employers typically are not willing to retrain older programmers in the new skills. And even better, the report notes more than once that employers are not willing to hire programmers who retrain themselves, say by taking courses. In light of the latter point, why does the report then advocate training programs as the “solution”?

Also, on the retraining issue, the report notes several times that employers don’t want to retrain a programmer in, say, Java, because then the programmer would defect to some other employer who will pay him/her more. Yet the report fails to notice the implication of that statement by employers: It is an admission that the employers want cheap labor. There is no shortage of labor, just a shortage of cheap labor.

The study makes too much distinction between various job titles, such as Programmer, Software Engineer and so on. As I have discussed earlier in this paper, people with these different titles actually tend to do the same work.

It was disappointing to see pages and pages of material on how to increase the number of school kids entering the IT career pipeline, including that classic ITAA line about the “nerd” image of the

profession. It is important to keep in mind that the ITAA originally formulated that line to “explain” the alleged “decline” in computer science enrollment in U.S. colleges. American kids just aren’t interested in such a nerdy field, the ITAA claimed. Yet as the DOC itself report points out, CS enrollment has been skyrocketing in the last few years. Thus all this material in this newer DOC report was addressing a problem which did not exist in the first place, as DOC itself discovered. And much more importantly, how can the report simultaneously worry about age discrimination on the one hand yet on the other hand advocate expanding the labor supply, which would exacerbate the age discrimination problem?

- The industry-sponsored *Silicon Valley Joint Workforce Initiative Study* (A.T. Kearney Co., May 18, 1999). This study is not remarkable in any particular aspect except one: The study allotted only 3.0% for its Salary Premium factor due to the alleged shortage. Again, if employers were desperate to hire people, which they claim, they surely would be willing to pay a premium of more than 3.0% to get someone.
- The Computing Research Association Study, *The Supply of IT Workers in the United States*, 1999. I have earlier in this paper described the vested interests in industry and academia which give these groups incentives to declare an IT labor shortage. (This CRA study stops short of declaring that a shortage exists, but it does say that “the preponderance of evidence” suggests a shortage, or at least a tight labor market.) The panel overseeing this study consisted of members from both of these groups, and as a result the study is, unfortunately, one of the most lacking of those I am reviewing here. The study sidesteps the age discrimination issue entirely, completely ignores the key issue of overspecification of skills in job requirements, and so on—all the issues that the second report by the Dept. of Commerce, an overtly pro-industry body, has the courage to address.

The report is quite biased in its coverage of the H-1B issue. It airily dismisses the charge that the H-1Bs are exploited in terms of low salaries, by simply repeating the industry claims. In spite of the report’s implicit claim to gather together all available data, it ignores studies by UCLA Asian-American Studies Professor Paul Ong, Cornell University Law Professor (and immigration attorney) Stephen Yale-Loehr, and my own statistical study, clearly showing the exploitation.

This report also makes the same serious error made by the second DOC study, by incorrectly separating the various job titles for software developers. There are many, many other serious errors, too many to list here.

The management of the research in this report appears to have been very shoddy. When I tried to verify the citation for one of the statistics in the report (concerning career longevity in IT), I found that the cited reference, the *Digest of Educational Statistics*, did not contain the claimed data. I asked both of the study’s authors about this. One of them said he didn’t know, and referred me to the other author. The latter admitted that the cited reference did not contain the claimed data, and said that he didn’t know the correct source. He stated the name of the assistant who did this work, but did not respond to my request to contact her.

- The IT Workforce Data Project, sponsored by the Sloan Foundation. This is a bland analysis, due to the authors’ insistence on using only the coarsest government data. It also again makes the same serious error made by the second DOC study and the CRA study, by incorrectly separating the various job titles for software developers. However, the authors conclude that “A review of five different kinds of indicators of demand yields no compelling evidence that there is a current shortage of IT workers or that such a shortage threatens to damage the industry in the near future.” (*Dr. Dobbs Journal*, April 2000).

- The study on Workforce Needs in IT, by the National Research Council. This study was mandated by Congress in 1998, as part of legislation which increased the H-1B quota. The charge, as codified in the law, was to investigate (a) whether age discrimination is common in IT, and (b) the impact of the H-1Bs on the labor market.

Though the project committee does include some pro-labor members, it is dominated by industry representatives and allies of industry. The committee includes members from Intel and Microsoft, the latter representative being Ira Rubinstein, Microsoft's chief lobbyist for H-1B visas.

The committee's chair, Alan Merten, is president of George Mason University. As shown earlier, academics have huge incentives to toe the industry line on the H-1B issue, and in addition, Merten sits on the boards of several high-tech firms, such as BTG Inc., Comshare and the Indus Group. (*Washington Technology*, August 29, 1996.) He decided *before* the study began, without waiting for results, that the industry claims of a shortage were at least partly true, an irresponsible prejudgment. (*San Jose Mercury News*, September 20, 1999.)

When the NRC committee originally set hearings in Silicon Valley in September 1999, the committee invited testimony from a number of Silicon Valley employers, and their allies in academia, but did not invite even one speaker who is critical of H-1B policy. After I contacted them to complain, they did set up one panel session to hear the non-employer side of the issue, but they had been prepared to spend three days in the epicenter of the high-tech quake without such a panel.

Moreover, the committee has diluted its analysis, by choosing to address a wide variety of issues, rather than focus on issues (a) and (b) as mandated by Congress. The likely effect of this will be that, even if the committee does find that age discrimination is common in the field, that finding will in effect be little more than a footnote in the report, and will be little noticed.

As of June 2000, this study has not yet been completed. However, my prediction ever since the project's inception has been that the final report will be heavily biased in favor of industry. It will likely adopt the favorite line of the industry lobbyists, "Education Is the Answer," which the industry uses as stalling tactic. The lobbyists say, "Education is the long-term solution, but we need H-1Bs in the short term." I have repeatedly explained to the committee that education is NOT the answer—we are not using the programmers we already have, so increasing their numbers would only give the industry more people to reject—but an educational theme would not only fit in with the industry's lobbying tactics, but would appeal to the committee's pro-labor members too, since they are accustomed to such solutions. (Similarly, I expect to see a theme of retraining, which as explained above is also inappropriate.)

- American University professor Robert Lerman's study. This report has been mentioned above. It finds that there is no evidence of a labor shortage. However, again it is not detailed enough to address issues such as age discrimination, overspecification of job requirements, etc.
- UC Berkeley professor Clair Brown's study. The same comments apply here as for Professor Lerman's work.

The "shortage" claim is related to two other issues: (a) age discrimination, and (b) importation of foreign programmers and engineers as cheap labor. Some studies and surveys related to these issue which are discussed elsewhere in this paper are:

- A study of the relation of age to unemployment duration among engineers, by Prof. Laura Langbein. (Sec. 5.)

- An *InformationWeek* survey of hiring managers which found that only a small fraction of them would prefer to hire an applicant with more than 10 years of experience. (Sec. 5.4.)
- A *Network World* survey of hiring managers which found that the younger the manager, the less likely he/she would be to hire an older programmer. (Sec. 5.9.)
- Prof. Paul Ong’s study showing salary exploitation of immigrant engineers. (Sec. 9.2.3.)
- A study by Prof. Stephen Yale-Loehr and Dr. Demetrios Papademetriou showing salary exploitation of H-1B programmers. (Sec. 9.2.3.)
- An audit by the Department of Labor regarding salary exploitation of H-1Bs. (Sec. 9.2.2.)

5 Rampant Age Discrimination—at Age 35

Mid-career programmers often have a very difficult time finding programming work, so much so that large numbers of them leave the field.

The following is very instructive (*IEEE-USA Perspectives*, March 1999):

IEEE-USA’s 1998 Unemployment Survey shows that despite a growing economy in 1998, the mean duration of unemployment among our members has increased from 84 weeks in 1995 to 103 weeks in 1998. Using data from the survey, Dr. Laura Langbein of American University has calculated that each additional year of age of members seeking new jobs translates into three additional weeks of unemployment.

5.1 Underlying Factors

Dr. Langbein’s study cited above (the full study is available at <http://www.ieeeusa.org/EMPLOYMENT/langbein.pdf>) did not determine the cause of this phenomenon. However, abundant evidence from many other sources shows three underlying factors:

- Older workers often lack work experience in the most up-to-date software skills. (Note: The key phrase is *work experience*. Employers are not willing to hire an older programmer who has taken a refresher course in a new skill.)
- Employers like to hire new college graduates or young workers within a few years of graduation, because they work for lower salaries, and they generally are single and thus can work large amounts of overtime without being constrained by family responsibilities. Employers may also perceive that the new graduates have more modern skill sets, though this effect is limited.¹⁴
- The “I only hire those who look like me” syndrome: Many of the hiring managers are young, and are either consciously or unconsciously uncomfortable with hiring older workers.

¹⁴The new graduates may know Java, for instance, but not TCP/IP, SAP or any of the literally hundreds of software technologies in use today. There is no way a college curriculum can teach them all.

5.2 Typical Example: Intel

Intel lobbyist Eva Jack conceded to *Computerworld* magazine (*IEEE Computer*, February 1996) that the firm often focuses its hiring policy on new graduates. Tim Jackson's book, *Inside Intel* (Dutton, 1997), provides a number of disturbing details:

- Intel's policy apparently was instituted in response to a suggestion "by management consultants who feared the company was aging too fast, [recommending] easing older employees out of the company and replacing them with younger ones."
- Craig Barrett, Intel's Chief Operating Officer, replied to a corporate downsizing question raised at a stockholders' meeting dismissively, commenting "The half-life of an engineer, software, hardware engineer is only a few years..."
- Intel's focus on new or recent college graduates is so intense that it even has a special acronym for the term, RCG (Recent College Graduate), which dominates its employment recruiting discussions.
- Intel has also been the defendant in several age-discrimination lawsuits, including by one of its top salesmen, 40-year-old Bill Handel, who Jackson reports "was a great deal more expensive to keep than a newcomer only a few years out of college."

To my knowledge, Intel has never denied these claims, including when I cited the claims during public debates at which Intel officials were present, such as in a television debate between the author and Intel representative Coeta Chambers (Bay TV, San Francisco, March 3, 1998). And when the author offered during that debate to give Intel a list of older unemployed or underemployed software specialists who are seeking jobs, Intel declined the offer.

5.3 Comments by Recruiters and Analysts on the Age Problem

Even an *Information Week Online* article (March 30, 1998) which claimed a severe software labor shortage correctly stated that the opportunities are mainly for the young:

"Younger people with hot skills have the most options open to them," says Tom Morgan, a VP in the Chicago office of Pencom Systems, a national IT recruiting firm.

Employment agents tell the story clearly. Andrew Gaynor notes (interview with the author, July 1, 1996) that anyone with 10 or more years of experience without currently-"hot" skills "is at a complete disconnect" in finding work. Susan Miller says (interview with the author, June 26, 1996) that former defense industry programmers "are usually shunned by the industry. I get a tremendous number of re'sume's from them but I can't place them." Gaudi Lucca told the author in August 1997 that very few programmers with 10 or 15 years of experience but lacking current skills would be able to find programming work. And Kim Lee, of the Network Connections employment agency in the Silicon Valley remarked (interview with the author, June 26, 1996), "In 1988 the employers would have retrained [older] people but *they're not desperate enough to do so today.*"

Prominent software project management writer Edward Yourdon, who follows national trends in the industry, comments,

...a lot of [older] programmers have disappeared—I've visited organizations that used to have 100 software people...then returned two years later to find that the staff had been reduced to a dozen younger and less expensive people." (*The Rise and Resurrection of the American Programmer*, Yourdon Press, Prentice-Hall, 1996.) He then notes that a major trend (in the computer applications realm) has been to replace older workers with "cheap, young C++ programmers.

A *Dallas Morning News* article (June 2, 1999), noted that:

The age issue often boils down to a hot-skills issue, said Andrew Jackson, president of Bravo Technical, a Dallas provider of technical talent.

"When someone comes to us and says they need someone with skills in Java [a programming language used on the Internet], we go to our database, and what we come up with is that people who have this experience are 25 to 35 years old," he said. "Does it happen? Yes. Is it intentional? No."

It should be noted, though, that often it in fact is intentional. While there are many sincere employers as Jackson indicates, the sad truth is that many others—especially those who are speakest loudest in claiming a labor shortage—who deliberately use the skills issue as a pretext to avoid hiring the older, perceived-expensive, programmers.

Though age discrimination is not caused by the H-1B work visa program, it is clear that the program greatly exacerbates that discrimination. If the employers did not have the foreign labor pool to draw from, they would be forced to pay more attention to the older programmers here. The *San Francisco Chronicle*, May 19, 2000 noted:

Silicon Valley headhunter Linda Tuerk said that in her experience, employers are saving a lot of money by hiring H-1B workers, no matter what the rules say.

"Companies are firing older, more-expensive workers – people making 80 grand – and they can turn right around and hire two people right off the plane for 45 grand each," Tuerk said.

And from the same article:

The companies are in too much of a hurry to make use of the talent that's available to them, said Bill Payson, the head of SeniorTechs, an employment firm. "There's a shortage of ready-made techies," he said. "What they really want is somebody who's been doing exactly what they're looking for as recently as yesterday, available tomorrow."

Payson insists the real reason the tech companies are using the labor shortage argument is to save money by hiring foreign nationals at Payson has 12,000 reasons to believe that there's no huge talent shortage in IT. That's the number of unemployed and under-employed, experienced technology workers listed in the database of his employment firm. Most are over 50, although Payson has been getting more interest from professionals in their 40s who feel they are already experiencing age discrimination.

"Our success rate is minimal. One out of 10 employers (who clients visit) hire somebody," Payson said.

5.4 Industry Officials and Lobbyists Admit That the Older Programmers and Engineers Have Difficulties Getting Hired

Many employers' insistence on hiring only programmers who have a specific software skill is sincere, though again, misguided since any competent programmer can learn a new software skill quite quickly. **But for too many employers, especially the ones who lobby heavily in Congress, the skills issue is just a red herring, a pretext for avoiding the older programmers and hiring cheaper workers.** Age discrimination is rampant in the industry, as more and more employers focus their hiring on the cheaper young people.

An article in *IT Recruiter* in October 1999 contained a quote which illustrates the situation:

...Arthur Martin, HR director for Connaissance Consulting, an IT telecomm and consulting firm in Columbus, Ohio. Martin says about 20 percent of his applicants are older, though **fewer than that have been hired.**

(Emphasis added.)

Martin goes on to say that the discrepancy is due to lack of skills. (Recall that for some employers the skills issue is just a pretext, though many sincere, though misguided, employers do apply this screening too.) But at the very least his remark shows that the older programmers do face problems getting work.

We have seen earlier that Intel has admitted preferring new graduates, and has dismissed the problems of older engineers by saying they have a "half-life" of only a few years. This attitude is not limited to Intel by any means; it actually pervades the industry. One engineer phrased it this way (*San Jose Mercury News*, September 4, 1995):

"There definitely seems to be a life cycle to engineers," said Fred Fehrer, 52, who was an engineer for Hewlett-Packard Co. for 13 years. "Engineers seem to be most valuable when they're five to 10 years out of college. Then there's a slow decline after that."

This problem has also been described for Microsoft. (*The Microsoft Way*, by Randall Stross, Addison-Wesley, 1996.) A hiring manager in a Silicon Valley firm who is a former UC Davis student told the author (March 28, 1997),

Well, I want to state that this is in my opinion not a good policy, but the top management in our company has directed us to focus our hiring on new or recent graduates only. These are people who have no family and can work long hours. Yes, salary is a major factor; that's what it boils down to. You work the young ones for five years and then replace them. I have objected to this, because I believe that many of our projects are being hurt by the fact that everyone is so inexperienced.

A July 14, 1997 article in the *Washington Times* quotes NeuroSystems CEO Ed Robertson as to the central issue in hiring recent college graduates:

If we go out to the marketplace and find a 40-year-old software engineer, we'll have to pay that individual more.

The March 22, 1999 issue of *Internet Week* observed (emphasis added):

For many expanding companies, college recruiting represents a major part of the hiring strategy. There are pros and cons to hiring college students. And to be successful, the hiring process requires careful attention. But **recruiters say there's no better way to access a pool of eager and low-cost talent.**

Actually, as explained in Section 6.2, even new graduates are not sought after much by employers, contrary to industry claims. The employers prefer a modicum of experience—but they shun those with “too much” experience. An *InfoWorld* article (July 20, 1998, <http://www.idg.net>) featured summarizes the problem:

“The most sought-after person has three to 10 years of experience—they’re not highly paid yet—and they’ve got a lot of education in the latest tools and OSes,” says Bill Schaefer, president of Schaefer and Associates, in Melbourne, Fla...

“I’d love to have somebody with 20 years of experience, but unfortunately I’m only paying for three or four,” says the IT director at a large law firm on the West Coast.

The article goes on to note that even though many older workers state that they are willing to work for less, employers’ perception to the contrary means that the workers do not even get interviews. Many older programmers tell me they have encountered this problem.

Sharon Gadberry, president of Transitions Management/Outplacement National in San Francisco, noted that job ads will specify “five years of experience—they usually mean no more than that...Companies are trying to screen out the older workers [often to save on salary].”¹⁵

Lars Poulsen, head of RNS, a network router firm in Santa Barbara, said that he aims for a median length of experience of five to seven years among his engineers. (Interview with the author, June 24, 1996.)

This trend was noticed in the March 29, 1997 issue of *The Economist*:

Age and experience, which elsewhere get people promoted, are no help in the [Silicon Valley]; on the contrary, there is a distinct bias in favor of youth. Nowadays the average software-engineering qualification becomes obsolete in around five years, so a student fresh out of college may be more valuable to a company than a 40-year-old.

Ann Reishus of Net Perceptions in Minneapolis told the author (June 25, 1999) that her firm primarily recruits programmers with three to seven years of experience. Another recruiter, who is with a major networking systems firm, gave exactly the same age range to the author (June 24, 1999).

Intel’s own internal recruiting literature points to a focus on “NCGs” (new college graduates) and “RCGs” (recent college graduates). (The time limit for an RCG is one year after graduation, according to Intel recruiter Pearl Seto.) These terms apparently are used for some other firms as well; I have seen internal documents from them indicating that various positions were earmarked for RCGs.

One CEO (Bob Forman of IMI Systems, a national programming consultancy) who heard me speak on this subject approached me after my presentation and said, quite angrily, “You are wrong that the industry does not hire older people who don’t have hot skills. My company is anxious to hire as many programmers as it can get.”¹⁶ I then suggested that my wife, a software engineer with 15 years of experience, send his company

¹⁵Ms. Gadberry was quoted in the *San Jose Mercury News*, September 4, 1995.

¹⁶Forman is also quoted in a similar comment in *Computerworld*, January 19, 1998.

her re'sume', and that if the re'sume' were rejected without an interview, I use his firm as an example in my future writings on this topic. He quickly backpedaled, saying that my wife's re'sume' might be rejected because the firm finds that her current salary is too high.

My reply to Forman was that this indeed is the problem. The industry claims there is a shortage of workers when what they really mean is that there is a shortage of cheap workers, in the form of new college graduates and imported foreign nationals. I discovered later that Forman is Chair of the ITAA's Immigration Policy Committee, in charge of lobbying for an increase in the H-1B work visa.

The industry also says that if they retrain their programmers in a "hot" skill, the newly-enfranchised programmers will leave them for higher pay elsewhere. (*Workforce Magazine*, May 1999; *Orange County Register*, June 19, 1999; also see the ITAA report.) But **in saying they refuse to retrain on the grounds that the programmers would then demand more money, employers are thereby admitting that they are hiring the younger domestic programmers and the H-1Bs because of their cheap labor.** The same point applies to those employers who say they don't hire older programmers at young-programmer salaries because they would leave for higher pay at another firm later on.

The July 5, 1999 issue of *Information Week* presented a striking illustration of the problems which older programmers face:

It seems safe to say that experience may not be the most valued commodity, according to a survey of 200 IT managers nationwide conducted by InformationWeek Research in May. Though age wasn't specified in the question, only 2% of the managers said they would most likely hire a worker with 10 or more years' experience. Almost half—46%—preferred to hire a worker with four to 10 years' experience, while 26% said they would hire a worker with less than three years' experience, and another 26% wanted an entry-level worker or recent college graduate.

There is no better way to show the industry's emphasis on youth (and its general disinterest in workers who are in their 40s or even 30s) than to look at how firms in this field define "senior" workers. Consider for example the employment Web page of Sun Microsystems (as of March 14, 1998), one of the most vocal firms claiming a labor shortage. One of the first questions asked of the job seeker there is "Experience Level," which of course is a proxy for age, and thus possibly an illegal question. But even more interesting is the choices the user is given for answers to this experience question:

[] Entry Level (0-2 years)
[] Intermediate (3-5 years)
[] Senior (6+ years)

In other words, if you are 28 years old, six years out of school, Sun classifies you as "Senior"!

Sun turns out to be typical in this regard. Following are the numbers of years of experience (as a programmer and engineer in general, not in a given skill) listed in job announcements by various firms:

(Most of these are drawn from specific jobs on the firms' Web sites. An exception is Geoworks, whose information is drawn from a Geoworks job ad in *Tech Week*, July 12, 1999.)

The author debated the issue of the alleged labor shortage with Warren Leiden, president of the American Immigration Lawyers Association. (KQED-FM, San Francisco, March 6, 1998.) Leiden was one of the

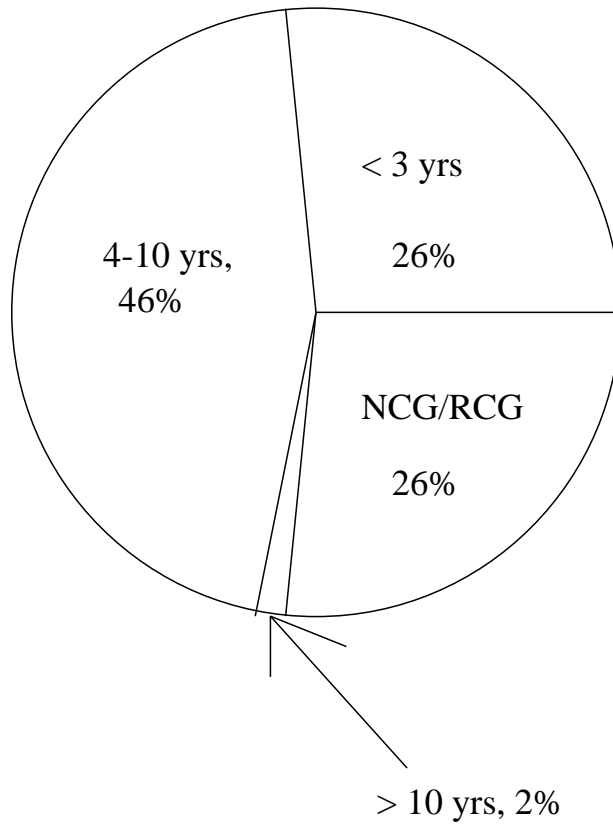


Figure 1: InformationWeek poll results

Best Buy	Senior Programmer Analyst	2 years
Compaq	Senior Software Engineer	3-5 years
Geoworks	Senior Software Engineer	5 years
Intel	Senior Software Engineer	5 years
Lotus	Senior Software Engineer	5 years
Oracle	Senior Software QA	4 years
Sun Microsystems	general technical	6 years
Corsair Communications	Senior Software Infrastructure Engineer	3 years
Baan USA	Senior Technology Engineer	3 years
The Learning Company	Senior Software Engineer	5 years

Table 3: Years of experience to qualify for a senior position

drafters of legislation proposing an increase in the yearly cap on temporary work visas for foreign professionals During the debate Leiden defined “mid-level” programmers to be those having only “a year or two of experience.”

5.5 Shunned Even Though Possessing a “Hot” Skill

In many cases, even if an older programmer does have a “hot” skill, he/she still may find it difficult to get work. Bill Halchin is a case in point. In the spring of 1998 Sun Microsystems Vice President Ken Alvarez, who had been heavily lobbying Congress for an increase in the yearly H-1B quota, stated that he needed to hire H-1Bs for operating system kernel development because he could not find American programmers in that field. Halchin, who had nearly 20 years of kernel experience, with a re’sume’ reading like a *Who’s Who* of industry firms, applied to Sun. He did not even get an interview. After four months of unemployment, he finally found a temporary programming position at another firm.

Halchin had a similar experience in the spring of 1999 with Ecutel of Alexandria, Virginia. The firm’s CEO, John Harrison, issued a news release through PRNewsire on March 17, discussing his testimony that day to the House Science Committee. He had expressed to the committee the usual claims made by the industry lobbyists, as seen in this excerpt from the press release:

Something is wrong when you put an ad in the Washington Post for a software engineer and the only qualified applicants you receive are from non-U.S. Citizens, said John Harrison, CEO and co-founder of Ecutel, one of the nation’s most promising high-tech companies.

In testimony before the House Science Committee today, Harrison told of the extraordinary cost and difficulty he has experienced trying to keep his company staffed with engineers. Harrison asked our nation’s lawmakers to proceed on a two-pronged approach—dramatically stepped up math and science education for today’s students, and for the short-term, eased immigration laws...

Harrison explained how the difficulty of hiring skilled engineers that are U.S. citizens has hindered his company. Ecutel paid legal fees of \$80,000 to address immigration issues faced by its engineers last year. The company was prohibited from bidding on contracts that required security clearances and was unable to work in some areas of encryption/decryption. Further, its non-U.S. engineers were not able to be used for sales calls outside of the U.S. as few have multi-entry VISAs, which are costlier and more difficult to obtain.

Ecutel’s Web site said that the firm was seeking people with the following skills:

Intermediate and Senior Engineer Positions Looking for several energetic and self-motivated Software Engineers with at least 5 years of experience or familiarity in 2 or more of the following: C/C++, TCP/IP, Mobile IP, IPSec, Device Driver, Internet RFC, Mobile Computing, GUI, RDBMS, Networking, Security, Web Development, Microsoft/Unix OSes, general Internet communication protocols.

Halchin had years of work experience in six of the skills this ad expressed interest in, considerably more than the threshold of two stated by the ad itself. Yet he was not even called for an interview when he applied to the firm, even after two followup e-mail messages to Harrison.

Ed Petron found that even being a successful author on Linux (a popular version of the UNIX operating system) is not enough for most employers:¹⁷

¹⁷E-mail to me, February 2, 2000

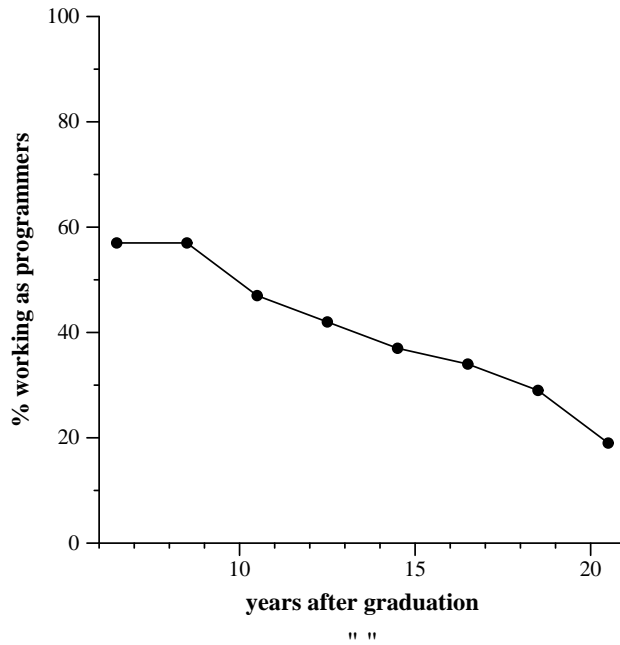


Figure 2: attrition rates from CS grads working as programmers

I have been out of work for several months now...I am the author of *Linux Essential Reference* from New Riders Publishing which was first released in December '99 and is about to enter its second printing. I ..have never even been considered for any kind of UNIX job, even an entry level one.

5.6 Careers in Programming Are Short-Lived

As a result of age discrimination, most careers in the programming field are short-lived. (Recall that the claimed “IT labor shortage” is actually in the programming area, as the vast majority of high-tech H-1Bs are doing programming.) It is very difficult for most programmers to get programming work after age 40; some still work in nonprogramming but computer-related jobs such as customer support, marketing and so on, and many leave the computer field altogether. The graph shows data, extracted from the National Survey of College Graduates in 1993, showing the percentage of computer science graduates working in software development various numbers of years after they finish school:

These attrition rates are striking. Five years after finishing college, about 60 percent of computer science graduates are working as programmers; at 15 years the figure drops to 34 percent, and at 20 years—when most are still only age 42 or so—it is down to 19 percent. Clearly part of this attrition is voluntary, but most are forced to seek other work when they see the handwriting on the cubicle wall: Employers do not want to hire older programmers.

It should be noted that other technical fields do not show this rapid decline of work in their area. For example, consider civil engineering majors. Six years after graduation, 61% of them are working as civil engineers, and 20 years after graduation, the rate is still 52%; compare this to the decline for computer science majors from 57% to 19% seen above.

Industry lobbyists have tried to dismiss large attrition rate among computer science graduates by saying

“They all became managers!” **But civil engineers become managers too, and yet we don’t see a large attrition rate for that profession.**

Another analyst then postulated that computer science graduates have a greater tendency to become managers than do civil engineers, but this is not the case either. If anything, the opposite is true: The NCSG data show that among those who have been out of school 16 years or more, 13% of the computer science graduates were managers, while 18% of the civil engineers graduates held managerial positions.

In other words, careers in programming are far shorter than in civil engineering, even though both fields are technical and require attention to detail. The difference is that skill sets change rapidly in programming, but not in civil engineering. And again, it is not that programmers are incapable of acquiring the new skills, but rather that the employers won’t give them the chance to do so.

This same point was found in a study by the United Engineering Foundation (UEF), as reported in *IT Professional*, May/June 1999:

Most credentialed IT workers do enter a core [IT] profession, but then leave as they age. **This happens in other technical professions, but it happens a decade earlier in the IT industry.**

The difference between attitudes toward hiring in programming and civil engineering was described well by one civil engineer who read an earlier version of this paper:

I had no idea that these firms were screening resumes with scanners [for highly specific technical skills]! That is incredibly shortsighted. In thinking about this more, I think in our business [civil engineering] it is pretty easy to show that people with more experience are more productive because they have done many of the things before. Just today, a young engineer came to me looking for some information from a specific manufacturer to do some hydraulic calculations on filters. I told him not to even bother looking because it was going to be insignificant in the overall analysis. If he had done them a few times, he would not have wasted an hour or so looking around.

5.6.1 Unemployment Rates Are Meaningless for Programmers

Since people who cannot find programming work leave the field, unemployment statistics for programmers are meaningless. The former programmer who cannot find programming work and thus becomes, for example, a bus driver (as did a laid-off programmer involved in suing Siemens; see Section 5.10) counts in government statistics as an employed bus driver, not an unemployed programmer. (Carol Veneri, “Can Occupational Labor Shortages Be Identified Using Available Data?”, Bureau of Labor Statistics, <http://stats.bls.gov/pub/mlr/1999/03/art2full.pdf>.)

Here is an analogy: Suppose in a certain small town economic conditions became very poor, and the majority of working-age people could not find jobs and thus had to move out of the town. The few working-age people who did have jobs would remain, so the unemployment rate in this town would be very low—a completely misleading measure of the town’s economic health.

Rebecca Eisenberg of the *San Francisco Examiner* wrote (May 31, 1998),

Personal testimonials are even more powerful than the statistics. “There were 10 situations where I interviewed and was turned down...,” said a 62-year-old computer programmer with 30

years of engineering experience in Silicon Valley, who preferred to remain nameless. “I work in food service now. I deliver a lot of pizzas to high tech companies. We (cater) a lot of high-tech parties. Anybody with two eyes in their head can canvass the meetings and parties and see that in many companies there are few people who are over age 40,” he said. The programmer described a conversation he overheard at a recent company event: “Age became an important topic of discussion at this mid-day meeting, and they decided that the oldest person in their section of the company was 29”...

“I get rather annoyed at unemployment statistics,” the programmer said. “They might be talking about unemployment, but they are not talking about underemployment. Former high tech people have long since exhausted their unemployment benefits or are employed at something that they did not expect to be doing at their age.”

So unemployment rates do not give an accurate picture of the employers’ general refusal to hire the older workers. Nevertheless, it is significant that reportedly there was a high 17% unemployment rate for programmers over age 50 as of August 1997, according to *Computerworld* (January 12, 1998). This figure has not been confirmed,¹⁸ but one does not even need data to observe the trend. A stroll around any high-tech company will confirm that most people who work in this field are young.

Such policies have spawned a cottage industry in self-help books for programmers who find that they are no longer desired by employers, such as *The Computer Professional’s Survival Guide, Downsized But Not Out: How to Get Your Next Computer Job* and *The Programmer’s Job Handbook: The Skills You Need for Long-Term Job Security and Programming Success*.

5.7 How Re’sume’-Scanning Programs Lock Out the Older Programmers

As has been mentioned, most big firms scan re’sume’s electronically, searching for certain “hot” software languages or platforms. Both in the case of insincere employers who wish to weed out the older applicants, and in the case of sincere employers who have genuinely (though misguidedly) become obsessed with specific skills, this has the effect of locking the older applicants out, excluding them from even consideration for an interview.

This has been such a problem that *PC Week* ran an article (November 1, 1999) describing the problem and giving programmers advice in how to circumvent it. Here is an excerpt:

“At a big company, when they get re’sume’s, human beings don’t read them,” said Bill Payson, president of The Senior Staff Inc., a staffing company in Campbell, Calif., that places mature IT workers. “As far as possible, they clue the [software] to exclude candidates that don’t fit a pre-conceived profile. The profile is probably written by somebody in their mid-20s. ... That’s one of the problems tangential to the age problems—most large companies with HR departments have very young people as hiring managers.”

¹⁸This was questioned by reporter Miranda Ewell (*San Jose Mercury News*, April 5, 1998), who said that such information is not available, and who gave other statistics which, though not exactly measuring the same quantity as in the *Computerworld* article, seemed to be at odds with it. On the other hand, I have checked with the author of the *Computerworld* article, Laura DiDio (now an analyst with Giga Information Group of Cambridge, Massachusetts), who counters that she doggedly went through call after call to the BLS to get the exact information she wanted, and she finally did find someone who was able to provide it. It is not clear what really transpired here.

5.8 It Is NOT a “Failure of Programmers to Keep Their Skills Up to Date”

Again it is crucial to keep in mind that **the plight of the older programmer cannot be solved simply by the programmer taking some refresher courses in the new software skills. Even if a programmer takes a course in, say, the new Java programming language and then applies for a job requiring Java, employers will still not hire him or her, because the employer insists on actual work experience when hiring older people.** As noted by software employment agent Maryann Rousseau in the San Francisco Bay Area, “Taking a course is just not going to work for a senior person, given his salary.” Why hire a newly-retrained but more expensive 40-year-old when a newly-trained cheap new graduate is available? An *IDG.net* article (July 20, 1998, <http://www.idg.net>) observed, regarding “a large law firm on the West Coast,”

...some say a recommitment to training programs could help solve the problem...[But even if a veteran programmer] takes a Visual BASIC class, it doesn't guarantee that they will qualify for a [Visual BASIC] job. “I wouldn't hire them because they would not have the skill set,” says [the] firm's IT director.

John Sturgeski of the H.L. Yoh Company in Bloomington, Minnesota said (interview with the author, June 16, 1999), “Taking a class doesn't matter. The employers want experience in the actual work environment, to hit the ground running with no learning curve on the job. The rare exception might be if the hiring manager already knows the programmer personally.”

Ann Reishus of Net Perceptions in Minneapolis, who hires Java programmers, made a virtually identical statement (interview with the author, June 25, 1999): “We don't do training. They need to hit the ground running. A class in Java is not enough.”

Kim Lee, a Silicon Valley recruiter, also used the phrase “hit the ground running” in this context. (Interview with the author, June 26, 1996.)

I spoke with Frank Bellarmino of Parallel Partners in Chicago on July 29, 1999. He said that a recruiter, “We can't say [to a client] we've got a guy who has just taken a class.”¹⁹

Kristen Linblad of Utek Recruiter in Oak Brook, Illinois, discussed with me (July 29, 1999) a hypothetical case in which a programmer had years of programming experience but was only self-taught or had coursework in the Perl programming language. She said, “This would work if the employer only specified Perl as a ‘plus’ in the job requirements. If the employer specified Perl as a ‘must’, then no.”

Heather Arnold of Radiant Systems in Alpharetta, Georgia told me (August 1, 1999) that an applicant for a programming position must at a minimum have work experience in SQL. When I asked if coursework would be acceptable from a veteran programmer who applies, she said no, because “When you think of the tons of re'sume's we get, my eyes are going to be caught by those that are dead on [in terms of skills matches].”

A woman at Technical Staffing Corporation in San Francisco (who was not willing to give me her name) made similar comments to me when I interviewed her on December 16, 1997. I asked what would be available to a mid-career programmer, say 10-15 years of experience, who has been working with the C programming language but doesn't have currently-hot skills. She replied, “Just C, nothing else? They might find a position staffing a help desk.” I then asked where such a person could take a course, say in Java, and then get a programming job. Her reply was “No, not without hands-on [i.e. job] experience.”

¹⁹He speculated that this was primarily due to the fact that the client firms must pay him a referral fee. However, as seen by our other examples here, that is not the case. Employers will not hire a veteran programmer with only coursework in hot skills even if he/she applies directly, instead of via an agency.

5.9 Younger Managers, Older Programmers

In March 1998 a former employee of Inktomi, then one of the hottest new Silicon Valley firms, sent me a quite thoughtful account of his observations of the hiring process. He mentioned that one job applicant, a programmer with an excellent re'sume', was

gung-ho to work, learn what he needed, and was obviously smart enough, but he didn't fit Inktomi's profile and [so his re'sume'] was tossed [into the trash]

When I then asked why this applicant did not fit Inktomi's "profile" and was rejected, the reply was that the applicant was in his 30s (not even 40s) and—heaven forbid—married! Inktomi's two founders were ages 23 and 29 when they started the company in 1996. The firm's employment Web site boasts that the company is "jam-packed with fun people," an atmosphere which presumably would not be enhanced by the older, married-with-children crowd.

An article in *Network World*, September 14, 1998 found disturbing results in its reader survey:

Age does matter when it comes to IT hiring, according to a survey of 200 Network World readers with some degree of hiring responsibility. The survey clearly shows that younger network managers tend not to hire older workers.

Only 13% of the 30 survey respondents in the 20-30 age group hired anyone over 40 in the past year, but that percentage increased as the age of the hiring manager increased. Of the 80 network managers in the 31-40 age group, 24% had hired an over-40 person in the past year. The percentage rose to 39% for the 57 managers in the 41-50 age group and up to 45% for the 31 respondents over 50...

The survey results don't surprise Kathy Nichol, who has 18 years' experience as a high-tech recruiter in the Dallas area. Nichol says she works with one thirtysomething hiring manager who gravitates toward "young fast-track managers." When Nichol has recommended older workers, her client rejected them, saying the candidate lacked energy, couldn't cut it in a fast-paced environment, or should have been further along careerwise. "He doesn't even recognize what he's doing," Nichol says...

Companies don't want to hire older workers for entry-level jobs because they don't want a 40-year-old reporting to a 24-year-old. "It's a cultural thing," [Nichol] says. Naturally, the company won't come right out and say age bias is coming into play, but managers will come up with some other reason not to hire that person, she says.

Similar observations were made in *InfoWorld*, July 20, 1998:

...both older workers and younger managers may be daunted by the idea of a staff member working for a manager who could be his daughter. Almost half of the InfoWorld reader survey's respondents younger than 30 years old said they were managers, and more than one in five of the respondents older than 50 years were staff members.

"It definitely happens that you end up working for somebody half your age, so you have to present yourself as somebody who can be comfortable in that circumstance," says Joyce Plotkin, president of the Massachusetts Software Council, in Boston.



Figure 3: Network World poll results

Another frequently cited reason for older workers' trouble finding jobs is the perception that they don't have the energy and commitment of younger workers...

Because of family and other commitments, older workers are perceived as less willing to work long hours than younger workers.

However, *InfoWorld's* survey found that the average number of hours worked per week was high but remarkably consistent: 48 hours for every age group.

5.10 Age Discrimination Lawsuits Brought Against High-Tech Firms

As mentioned earlier, Intel has been sued for age discrimination several times. Apparently none has yet been successful, though such a suit is currently pending, brought by attorney Dru Keegan of San Jose.

Intel's lobbyists claim that no age-discrimination lawsuit against the high-tech industry has ever succeeded. This is not really correct, since the federal Equal Opportunity Commission did serve a "letter of violation" on Siemens Energy and Automation in Minneapolis in 1997. The 11 programmers who brought the complaint against Siemens then sued in federal court, and the case was settled out of court in August of 1999. Though that settlement included a secrecy provision and thus the details cannot be divulged (I served as an expert witness on behalf of the plaintiffs), a small part of the evidence in the case is in the public record, as part of an article in the *San Jose Business Journal*, December 14, 1998:

Advanced Micro Devices Inc., Intel Corp. and Siemens Energy and Automation Inc. are being sued by seniors who claim they were denied employment because of their age. In the Siemens case, 11 former employees over the age of 40 say they were laid off from a software facility in Minnesota, only to be replaced by younger workers.

Some applied for similar jobs at Siemens that opened up after the layoffs, but they were unable to even get interviews, according to the plaintiffs' attorney, Stephen Snyder. The Equal

Employment Opportunity Commission has sided with the workers. In a “letter of violation” sent to Siemens in 1997, the EEOC said it found “reason to believe” that age discrimination had occurred. According to the EEOC, the layoffs that included 11 former employees unfairly targeted older workers. “The termination rate disproportionately affected software engineers over 40, resulting in the termination of 21 percent of the software engineers over 40, and only 2 percent of the software engineers under 40”...

Mr. Snyder, the attorney representing the Siemens plaintiffs, said his clients were unable to find work after they were laid off, despite years of experience. One became a bus driver.

5.11 Sample Profiles of Underemployed and Unemployed Programmers

After seeing me quoted in the press on this topic, many older programmers have sent me laudatory e-mail, saying my description of the plight of such workers fit them perfectly. Here are a few geographically-diverse samples:

(From a man in the San Francisco Bay Area:) I have programmed since 1976, but lost “hot skills momentum” during 1991-1995, during which time I worked as an applications specialist for a local oil company. I was replaced by a much younger worker. Since then I have been studying networks, Visual BASIC, and other newer languages, but can’t obtain so much as an interview offer. I now earn about \$24,000 per year in retail sales and management.

(From a woman in Portland, Oregon:) Your statements about “middle age” programmers are right on target. I am 41, and had been out of the industry for five years [running my own business]. Upon my deciding to go back into software engineering, I [could only get offers for nonprogramming positions]...This after 15 years experience in software QA, as well as five years running my own business...I was fortunate enough to eventually find my current employer, and they were willing to take a chance and offer me a job based on REAL experience and intelligence...[but] as long as employers think that I’m out of date because I was studying computer science before they were born, I guess it will be hard to do anything based on my background.

(From a man in the Washington, DC area:) It is interesting to note that it is Oracle and MCI/WorldCom that are cited in [a 1999 article in which the two firms were pushing for an increase in the H-1B quota] as crying about the lack of “qualified” applicants in this area. I interviewed with BOTH of them, MCI (actually UUNet) TWICE, with no luck. I know I qualified for both of the jobs, otherwise why a face-to-face interview after the resume screening? I can only assume that when they saw my gray beard, that was the end of the process...It also was interesting that I starting getting a LOT more interest in my resume when I cut out 14 years of experience (1967-1981).

(From a man in Tennessee:) Based on personal experience, I’d say you are right in your summary of the true state of the IT job market: Nobody wants to pay serious money except for a handful of super-hot areas like Year2000 or fixing some Microsoft problems. I’ve got an MSEE from Caltech, six years at NASA, and six years running a PC business, and I quit to get one of those “hot jobs” that was supposed to be plentiful. Big mistake!!! At least I’ve found nothing meaningful in the Nashville area.

(From a man in New York City:) With over 10 years of experience in programming, I've been out of work and looking for over a year and a half with absolutely no luck...A friend suggested to me that looking in California for a Java job would be better, so I faxed my re'sume' to a recruiter two weeks ago. I spoke with the recruiter in San Francisco this afternoon, and she told me that my experience in other languages was worthless...and also that in my present circumstances (unemployed) that I was "out of the field"...She mentioned to me another person, with 10 years experience in the [software engineering] field whom she was helping, [but] who could not get a Java job because he had no paid experience in Java. I asked her if there was any age-discrimination in California (in the software field), and she indignantly replied "no." She also suggested that I look in New York because the companies out there [in San Francisco] wouldn't want to interview me (i.e. bring me such a "long distance"). I replied that they didn't seem to mind bringing people from China, which was an even greater distance.

(From a 47-year-old man in the San Francisco Bay Area:) I believe I have highly transferable skills in several key areas of strong demand and intensive growth in Silicon Valley, but in 15 months of essentially full-time searching have really only gotten two formal interviews...Emphasizing modest salary requirements and an eagerness to accept 'entry level' positions has proven entirely futile, as have all offers to submit to some form of testing to prove my competence...I claim competence in C++, perl, Unix, Windows95, etc., and in the course of my career have rapidly adapted to many computing environments, from various mainframes, Crays, to PCs. One anecdote you may appreciate: in stepping up to a contract agency's booth at a recent job fair, I was almost immediately greeted with "We haven't been getting many legacy jobs lately" (I have a mostly gray beard). Another very large agency told me flat-out that most of their clients are only interested in younger people.

(From a man in the Southwest:)

I am an India born US citizen and am opposed to this program allowing 95000 work visas for foreign hi-tech workers. I believe that the shortage, if any, has been created by laying off older hi-tech people such as myself.

I am 51 years old...I have over twenty years of experience... I applied for a job at [company name deleted] and I got a reply from them saying they did not have a suitable position for me. Since they have large advertisements in the paper for software jobs for people with my background, I believe that I was rejected on the basis of my age. [This company is] actively recruiting in India. I know this because my brothers live in India and keep me posted of this.

(From a 27-year-old man on the West Coast who had graduated three years earlier:) [When I interviewed for a position for a Java project], not one difficult technical question got thrown at me—all the questions were behavioral or opinion type questions. The most frequently repeated question was "When did you graduate—I don't see that date here." After I was offered the job, I pointed out that I knew a coworker who is much more passionate about Java programming. He has one more year of experience over me. The manager shook his head, "I don't think you understand—we are looking for more recent college graduates. Your case is a special case because we have to change the requirements to hire you."

Longden Loo, in the Los Angeles area, posted the following to an online forum run by the *San Jose Mercury News* in September 1998:

As a recently laid-off programmer with 20 years of experience, I'll attest to the incongruity of the industry's H-1B desperate clamor for more foreign help, ostensibly to relieve the shortage of needed technical labor.

Shortage? And here I, and my fellow 40 something programming brethren, have been begging for jobs, some for as long as four months with nary a bite from the same desperate employers! Personally, with over a hundred resumes submitted, 4 job fairs, 17 recruiters [employment agents]... I've netted only 2 interviews.

The H-1B supporters harp on the failure of our schools to provide an adequate supply of technical labor, but to which of my three children should I suggest a career to follow in Dad's footsteps and be obsolete and unemployable by the age of 40? I'd be derelict as a parent to do so.

Loo had been laid off by Northrup Grumman. Yet the ITAA's Harris Miller told the *Electronic Engineering Times* (October 8, 1998) that Northrup Grumman currently had a "plethora" of openings for programmers. Loo's response to this (in e-mail to me) was:

...Two more fellows were [recently] laid-off from my old group [at Northrup Grumman]...What burns me about the "plethora" of openings at Northrop are how empty those opportunities actually were.

After receiving my layoff notice, I made inquiries to several of those positions including divisions on the East coast, but was told I was "too experienced."

A few months before my layoff notice, I applied for an ideal inter-company position with a perfect match to my qualifications and only a few miles from my home. I waited and inquired for over 8 months and was always told (right up to my last week with Northrop) by HR that the position was still open and that they were still reviewing candidates. An insider friend of mine tried to circulate my resume there, but advised that there was a hiring freeze on positions related to various projects, possibly also the one I was interested in, though that certainly didn't deter them from continuing to run the ad in the posting of positions...

Similar themes were published in letters to the editor in the *San Jose Mercury News*, January 24, 1998, as well as in articles in *US News and World Report*, March 16, 1998, the *San Diego Union-Tribune*, March 7, 1998, the *San Francisco Chronicle*, March 9, 1998, *Wired Online News*, February 25, 1998, and the *San Francisco Examiner's* special Web page on this topic,

<http://www.examiner.com/workers/>

6 Educational Issues

6.1 Trends in University Computer Science Enrollments

The ITAA industry lobbying group claimed throughout 1997 computer science enrollments are declining, and called on the federal government to fund programs to attract more college students to the field. But ITAA's assertion was so misleading as to border on fraud.

The ITAA report lists declining numbers of computer science Bachelor's degrees from the late 1980s to 1994. But new computer science enrollment reversed its declining trend in 1995, increasing by 5% in

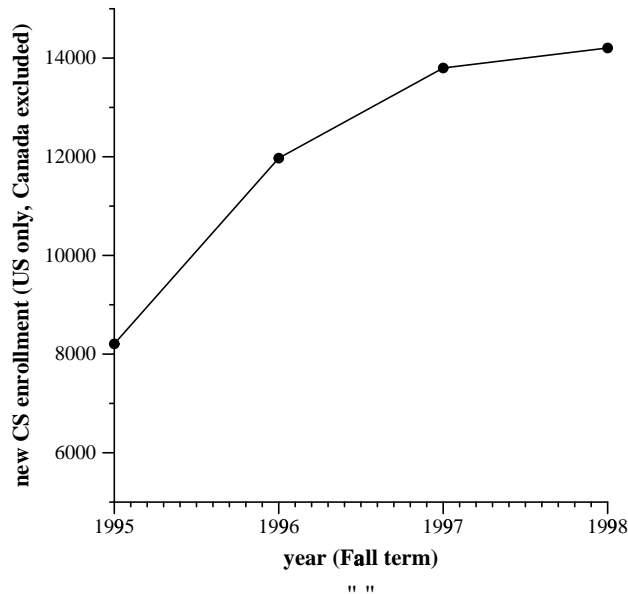


Figure 4: new CS enrollment in US

1995-1996, and by a whopping 40% nationwide in 1996-1997, and then by another 39% in 1997-1998, according to the Computing Research Association (CRA), a national consortium of university computer science departments.²⁰ Taking into account “compound interest” effects, this means that **new enrollment in computer science has nearly doubled nationwide in the last two years.**²¹

This information (the first 40% increase) was conveyed to ITAA’s Harris Miller and Tony Vickers by a CRA official when ITAA distributed a preliminary draft of their report at a roundtable discussion organized by the Stanford Computer Industry Project on February 19, 1997. Though ITAA stated at the time that they were soliciting comments and suggestions for improving their report, they did not include this information about the sharp increase in computer science enrollment in the final version of the report, apparently because it undermined their argument. In fact, ITAA continued to claim enrollment is declining (*San Francisco Chronicle*, January 8, 1998), even after ITAA’s suppression of the 1995 reversal trend was brought up in an interview with ITAA by the *Electronic Engineering Times* (September 29, 1997), until forced to stop when even the Department of Commerce found ITAA’s claim to be untrue. Since that time, the ITAA statements have avoided using the present tense in the word *decline*, but they continue to obfuscate the issue by discussing what happened in 1994, leading the listener to believe the situation still holds today. Interestingly, in his April 21, 1998 testimony to the House Immigration Subcommittee, Miller claimed that

²⁰ *Computing Research News*, March 1997 and March 1998; see their Web page, www.cra.org.

²¹ Update, March 1999: The same publication reports this month that “The recent precipitous rise in undergraduate [computer science and computer engineering] enrollments appears to have leveled off, at least for the moment (Figure 3). After doubling in the two years between 1995 and 1997, new undergraduate enrollments in CS and CE are off 4.2% this year.”

However, this drop appears to have occurred only in Canada, not the US. (CRA figures are for all of North America.) The Canadian figure reported in March 1999 was 1,898, a big drop from the March 1998 figure of 3,462. I don’t know if that latest Canadian figure is correct or not, but the main point is that if you subtract the Canadian figures from the March 1998 and March 1999 tables, you see that the trend in the US is still upward, not downward (13,799 new CS students in the US reported in March 1998, and 14,205 reported in March 1999).

It should be noted, though that new enrollment at my university, UC Davis, did decline; note that this was not due to a reduction in demand by students to enter our CS major but rather because we requested our campus administration to reduce new enrollment, due to extremely overcrowded classes.

the ITAA had never suppressed the information about the rise in enrollment, a stark revision of history.²²

Moreover, even industry representatives interviewed by *Business Week* (March 10, 1997) blamed the earlier decline in enrollment partly on “a glut of programmers in the mid-1980s.” The recent increase in enrollment is due to the rapid expansion of the industry which began around 1994. In other words, market forces are working quite well here; the supply of computer science students has been quite elastic to demand. So, quite contrary to ITAA’s assertion that students do not want to study computers, due to claimed “nerd” images of the field, or do not have the background to do so (see discussion on mathematics below), the fact is that **computer science enrollment has responded quite well to labor markets demands, rising and falling as the demand does.**

The ITAA later admitted that the decline in the numbers of computer science majors in the early 1990s was due to a slack labor market, rather than to some sort of “deficiency” in U.S. college students, as ITAA had claimed earlier. ITAA president Harris Miller told *Infoworld* (February 8, 1999):

The cutbacks in aerospace and defense sent a signal to the job market that engineers and math and science degrees were not going to be as much in demand in the 1990s as they were, in fact, going to be. Students were seeing the end of the Cold War, corporate restructuring, and layoffs. To tell them that they should focus on a computer science degree rather than a business or law school degree was not an easy sell.

Also in the same *Infoworld* article was the following:

Nate Viall, an IT market researcher at Nate Viall and Associates, in Des Moines, Iowa, says the late-1980s recession began with big layoffs in 1989 at Digital Equipment, followed by cuts at IBM. That was followed by the corporate “merger mania” of the early 1990s, which also resulted in thousands of IT workers losing their jobs, he says.

“All through the 1990s to about 1995, there were few months when there was not some news headline about IT layoffs,” Viall says.

The industry lobbyists also say that college computer science curricula are only producing 25% of the nation’s needs for programmers, again claiming this is due to a decline in enrollment. But it has always been the case that programmers have always come from many different fields, not just computer science. For instance, according to the National Science Foundation’s SEASTAT data, only 26% of all those working as programmers in 1993 had computer science degrees. In other words, the situation today is no different from the past, quite contrary to the alarmist tract written by the ITAA. In this light, it should also be mentioned that Clifford Adelman of the federal Department of Education has found that large numbers of non-computer science majors take at least mid-level courses in computer science.²³

6.2 The Job Market for New Graduates Is Not So Strong After All

During the 1997-1998 academic year, industry lobbyists were busily telling the press how “desperate” employers were to hire new graduates. They painted a picture in which new graduates would have multiple

²²Other reports commissioned by the industry, such as one supported by the American Electronics Association, have also been misleading in this regard, again typically by using a misleading range of years in which to measure CS graduation rates.

²³*Leading, Concurrent or Lagging: the Knowledge Content of Computer Science in Higher Education and the Labor Market*, Clifford Adelman, U.S. Dept. of Education, May 1997.

offers, all with fat salaries and signing bonuses, months before they even graduated. Here, for instance, is what two industry executives testified to the U.S. Senate, concerning the bidding wars they said firms were having over hiring new graduates (Reuters, February 25, 1998):

Microsoft's Murray agreed that recruitment was incredibly competitive, saying, "It has almost become a frenzy."

Texas Instruments' Leven added: "It's getting like athletics and I'm beginning to wonder if I'm living in a different solar system."

Yet if you pin one of these employers down and ask how many actual offers they made to graduates at a particular school in a given year, they will admit that it was only a handful. As explained in the next subsection below, the frenzied bidding wars were mainly for outstanding graduates from the elite schools.

According to Eric Hays of the UC Davis Career and Internship Center, 31% of graduating seniors in engineering in 1998 still had not found a job as of June 1998.

My informal survey on the Internet of graduating seniors specifically in computer science in June 1999 revealed that most of them had not found jobs by that time. **Moreover, that most of the ones who had found jobs were only in semitechnical positions, not programming.** Some of the UC Davis students were interviewed by *Tech Week*, in an article which appeared June 30, 1999. Here is an excerpt:

One student graduating with a bachelor's degree in computer science from the University of California at Davis, was disappointed he couldn't get a position in the Bay Area as a programmer. The student, who had a 3.1 GPA, was offered local jobs designing Web pages, work he considers to be beneath his skills.

Ultimately, he took a networking job in the Portland, Ore., area. "It seems [for] all the interesting positions in the Bay Area you need a graduate degree or a lot of experience," he said. "It they're desperate for workers, I don't see it."

Howard Louie, a 24-year-old who earned his bachelor's degree in computer science at UC Davis in March, also feels high-tech firms in the Bay Area are "picky" rather than parched for programmers. Louie decided to continue in UC Davis' computer science master's program to enhance his job prospects. But he still had some difficulty landing an internship in the Bay Area, let alone the promise of a job a year from now. A top business consulting firm declined to give Louie either, despite the fact that he graduated with a 3.6 GPA, interned for two summers at Intel and served as a network administrator at Davis for about a year. "The company has] some real technical divisions," Louie says. "I can't imagine why they wouldn't want someone that can leave grad school in one year."

The industry lobbyists' claim that new graduates of university computer science programs can easily find good jobs in the field was also debunked in a *Computerworld* insert in college newspapers, titled *Careers Spring 1999*, which was filled with articles with job-hunting advice for graduating seniors in computer science. Again contrary to the stories fed to the press by industry lobbyists claiming that most new graduates in computer science are besieged with job offers from anxious employers, the truth is that finding a job is not that easy after all. The insert starts by stating,

As a computer science or engineering major at an institution of higher learning, you already have taken large strides toward building a lucrative career. Soon, however, you will be pounding

the pavement alongside a horde of other recent grads armed with re'sume's touting the same impressive information technology credentials that you have. How do you distinguish yourself?

If employers are courting the new graduates so heavily, why the need to "distinguish oneself?"

The insert then says this more explicitly:

The Silicon Valley job market is so crowded that it isn't always easy for even the best-apportioned IT grads to differentiate themselves even with a broad array of programming language experience...

Having fantastic technical skills just isn't enough in the highly competitive world of information technology...

It takes more than technical skills to get a high-tech job.

The job market is "crowded," "highly competitive"? This certainly is not what the industry lobbyists are telling us. They claim it is the employers who must compete for workers, rather than *vice versa*.

6.3 Many Employers Recruit Only a Few Top Students at Only a Few Top Colleges

6.3.1 The Role of the Ranking of School

It should be noted that most firms recruit at only a few colleges. As noted in *Computerworld*, December 1, 1997, "...the likes of AT&T Corp., Intel Corp. and Hewlett-Packard Co. can afford to be choosy, selecting only those students with dazzling grades and extracurricular work experience." But it is not just the large firms which have such policies; most of the small firms do too.

For example, at San Francisco State University, right in Silicon Valley's back yard, only a handful of computer industry employers do on-campus recruiting. This was stated in an interview by the author with the Computer Science Department Chair, Dr. Gerald Eisman in June 1996. When the author spoke with him again in the spring of 1998, he stated that recruiting by the big firms had even decreased further since I had talked to him in 1996. Even Intel, with its heavy emphasis on new or recent college graduates, does not recruit there.²⁴

TJ Rodgers, the CEO of Cypress Semiconductor who has been so outspoken in favor of using the H-1B program to help remedy a claim high-tech labor shortage, admitted in a debate with me (*San Jose Business Journal* Power Breakfast, June 24, 1999) that his firm does not recruit computer science graduates from my school, UC Davis. Apparently realizing that this created a bad impression, he hurriedly contacted UC Davis later that day and posted some job openings for his firm there, announcing them at another debate with me on local radio two days later. When I pointed out that even then the positions he posted were not for programming, he said that UCD CS graduates were not "qualified" for such work.

At the University of Nebraska, Microsoft does engage in on-campus recruiting, but very few other high-tech firms do.²⁵

²⁴Meeting with Intel college-relations staff, January 1998; see also Coeta Chambers, Intel lobbyist, *Take Issue*, Bay TV, San Francisco, March 3, 1998.

²⁵Discussion with the department chair, 1997. Microsoft recruits at many more schools than do most firms, but still misses most of them. The firm did not add my university, UC Davis and another UC campus at Irvine, to its list until late 1995, according to Beth Award of Microsoft College Recruiting.

Here are the numbers of schools at which various firms recruit:

Cisco	20-40
Cypress Semiconductor	26
Lucent	10
Nortel (Winter/Spring interviews)	14
Qualcomm	20+
Synopsis	10

Table 4: Numbers of schools at which firms recruit new graduates

[Cisco: Randy Levinson, statement to the author, June 24, 1999; Cypress: J Rodgers of Cypress Semiconductor, testifying in Senate Judiciary Committee hearings, February 25, 1998; Lucent: James Seay, statement to the author, June 24, 1999; Synopsis, statement to the author, June 24, 1999; Qualcomm, the firm's Web page ("We visit over 20 campuses every year"), July 30, 1999.]

These are tiny numbers compared to the 1,061 colleges and universities offering Bachelor's programs in computer science. (The Computing Research Association Study, *The Supply of IT Workers in the United States*, 1999.) True, they cannot recruit at all of these schools, but again keep in mind that the employers are saying that they are "desperate" for new graduates. If they were desperate, they would be recruiting a more than just a tiny fraction of the schools producing graduates in this field.

Indeed, even the ITAA's Harris Miller has admitted this to *Tech Tech Week*' Umberto Tosi:²⁶

TW: It is possible that high-technology companies are contributing to the shortage by all looking to the same small pool of elite universities for candidates rather than opening up their searches?

Miller: That's part of the mind-set change we need to get from the companies. Some of them are there, some are not yet.

(Miller goes on to say that he believes employers should hire more programmers who have only Associate of Arts degrees. Again, this is motivated by a desire to reduce salary costs. A similar statement holds for efforts aimed at retraining secretaries or other nontechnical workers into programmers.)

After James Seavey, an executive at Lucent, had given a speech at an industry gathering, complaining that the universities were not producing enough high-tech workers (*San Jose Business Journal* Power Breakfast, June 24, 1999), I approached him and asked if Lucent could set up some internships for my students at UC Davis. His reply was that Lucent was only interested in working with a small number of schools.

6.3.2 The Role of Grades

Moreover, many recruiters are only interested in students with top grades. As a rough rule of thumb, at UC Davis I have observed that graduates with grades in the 3.5-4.0 range (on a scale of 4) tend to get the technical jobs, i.e. programming; those in the 3.0-3.5 range tend to get only semitechnical jobs, such as customer support or software testing; and those under 3.0 have trouble getting jobs in the industry altogether. There are certainly a number of exceptions to this (most of them involving students who already have some work experience in the industry), but this is the typical pattern.

²⁶February 13, 1998. See <http://www.techweek.com>.

Doug Pecchenino of Xilinx told me (August 26, 1998) that his firm is only interested in graduates with grade-point averages (GPAs) of above 3.8 on a 4.0 scale. Valaiya Smith, a new graduate writing in *Computerworld* (August 3, 1998), complained that employers' restriction to those having GPAs higher than 3.5 is unfair to people like Smith who are married with families and working full-time while going to school.

Two Intel engineers recruiting at UC Davis on October 13, 1999 (Linus Maxino and Pearl Seto) told me that Intel has no interest in those with GPAs below 3.0, with rare exceptions made only if the applicant is very close to that threshold.

In summer 1998, a new UC Davis graduate mentioned to me that he had been unable to get any offers for technical positions. He had a GPA of 3.4, is a first-rate programmer, has a very keen work ethic, is very articulate and so on. I then pressured a Silicon Valley firm which I will call XYZ Corp. XYZ had in the last few years hired five or six UCD graduates, all of whom had GPAs in the 3.8-3.9 range. A year earlier I had pushed them to hire a UCD grad whose GPA was only 2.9, and the company had subsequently reported to me that he had turned out to be one of their top programmers. Yet even then they decided not to hire my new "case," the one with a GPA of 3.4. Even more interesting was their grounds for their decision: Of the dozen or so people who had interviewed him, all but one were very positive in their evaluation of him, but the fact that the one exception was lukewarm was enough to reject him.

A former UC Davis student (with top grades) told me,

[When I graduated and started work with Oracle in 1989] Oracle's policy was to only hire from the top 12 universities in the country...At one point, I interviewed with a manager in the application division. While we were sitting there talking, I noticed that he had a chart of his organization [of people who already working there] in front of him. Instead of just names and titles, this chart had much more detail. It listed each person's skills, where they graduated from, and their GPA. I was shocked and greatly relieved that nothing came of the interview.

To Oracle's credit, the firm is now one of the few in Silicon Valley to recruit at San Francisco State University. But the incident above is bizarre, to say the least, and not in Oracle's own best interests. And Oracle, one of the firms most vociferously claiming a worker shortage in 1998, still was not so desperate to consider applicants who were not in the very top of their graduating class; their employment ad in *San Jose Mercury News*, October 4, 1998, began by asking "Are you in the top 1% of your class? Are you looking for a job with a company in the top 1%? If you answered yes to both of the above questions, then this is your opportunity to join Oracle..."

All this is completely inconsistent with ITAA president Harris Miller's statement in the *Ottawa Citizen* (June 20, 1997):

[Miller] said guidance teachers and parents should stop discouraging students with average grades from entering high-tech training...

6.3.3 Case Study: Samuel Lin

Even top grades from a top school may not be enough to get a job. Samuel Lin did all the right things society asks—top grades at Princeton for his Bachelor's degree, and then the same for his Master's at Cornell University, one of the nation's foremost engineering schools. Yet in spite of having a newly-minted Master's in Electrical Engineering in the spring of 1998, specializing in the semiconductors area, not one company offered him a position. He wrote to congressional offices, stating that

...it is NOT correct to simply dismiss concerns about this issue as being xenophobic and anti-immigrant. Although I am a U.S. citizen, my parents were both immigrants from Asia...[However,] regardless of the dramatic statistics and numbers that are being thrown around, my experience is that the purported “desperate shortage” of skilled workers is simply NOT true.

Of particular relevance to my experience is the recent testimony (April 21, 1998) before the Subcommittee on Immigration and Claims of the House Judiciary Committee by Daryl Hatano of the Semiconductor Industry Association (SIA) in favor of raising the H-1B immigration visa cap (posted at their website—<http://www.semichips.org/>). Hatano supports the claim of a “workforce shortage” with a considerable and impressive list of “employment opportunity websites at SIA member companies.”

The crucial fallacy here is that just because a job description is posted does not mean that the company is willing to hire a qualified candidate whether foreign or domestic...

The companies may insist they have a “desperate shortage,” but I personally have already applied for employment to most of the companies that Hatano claims have “500 openings for semiconductor positions,’ with, so far, NO success.

Lin never did find an engineering position in the industry.

6.4 ITAA Claims About U.S. Youth’s Lack of Interest/Qualifications to Study Computer Science Are Incorrect

6.4.1 Exploding CS Enrollment Disproves the Claim

The ITAA also claims that American students do not study computer science because (a) they think it is “nerdy,” and (b) they lack math skills. But as discussed earlier in this paper, computer science enrollments have risen and fallen directly in response to the ups and downs of the IT job market.²⁷ **The fact that computer science enrollment has been skyrocketing in the last few years shows that there are plenty of students with the interest and background to study this subject.**

(By the way, one does not use math in most software development in the first place. The reader can verify this by picking up any book on, say, Java programming at a local book store. In fact, in his 1999 guide to programming careers, consultant and author Jesse Liberty even advises would-be programmers not to worry if they have never been math fans: “...skill in math is almost irrelevant [to the programming field] today.”)

6.4.2 Ph.D. Enrollment

Lobbyists also decry the fact that about 40% of U.S. Ph.D.’s granted in computer science go to foreign students, with the implication being that there is “something wrong” with American students.²⁸ But this ignores the fact that **we are overproducing Ph.D.’s in the first place.**

²⁷This is illustrated graphically in data collected by Larry Mishel of the Economic Policy Institute; see <http://www.epinet.org/webfeatures/snapshots/archive/120899/snapshots120899.html>

²⁸Some newspaper reports have erroneously stated that large numbers of U.S. undergraduates in computer science are foreign students. This is incorrect; only 6% of the computer science Bachelor’s degrees nationwide are awarded to foreign students. See *Computing Research News*, March 1998.

Those who are plied by the industry's feigned interest in PhDs would be baffled by the following incident. On October 13, 1999, a team of Intel engineers recruiting for new graduates visited my department at UC Davis. I mentioned that I had a couple of PhDs in electrical engineering I could refer to them, one a new graduate and the other a 1992 graduate. In reply one of the recruiters blurted out, "No, Intel is not very interested in PhDs; they are too expensive." The other added that she did not think a PhD would have enough to challenge him or her at Intel, except in the case of very highly specialized research areas.

In his 1999 guide to programming careers, consultant and author Jesse Liberty notes that "If you are interested in an academic career, or want to do research, or are interested in artificial intelligence, a doctorate in computer science may well be required. If you want to develop software for commercial applications, not only is a doctorate not necessary, it may be detrimental to your career."

A report by William F. Massy of Stanford University and Charles A. Goldman of the RAND Corp., *The Production and Utilization of Science and Engineering Doctorates in the United States*, studies the problem in great detail (Stanford Institute for Higher Education Research, Stanford University, July 1995), finding for example that we are overproducing Ph.D.'s in electrical engineering by 44%.

And this is an understatement of the problem, because the study was based on unemployment, whereas the real problem is underemployment. While a Ph.D. may be employed, as found in the Stanford/RAND study, he/she is in almost all cases doing work which does not need a Ph.D. Overproduction of computer science Ph.D.'s was a major theme in an article by Professor Anthony Ralston of the State University of New York at Buffalo in the *Communications of the Association for Computing Machinery* (March 1996), the ACM's flagship professional journal. Ralston writes:

[In the coming years] we are almost certain to continue to produce more—probably far more—Ph.D.'s in computer science than will be able to find the kinds of research jobs which attracted them to seek doctorates in the first place, and perhaps more than will be able to find jobs at all. Many of us are, in fact, accepting students under false pretenses...

Ralston goes on to say that the Ph.D.'s may still be hired for computing jobs that do not need a Ph.D., but countered, "But does this justify the cost—to taxpayers, to government, to the students themselves—when the attainment of a Ph.D. adds little to the abilities of the candidates to do [these] jobs?"²⁹

Ralston's point is illustrated quantitatively by an article in the Fall 1999 issue of *The American Outlook*. Based on National Science Foundation data, the article found that the field of computer science paid the smallest salary premium for a Ph.D. over a Bachelor's degree among the fields analyzed. Computer science Ph.D.s were paid only 38.7% more than Bachelors graduates, compared to 73.8% for physics, 116% for economics and 150% for political science. This shows why U.S. students don't go on for a Ph.D., and shows that industry itself does not value the degree.

Universities have lobbied heavily for liberal H-1B policies, for reasons directly related to the Ph.D. issue. Ph.D. production and research are, as the Stanford/RAND report noted, the currency by which faculty and administrator success is measured. Research is what brings in the large federal grants, which not only increase faculty salaries but are also used by the universities for operating expenses. A faculty member's promotions are determined largely by his/her amount of federal funding, number of Ph.D. students and so on.

This relates to the H-1B issue in the following way. Since the training gained through a Ph.D. is not needed

²⁹Ralston's point about the taxpayers refers to the vast sums spent by the federal government for the research projects on which the Ph.D. students work.

for work in the industry, and since the gap between industry salaries and graduate-student assistantship stipends is so large, most domestic students are not interested in pursuing a Ph.D. Thus the universities must turn to foreign students to populate their Ph.D. programs. Rather than simply allow Ph.D. production and research to fall to the relatively low level justified by industrial and societal conditions, the universities will do anything to maintain high levels of these activities. Hence their vigorous lobbying for liberal H-1B policies. Note also that universities themselves employ H-1B researchers, and one aspect of their lobbying efforts has been to get Congress to exempt universities from paying H-1Bs market wages.

Again, we do not need to produce so many Ph.D.'s in the first place. However, it is interesting that the **federal government's National Science Foundation (NSF) actually promoted policies which they knew would result in low enrollments of domestic students in Ph.D. programs.** As we will explain later in our section on the use of H-1Bs as a source of cheap labor, MIT mathematician/economist Eric Weinstein found that the NSF actually planned to hold down Ph.D. wages by bringing in a glut of foreign scientists and engineers. The NSF documents reveal that NSF realized that by holding down Ph.D. salaries they would cause domestic students to lose interest in Ph.D. programs, while foreign students would still enroll in those programs as steppingstones to immigration. Since the lobby for increased H-1B quotas has often made use of data provided by allies in the NSF, Dr. Weinstein's discoveries take on special significance.

6.4.3 Case Study: Gene Nelson

The ITAA's claim that if only American youngsters were better at science and math then we would not need to import H-1B workers is a cruel joke to the legions of underemployed programmers who excelled in those subjects during their formative years. Gene Nelson, for example, won an award in high school at the International Science Fair, and went on to earn a Ph.D. in biophysics. He eventually became a programmer, but after being laid off in 1997 has failed to find further programming work. He was unemployed for several months in 1998, and finally found a job staffing a software phone-in help desk, a nonprogramming position at half his previous salary; even that job vanished when he was laid off in early 1999.

6.5 Education Is NOT the Answer for Older People

The ITAA and other industry lobbyists claimed in 1998 that their request for an increase in the quota for foreign programmers was just temporary, with education being the long-term solution. As shown earlier in this report, this is false; we do not lack people trained in high-tech, but instead we have a problem in that the industry is not making use of the available labor force.

The industry seems to be especially disinterested in hiring "older" people, even in their early 30s, who have gone back to school and obtained a high-tech degree. Anyone who thinks that "education is the answer" should consider cases like the one cited in the *Sacramento Bee*, March 14, 1998:

One such prospective high-tech employee [with an advanced degree in computer science who cannot find work] is Peter Van Horn, 31, who is looking for a job in computer graphics. He has an undergraduate degree in aeronautical engineering and a master's in computer science from California Polytechnic State University, San Luis Obispo.

In nearly four months of looking for a job, he has applied to more than 38 companies and has, so far, talked to only two. "At Cal Poly, I always heard how great the market was, how if you have a degree in computer science you could get a job," said Van Horn, now a Bay Area resident.

“My credentials are good...Companies are constantly talking about a shortage of workers, but if that were the case, you would think I’d have more than two interviews.”

Van Horn did “all the right things,” everything society told him to do, and yet he could not even get an interview, right in the middle of Silicon Valley, for four months. In addition to sending out re’sume’s on his own, he also was working through employment agents, but with no results. After four months, at the end of March 1998, Van Horn did finally get a programming job, but his experience shows quite graphically that these supposedly “desperate” employers are not so desperate after all.

Van Horn’s experience, at the “old age” of 31, is shared by Bard-Alan Finlan, age 43, who also went back to school and was shunned by employers after he graduated. (*San Diego Union Tribune*, March 7, 1998.) Armed with a new computer engineering degree from UC San Diego, he applied four times to Qualcomm, a large San Diego firm which claimed to be desperate to hire engineers, and yet Qualcomm did not even give him an interview. He had no luck with all the other firms he applied to either; at the time the newspaper article appeared, Finlan had had only one interview in a year and a half. He finally did secure a job, but even then it was only as a technician, a job typically paying much less than what an engineer makes.³⁰

Another college returnee, Christin Luka, was so frustrated by her failure to find a position after graduation that she wrote an op-ed about it in *USA Today*, October 28, 1999:

It’s hard to open the business section of any newspaper these days without running across an article bemoaning the “skilled-labor shortage” that is supposedly threatening the heart of American business. It’s time someone called these companies on the farce they’re so busy publicizing, because the workers are out there. The perceived shortage lies in the difference between the employers’ notions about what the “ideal” candidate looks like, and the reality of the American workforce.

I am a recent college graduate—again. A career-changer with nine years of professional experience, I maintained a 3.9 GPA in Information Technology while working and attending classes at night. After graduating, I discovered the cold hard truth about entry-level job seekers: we are pariahs. The very same companies that are putting pressure on institutions of higher learning to produce high-tech workers refuse to even consider hiring new graduates...

The “skilled-labor shortage” is really a refusal by employers to open their minds to the rich diversity of job seekers that are pounding the pavement at this very moment. Undeniably, the classifieds are brimming with employment opportunities. But read between the lines, and you’ll find a plethora of preconceived notions of the ideal candidate. He or she should be the right age, have neither too little nor too much experience, live in the right place, look a certain way and be willing to accept whatever compensation is offered.

The following letter to the editor appeared in the August 1998 issue of the IEEE magazine *Computer* (the more complete text quoted here was posted on the IEEE Web page):

I have been following the give and take on the so-called IT worker shortage for months. I don’t have any hard evidence, but my personal experience makes me believe that the shortage is a hoax.

³⁰Qualcomm then claimed in the same newspaper on March 26 that it had just called him to hire him when he got the technician job. However, Finlan told me that just the opposite was the case; Qualcomm did indeed call him, but only to tell him that they had reviewed his re’sume’ again, and that they believe that they had made the correct decision in NOT interviewing him.

Several years ago, I was doing embedded systems work, and the company hired someone in over my head because I did not have a degree. I began looking for a new job, but prospective employers always cited my lack of a degree if they bothered to give a reason for turning me down.

Three years ago, I enrolled in college, and last month I graduated with a B.S. in Computer Science and a 4.0/4.0 GPA. I figured that formalizing my experience with the expected degree would surely ease the way. During the past six months, I've sent out over forty resumes and posted it on several web sites. So far, I've had four offers to interview. After the last interview, I was told that my qualifications were impressive but not quite a match with their current needs (which had evidently changed since before the interview). I believe there was another reason: they had not expected a recent graduate to be forty-five years old.

It is time to put a name on this "shortage," and that name is age discrimination. I suppose my view is pretty narrow, but as long as I am unemployed there is no shortage.

Terry Vaughn

The *San Jose Business Journal* (August 24, 1998) stated,

One person on that list is Terry Oldberg, a 58-year-old Los Altos Hills resident with master's degrees in mechanical and electrical engineering. He said he took a year's worth of programming courses in order to find work after leaving a nuclear engineering job in 1988—but hasn't had any luck. "I was willing to work for people for free to get re-established in a new field," he said. "No one was willing to take me up on it."

Another example, from the *San Francisco Chronicle*, May 19, 2000:

When he got his degree in computer science from the University of California at Santa Cruz in 1997, Don Harlor thought he could write his own ticket in Silicon Valley's booming job market. But after three years of sending out resumes, relentlessly networking, attending job fairs and going through two to three interviews a month, Harlor is working as a census taker to keep himself occupied.

Although he hasn't given up his dreams of landing a job in software quality assurance, Harlor realizes that at 56, he's fighting an uphill battle in an industry that puts a premium on younger workers...

As these examples show, education is NOT the answer; in all of these examples, the workers have brand-new high-tech degrees, and thus up-to-date skills, and yet the industry is not anxious to hire them.

6.6 No Shortage of Applicants for Computer Science Teaching Positions

It should be pointed out that there is no shortage here either—our Computer Science Department at UC Davis has been contacted by hundreds of applicants each year for faculty positions (for typically two or three openings).

There are, however, interesting analogies in academic hiring to the case of programmer hiring. Just as in industry's insistence on hiring only programmers with very specific software skills, research-oriented universities insist that applicants for faculty positions have research experience in a very specific micro-area. For example, they may wish to hire someone who has done research in "mobile computing"—Internet access via wireless networks. The department would not be willing to hire someone who has done research in computer networks in general, much less someone who has done research in computer science in general. And worst of all, in general older professors from other schools need not apply for the position in the first place—where "older" generally means "over 30." Once an academic is more than two or three years out of graduate school, his/her chances of changing jobs from one school to another are very slim, unless he/she has attained truly outstanding fame.

7 On Skills Requirements

7.1 Employers' Extreme—and Ever-Worsening—Obsession with Specific Software Skills

ITAA president Harris Miller, in his claims that the industry is experiencing a desperate labor shortage, is fond of telling journalists, "Just look at all those job ads in the Sunday newspapers!" The fact is that those ads tell a story that Miller doesn't want reporters to notice: Employers are not willing to hire "just any programmer." The ads insist that the programmer have experience in a specific software technology. As mentioned earlier, most employers use re'sume'-scanning machines to screen applicants, automatically rejecting anyone who is not an exact fit for certain skills sought by the employer.

One contracting programmer told me how absurd this overemphasis on skills can become:

Back in the early 90's I was a Clipper application development specialist. I had worked with every version of Clipper since 1986. The early versions of Clipper used names like Autumn 86, Summer '87, etc. Around 1991 they decided to go with a number oriented version scheme, starting with 5.0. By 1993 I had over 6 years of experience in Clipper, and was current through version 5.2 or 5.3...a headhunter shop called me up and asked if I knew Clipper. I had 5.2 listed on my resume. They called me back...and said the client's human resource department passed me over [because] "the client is using Summer '87, and you only have Clipper 5.2 on your resume."

Another contract programmer, Bill Halchin, had worked on device drivers in operating system kernels for nearly 20 years, but happened to work for about a year on other computer projects. When in January 1999 he then sought another position in device drivers, a recruiter in Texas then complained, "Don't you have any device driver experience after November 1997?"

As we will discuss in detail below, this obsession with specific skills is unwarranted, akin what would happen if Chevy dealers refused to hire seasoned mechanics with experience on Fords. Amazingly, the current trend is even worse: Many employers want not only experience with specific software, but also experience in specific application industries, say banking. An April 5, 1999 article in *Computerworld* illustrates this (emphasis added):

Employees with C++, Java, electronic data interchange (EDI) and data warehousing skills are in demand...And given the importance of electronic-commerce projects, companies are getting

more specific about what they need, seeking not just generic knowledge of technologies, but “people with specific platform and most importantly specific **industry** expertise,” Fox says.

Neish agrees. “We had some very precise needs,” he says. For example, he says, it’s not that there aren’t a lot of people with SAP experience out there, but being part of a large team implementing SAP and having an in-depth understanding of how it relates to industry-specific EDI and Internet development for mission-critical projects is another matter altogether.

Since software technology will continue to change extremely rapidly, and since employers are not willing to hire a veteran programmer who learns a new software skill via coursework, employers have set up a system which guarantees that the claimed/perceived labor “shortage” will be PERMANENT.

The point made by Neish in the quote above is especially significant in this regard. The glut of programmers on the labor pool is now getting to the point where there are many applicants with the skill he wants, SAP. So now he can afford to be even pickier, insisting on experience in a given applications industry.

Similarly, a November 22, 1999 article in *Infoworld* quoted David Foote, managing partner at IT compensation consulting company Foote Partners and Foote Research Group, in New Canaan, Conn.:

“It’s one thing to say that you have a year of SAP [experience], and it’s another thing to say that you have a year of SAP [experience] working with one company on one project, and you actually saw the project through to completion,” Foote says. “For many candidates, there’s an experience factor that’s missing.”

The same attitude was noted earlier in this paper, in *Computerworld’s* publication, *College Careers Spring 1999* (similar comments appeared in their Fall 1999 issue):

Although there may be a shortage of programming talent in the Seattle area, employers aren’t so desperate that they’ll take just anyone, says Bob Stange, a vice president at Staffing Options, a Lynwood, Wash.-based executive recruiting firm. “It’s not enough just to be a good programmer,” Stange says. “My clients want people who are going to be able to understand what it is they do in the marketplace.”

On October 13, 1999, two Intel recruiters visiting UC Davis told me that even in the case of new graduates, Intel does a skills match in selecting which applicants, if any, to interview.

Similarly, an August 9, 1999 article in the online edition of *The Red Herring* quoted entrepreneur John Chang:

“There are plenty of straight programmers in the Valley,” says Mr. Chang, “but there are very few people who can take business logic and translate it into software code.”

In fact, the employers have been repeatedly upping the ante. In 1997 they were saying there were not people who are programmers; after the fact came out that employers receive large numbers of applications from programmers but only hire around 2% of them, they became more restrictive, insisting that there are not enough people who are programmers and have specific software skills; then, as seen above, they become even more restrictive, saying there are not enough people who are programmers and have specific software skills and know a particular business sector well.

So again, there is an ever-increasing pickiness among employers. The larger the labor pool, the more the employers cry “shortage.” They thus are creating an artificial “problem” which their own actions render physically impossible to solve.

7.2 Employers Should Hire on General Programming Talent, Not Specific Software Skills

This obsession with specific skills is unwarranted. What counts is general programming talent—hiring smart people—not experience with specific software technologies.

Studies show a dramatic 10-to-1 variation in programmer productivity, by virtually any criterion—time to finish a product, number of errors, and so on. (See for example, in *Peopleware: Productive Projects and Teams*, by Tom DeMarco and Timothy Lister, Dorset House Publishing Co., 1987, pp.44ff.) In other words, the best programmers work 10 times faster, produce 10 times fewer errors, and so on, than the worst ones. In other words, raw analytical talent, not paper credentials, is what really counts.

A study quoted *Myths and Methods: a Guide to Software Productivity* by David T. Fisher (Prentice-Hall, 1991) found that the factor Personnel Capability, i.e. general talent and energy of the programmers, counted for a score of 4.18 in a productivity prediction equation. This was by far the largest factor; the next largest was Product Complexity, with a score of only 2.36. The factor (Programming) Language Experience, i.e. experience with a specific software skill, had the smallest score among the 15 factors studied, with a score of only 1.20. Fisher comments:

The relatively small impact of language knowledge is an important fact which is not intuitively obvious. Judging by advertisements for programmers it would seem that [IT] managers tend to overemphasize specific language experience.

Bill Gates has described Microsoft hiring criteria as follows: “We’re not looking for any specific knowledge because things change so fast, and it’s easy to learn stuff. You’ve got to have an excitement about software, a certain intelligence...It’s not the specific knowledge that counts.” (*Wall Street Journal*, November 8, 1994.)

Jim McCarthy, one of Gates’ software development managers at Microsoft, points out in his book, *Dynamics of Software Development* (Microsoft Press, 1995, p.168),

The biggest mistake I see managers make as they hire people for software development teams is that they overvalue a particular technology. To verify this tendency, all you have to do is look at the want ads: ‘Wanted: foobar programmers. Experience with whatsit required.’ Obviously, conversance with a given technology is a wonderful attribute in a candidate, but in the final analysis it’s an extra, not mandatory. After all, most software development technologies have a half-life of about one year.

Ironically, Microsoft has grown so large that Gates’ and McCarthy’s philosophies don’t reach down to the shop floor, and managers there are now just as obsessed with skills as the rest of the industry. The first demand made of users accessing Microsoft’s employment opportunities Web page (and those of most other software firms) is “State your skill set.”

7.3 New Software Skills Can Be Picked Up Quickly

Programmers can become productive in a new software technology in a matter of weeks.

As Garrent Bechler, a recruiter with RHI Consulting in Walnut Creek, California put it, “Any programmer who already knows C [the industry standard for the last 15 years], needs only a week, maybe two, to reach proficiency in Java.” (Interview with the author, March 24, 1998. See details on this point in the section titled “The Retraining Issue” in this report.)

This point on the quickness with which new software technologies are learned can be seen in data on factors affecting completion time for software development projects, cited in one of the central works on software engineering, *Software Engineering Economics*, by Barry Boehm (Prentice-Hall, 1981, p.530). Those data indicate that programmers reach perhaps 80% of their full productivity level by one month, and full productivity by the next time period studied, four months.

Silicon Valley employment agent Andrew Gaynor told *US News and World Report* (March 16, 1998) that shortsighted employers who are insisting on a given skill will let a job go unfilled for months, when in fact an experienced programmer without the skill “could easily come up to speed in a few weeks.”

Amit Kamra, head of Information Systems Transition Services, said that his company could not afford to hire someone who would have to learn the given technology on the job, say Microsoft Windows programming. (Interview with the author, August 24, 1995.) But when I asked him how long it would take for an experienced programmer to become productive in Windows if he/she did not know this technology beforehand, he answered, “[Up] to two weeks, maybe all the way up to a month and a half to become truly productive.” I asked why they did not hire such people, given the shortness of such time periods, to which Kamra replied, “Well, we could, and we did so once with good results [he then gave the details]...But well, during those two weeks [of learning] the project is slowed down a bit, especially since others on the project would have to help the new person.” Though Kamra’s remarks show that learning on the job is of course not ideal, the point is that they certainly show that the industry is wrong in claiming that possession of specific skills is an absolute necessity.

8 The Retraining Issue

When Senator Alan Simpson introduced his 1995 bill to tighten up our policy on high-tech hiring of foreign nationals, employers protested that they need the foreign workers to fill a software labor shortage. After Secretary of Labor Robert Reich then stated that the problem was that employers are not retraining their existing employees, industry officials protested that they do spend vast sums of money on retraining. However, as will be shown below, the fact is that **most employers are not willing to retrain programmers and engineers who apply for positions with them.**

8.1 On-the-Job Learning, Not Formal Retraining, Is Best

It should be strongly emphasized that the term *retraining* is itself misleading, as it implies formal instruction. The fact is that any competent programmer can pick up a new software skill on his/her own, on the job, without formal instruction. Say for instance the skill to be learned is Java, and that the programmer has been up to now been using the C language, the industry standard for the past 15 years. (By the way, contrary to the claim that most older programmers who have trouble finding work are old COBOL programmers, most of the ones who contact me are actually C programmers.) All that need be done is give the programmer (a) two or three books on Java, (b) a real Java project to work on, and (c) a Java resource person to contact as a last resort if some question is not answered in the Java books.

A key point that typically programmers work in groups, not alone. A programmer will be assigned to work on one small piece of a large program, with the broad outlines of the program already in place. It is especially easy and quick for the new team member to adapt to the language used, in this case Java, in this context. For example, the fact that the data structures, relations between components and so on are already there means that the programmer makes a natural transition to Java's "object-oriented" viewpoint (as opposed to "using Java to write C").

A competent C programmer making this transition will writing Java code for the project within a week, will be fully up to speed within two weeks, and will feel like an "old pro" in Java within a month. Note that the programmer will not learn "every nook and cranny" of Java during this period—but he/she will likely never do so (and any veteran Java programmers hired by the project also will not know every possible detail either). Instead, the programmer will pick up new esoteric details of the language on an as-needed basis, if and when the need arises.

8.2 Most Employers Are Unwilling to Retrain

Most employers are unwilling to retrain, either through formal instruction or via on-the-job learning as described above. As mentioned earlier, Kim Lee, of the Network Connections employment agency in the Silicon Valley, has noted that (interview with the author, June 26, 1996) "In 1988 the employers would have retrained [older] people but they're not desperate enough to do so today."

The point was made quite forcefully by Susan Miller, a computer industry employment agent who says that 90% of the workers she places are foreign nationals. (Interview with the author, June 26, 1996.) Pointing out frankly that her own high income as an employment agent depends largely on the fact that the industry is not providing retraining for existing employees, she nevertheless feels that

It's a very closed industry in that respect [retraining]. The trap the industry falls into is that they don't spend time retraining. It would be much more cost-effective for them to retrain the employees they already have; by not retraining they are driving salaries way up, since so few people have the "right" skill sets. The employers haven't been smart. They have been very closed-minded, with blinders. If I could change one thing about the industry, that would be it.

Two of the industry firms claiming most vociferously that there is a labor shortage have been a mass of contradictions on the retraining issue. Intel has said that it does retrain (Bay TV, San Francisco, March 3, 1998) and that it is not willing to retrain (*IEEE Computer*, February 1996; also CNN, March 1998). Cypress Semiconductor also said yes (California Report, NPR, March 27, 1998) and no (The Newshour with Jim Lehrer, April 3, 1998) to the retraining question.³¹

HR Magazine (June 1998) quotes Joe Nyitray, director of staffing for Dow Jones and Co. Inc., as saying that "There's a real focus on skill sets needed right now. I recently attended a conference on retention where participants were simultaneously hiring and laying off—even in IT—all because of the need to get things involving new skill sets done fast. Training never came up as an alternative."

Computerworld reported in June 2000 that IBM, Hewlett-Packard, Ernst and Young and so on

³¹Days after a lobbyist for a highly prominent Silicon Valley electronics firm had told national media about the large sums of money the firm spends annually on training, I discussed this with a high-level official in the company. Speaking to me on background, he at first repeated the large figures his firm spends on training. Yet, when pressed he conceded that the company mainly provides training for its technicians, not its engineers or programmers.

[are laying off programmers off while] hiring people with the right skills—not teaching old dogs new tricks.

A 1998 UC Berkeley study (“The Perceived Shortage of High-Tech Workers,” Clair Brown, Ben Campbell, and Greg Pinsonneault, Dept. of Economics, UC Berkeley) found that

Companies have little incentive to train older engineers because they can hire from the large flow of newly-trained and cheaper engineers. Companies save money on training since the recent graduates already have cutting-edge knowledge.

Many employers will indeed train their existing employees, but refuse to hire new ones who need retraining. I have often observed this myself, and it was also stated in a *Dallas Morning News* article (June 2, 1999):

Cathy Rodewald, senior vice president and chief information officer for Amresco Inc., a Dallas-based real estate and financial services firm, said she trains existing staff but wants a new employee ready to go.

If a valued employee shows interest in a posted job, “we’ll try to retool that employee. That’s because they’ve already proved themselves,” she said. “If I go out on the open market to try to find a person, I’m probably going to require the exact skill set.”

Indeed, the industry often says it cannot afford the time to retrain, because they need to hire personnel for a project immediately. But this is disingenuous, as the industry is also claiming that as many as 30% of software positions take six months or more to fill. (*Wall Street Journal*, December 1, 1997.) The *Silicon Valley Joint Workforce Initiative Study* (A.T. Kearney Co., May 18, 1999) found that the average time a job is left unfilled, among all high-tech jobs in Silicon Valley, was 3.7 months. During this time the same programmers employers are unwilling to hire now because of lack of a hot skill could learn the given technology and be productive.

This point was also noted in an article in *Computerworld* (January 3, 2000), highlighting the incongruity of searching for six to nine months for someone who can “hit the ground running” without retraining:

Partly because of the competition [for programmers having specific software skills], and partly because IT shops want people who can hit the ground running, IT positions often linger unfilled as long as six to nine months, managers say—a lifetime when business is moving at Internet speed...

But because many of the technologies driving staffing needs are not much older than that three to five years companies are looking for—if that old—solid experience is hard to come by. That creates a vicious circle, says the technology director at a retailer based in the Southwest, who asked not to be identified. “You don’t want to hire an entry-level person, because it takes time to get people trained,” the director says. “You keep hoping you can find somebody, but then by the time you do, you could have trained someone.”

The industry also says that if they retrain their programmers in a “hot” skill, the newly-enfranchised programmers will leave them for higher pay elsewhere. This is correct, but the employers are missing the point: If the industry did not pay a premium for these skills in the first place (a consequence of refusing to hire programmers who lack the skills), this frequent job-hopping would not occur.

Moreover, in refusing to retrain on the grounds that the programmers would then demand more money, employers are admitting that they are hiring the younger domestic programmers and the H-1Bs because of their cheap labor.

As pointed out earlier, programmers seeking work cannot remedy the problem by retraining on their own. Employers will not hire a older programmer for a Java project on the basis of the applicant's having taken a Java course.

During the 1995-1996 Congress, Senator Alan Simpson (R-Wyo.) proposed that a fee be imposed on employers who hire H-1B workers. Originally set at \$10,000 and then lowered to \$5,000, the fee would go to retraining domestic workers. The industry lobbyists furiously opposed the proposal (which was then dropped), and expressed the same fierce opposition in February (and August) 1998, even for a tiny fee of \$250. Clearly, this shows that the insincerity in the lobbyists' claims that they are desperate to hire people; if they were desperate, such a nominal fee should be nothing to them.

8.3 Retraining Programs Have Failed

As indicated earlier, given the opportunity any competent programmer can pick up a new software skill on the job, quickly, so what is needed is a change in employer hiring policies, not formal retraining programs. Moreover, **retraining programs for engineers and programmers are largely a waste of money, not helping employers cope with their claimed shortage of such professionals.** Such programs often boast a high placement rate, but the problem is that the engineers and programmers who "graduate" from them don't get jobs as engineers and programmers. Then tend to get jobs as technicians, customer support personnel and so on. See for example testimony by Bill Bold of Qualcomm to the California state legislature, March 25, 1998. Even the Massachusetts Software Council, widely viewed as the best of the software retraining programs, only places 20% of its participants in software development positions, according to a report by the Dept. of Commerce retraining task force, prepared for the ITAA/DOC convocation held in Oakland, California, January 1998. **Thus, these programs don't help employers fill the engineering and programming positions they say they are desperate to fill.**

9 The Role of Programmers and Engineers Imported from Abroad

9.1 Overview

As we have seen, industry employers tend to shun older programmers. One of the major factors underlying this is that employers have another labor source to turn to, in the form of foreign nationals whom they sponsor for immigration or work visas. For example, about one-third of Silicon Valley programmers and engineers were foreign-born as of 1990,³² most of them sponsored for immigration originally by employers.

(Industry lobbyists make claims along the lines of "Only 5% of our programmers are H-1Bs," but this is misleading, since many more of their staff originally started as H-1Bs but then were sponsored by their

³²The proportion is much higher today, said to exceed 50%, though exact figures are not available. The reasons for the increase include the 352% increase in H-1B visas during 1990-1995, and the Chinese Student Protection Act of 1992, which gave green cards to an estimated 100,000 Chinese nationals, most of them in technology areas. Future trends are difficult to predict, given how much the situation has changed in the 1990s; for instance, ethnic Chinese comprised 76% of the immigrant programmers and engineers in Silicon Valley in the 1990 Census, but in 1998 the Indian H-1Bs outnumbered the Chinese ones by a 5-to-1 ratio.

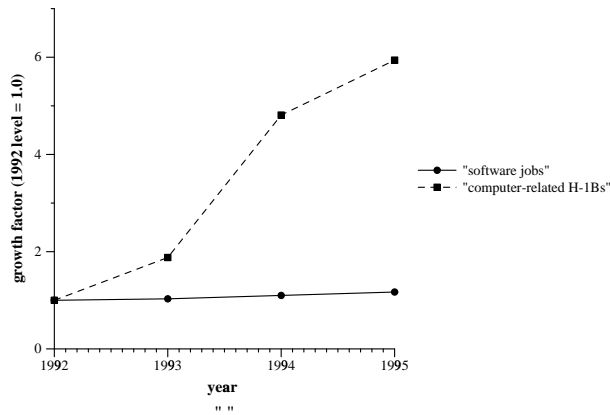


Figure 5: comparison of growth rates

employers for green cards. It is also very misleading in that these employers are not counting all the H-1B workers at their firms who are subcontracted by agencies.)

Without the foreign-national labor supply, employers would be forced to use the existing domestic labor pool of older people. For this reason, the foreign-labor issue is central to our theme here, and will be addressed briefly. (See the author’s analysis at

<http://heather.cs.ucdavis.edu/pub/Immigration/ImmigAndComputerIndustry/SVReport.html>,

for extensive details.)

It is easy to see that there is something very wrong with the H-1B program, in that **the number of software H-1Bs is growing 10 times faster than the growth rate in jobs:** The number of H-1B work visas requested by industry for computer programmers increased by 352% from 1990-1995, during which time the number of programming jobs increased by only 35%.³³

The “country of choice” among employers importing this labor is currently India, with nearly five times the number of H-1B visa holders than the next-highest country, China. (*Los Angeles Times*, May 19, 1998.)

9.2 H-1B Work Visas As a Source of Cheap Labor

In October 1999, Susan deFife, CEO of womenConnect.com of McLean, VA, testified to the Senate in support of higher H-1B quotas. She gave the example of a new graduate she had hired in 1998 as a system administrator, a Mexican national who had just graduated from a U.S. school. Ms. deFife emphasized that she found this worker only after months of exhaustive searching. Yet a subsequent inquiry under the Freedom of Information Act (FOIA) showed that deFife was only paying this person \$35,000 per year—when the national average for new graduates was \$45,000!

Similarly, John Harrison, CEO of Ecutel in Alexandria, Virginia, testified to the House in March 1999 in support of an H-1B increase. He issued a press release which said,

Something is wrong when you put an ad in the Washington Post for a software engineer and the

³³*Software Workers for the New Millennium*, National Software Alliance, Arlington, VA, January 1998. Note that before 1990 the H-1B program had the name H-1. The graphic here is only for H-1Bs, with statistics starting in 1992.

only qualified applicants you receive are from non-U.S. Citizens, said John Harrison, CEO and co-founder of Ecutel, one of the nation's most promising high-tech companies.

A FOIA request later revealed that Ecutel had hired several H-1B programmers at a salary of \$35,000, again far below average.

This is outrageous. Here were two of the best examples the industry lobbyists could find in claimed support of the H-1B program, and yet both of them were in fact paying their H-1Bs salaries well below average.

Many employers find H-1B (pre-green card) programmers and engineers attractive because they will accept lower salaries and poor working conditions. We will discuss the details in this subsection.

9.2.1 Some Cautionary Notes

Before getting into the details on this issue, **we wish to emphasize that one must be extremely careful with salary studies, because if the proper variables are not adjusted for, salary differences can be masked.**

In particular, it is extremely important to note that **salary exploitation occurs primarily in the first 5-10 years of the foreign national's time in the U.S.** This is because of the fact that employers have enormous leverage over the worker during the time the worker's green card is pending. (See Section 9.3, "Indentured Servants" below.) For some workers, the salary gap also persists for some time after the worker receives a green card, but the gap eventually is closed for almost everyone.

Therefore, **salary studies which lump together all immigrant workers, both newly-arrived and long-established, will not reveal the exploitation of the newly-arrived.** Even worse, if a study merely looks at foreign-born status, it will pick up those who immigrated to the U.S. as children under family reunification laws; these people had green card or citizen status when they entered the workforce and thus were not exploitable by employers.

It would also be misleading, for instance, to compare the salaries of immigrants having Master's degrees and working in high-wage regions with those of natives having Bachelor's degrees and working in low-wage regions. This is a common problem with many studies and surveys, such as those of the National Science Foundation (cited by ITAA analyst Stuart Anderson), the *Electronic Engineering Times*, the Institute of Electrical and Electronic Engineers and the National Science Foundation, all of which typically omit important variables.

Another way in which salary differences can be masked is the study does not account for specific software skills. As explained below, the "prevailing wage" aspect of H-1B law does not require employers to account for skills in wage determination. Thus an employer can hire an H-1B programmer with a background in Java, for which the employer would normally pay a salary premium, for the price of a generic programmer who does not know Java, and yet still technically comply with the law. So, **a salary study which does not account for specific software skills might misleadingly make it appear that the foreign-national workers are being paid as well as natives, even though in actuality they are being underpaid.**

9.2.2 Government Analyses

The Department of Labor has found widespread abuse of the work-visa program.³⁴ Among other things, they found that 19% of the employers were not even paying the salaries they had promised in their H-1B applications, even more remarkable because the salaries in the applications tend to be low to begin with. The employer requesting an H-1B is supposed to pay the prevailing wage, but there is such a large variation in wages anyway that it is easy to mask an offer of an unfairly low salary. (This issue will be discussed in much greater detail below.)

DOL also found that though state employment departments are supposed to refer domestic candidates for jobs for which an employer-sponsored green card is pending, “Of the 28,682 applicants referred on 10,631 job orders during the period, only 5 (0.02 percent) were hired.”

Amazingly, policy makers in another federal agency, the National Science Foundation (NSF), actually planned to bring in foreign nationals to produce a glut of labor in science and engineering, at least at the postgraduate degree level. In early 1998, Dr. Eric Weinstein, a mathematician at the Massachusetts Institute of Technology, uncovered internal NSF documents which expressed concern that science and engineering salaries were getting too high, and proposed as a solution to this “problem” bringing in a glut of foreign labor. It is amazing that a federal agency would actually plot to keep U.S. citizens’ salaries down. Subsequent to the writing of these documents, the NSF pushed Congress to establish the current H-1B program, in much expanded form compared to the old H-1 program. Dr. Weinstein’s paper on this scandal is available at

<http://www.mit.edu/afs/athena.mit.edu/user/e/r/erw/Public/SG/NSF.html>

9.2.3 Analyses from Academia and Research Institutions

A researcher with the pro-immigration Carnegie Endowment for International Peace put it this way (*Kansas City Star*, July 16, 1995):

“Do you want me to call it a sham?” asks Demetrios Papademetriou, a former Labor Department immigration official now with the Carnegie Endowment for International Peace. “Do you want me to call it a hoax? Sure it is. This program has never worked, and it never will.”

Papademetriou and Stephen Yale-Loehr—who is an immigration lawyer and thus would be expected to oppose reform of the H-1B process—reported in their book, *Balancing Interests: Rethinking U.S. Selection of Skilled Immigrants* (Carnegie Endowment for International Peace, 1996), on their study of wages paid to foreign nationals in various professions. In data from the labor certification applications in the process of sponsoring the foreign workers for green cards. the foreign applicants in Computer Programmer positions in New Jersey were being offered salaries which were on average 21% below the mean for that profession, with an 11% figure in Texas. In the Computer Systems Analysts and Scientists category, gaps of 30% and 21% were found in New Jersey and New York, respectively. By law the gap is supposed to be no more than 5%.

Asian-American Studies Professor Paul Ong of UCLA, after correcting for a host of important variables—including English proficiency—found that immigrant engineers were paid up to one-third less than their

³⁴*The Department of Labor’s Foreign Labor Certification Programs: The System is Broken and Needs to be Fixed*, Final Report No. 06-96-002-03-321, Joseph Fisch, Assistant Inspector General for Audit.

native counterparts, and that the gap took 20 years to close.³⁵ And though Ong hypothesized various factors,³⁶ he cited earlier findings that the foreign engineers may be “willing to accept lower salaries in order to obtain full-time employment in the U.S., a prerequisite for permanent residency,” and the bottom line is that Ong noted that **“Companies took advantage of immigrants.”** (*Electronic Engineering Times*, July 18, 1994.)

My own analyses of the 1990 Census data on programmers and electrical engineers in Silicon Valley found that the immigrants were paid on average 15-20% less than natives of comparable age and education. In one of the analyses, for instance I tabulated salaries in Silicon Valley, for workers who had Master’s degrees (and not a Ph.D.), and at most 32 years old. For the foreign-born, the worker was included if his entry to the U.S. had been no more than eight years earlier.

(This last condition is crucial; as mentioned earlier, and detailed in Section 9.3, the major exploitation of immigrant programmers occurs during their first few years in the U.S., while in a *de facto* “indentured servant” state. Moreover, one must eliminate immigrants who had come to the U.S. as children through family immigration, and who thus were not exploitable later when they entered the workforce.)

I then simply computed mean salaries for all native and all foreign-born. The results were:

native: \$51,480

foreign-born: \$42,845

The native figure is 20.2% higher than the foreign-born one.

A 1998 UC Berkeley study (“The Perceived Shortage of High-Tech Workers,” Clair Brown, Ben Campbell, and Greg Pinsonneault, Dept. of Economics, UC Berkeley) found that the presence of the foreign engineers had indeed held down engineering salaries.

9.2.4 Statements by the Industry and Its Allies Themselves

We noted earlier that the *Red Herring* magazine, the “business bible” of Silicon Valley, actually endorsed the idea of using foreign programmers and engineers as a source of cheap labor, saying in its July 1998 editorial

...if companies say they want to hire more skilled foreign workers because those workers are cheaper, we should believe them—and increase the number of visas issued.

General Dynamics, the aerospace giant, even admitted in federal court that the imported workers from England were presented as attractive due to their “indentured” status; the pitch made by the British employment

³⁵*The State of Asian Pacific America*, Paul Ong (ed.), LEAP Asian Pacific American Public Policy Institute and UCLA Asian American Studies Center, 1994, p.179-180. The article is reprinted in *New American Destinies*, D. Hamamoto and R. Torres (ed.), Routledge, 1997.

³⁶One of those factors was an American education, which Ong found to make a 10% difference in salary. This was later used by ITAA researcher Stuart Anderson to downplay Ong’s findings of employer exploitation of immigrant engineers. But this 10% figure is well short of the 33% overall gap Ong found, and even the 10% figure itself is misleading, as it includes people who had immigrated as children with their families, who already had green cards or citizenship by the time they entered the labor market and thus were not exploitable by employers. In any case, Ong’s comment, cited below, that “Companies took advantage of immigrants,” makes his interpretation of his work quite clear.

agency to General Dynamics said that its clients were “prepared to work here in the United States for as much as a 40% reduction in current United States salary levels.”

It is ironic that even a *Wall Street Journal* article (January 8, 1998) claiming that American firms recruit abroad because of a labor shortage stated that “recruiting foreign talent is cheaper than hiring Americans.” The article quotes an American recruiter of foreign programmers as saying that he pays them \$20,000 to \$25,000 less than Americans with the same skills.

And the pro-business *Forbes* magazine said (May 31, 2000):

Indian programmers working in the U.S. on temporary H-1B visas typically earn 25% to 30% less than their naturalized colleagues. Kalra, for example, will earn \$60,000 this year, while others with his experience here could easily earn \$75,000.

Moreover, the simple law of supply and demand tells us that, again, even the sincere employers who hire H-1Bs bring down the price of labor, by increasing the supply. Industry officials have admitted this, such as this comment on CNN on February 9, 1998:

Robert Walley, executive vice president of Gemini, says that unless his company and others are able to find a new source of workers, “it would increase the prices of the resource pool. The people out there looking for jobs, they’re demanding premium salaries now, and it will just drive that higher.”

Similarly, the ITAA industry lobbying group also worried that “We can anticipate further increases in the salaries of IT workers” which make “U.S. companies risk their profitability.” (*Help Wanted: The IT Workforce Gap At the Dawn of a New Century*, ITAA, 1998.) In other public statements, the ITAA worried about IT salaries causing inflation. ITAA’s solution: Use foreign workers to expand the labor supply, thus reducing salaries.

Industry also freely admits that abuses also occur abroad; Sun Microsystems, a firm often cited by ITAA analyst (and now Senate Immigration Subcommittee staffer) Stuart Anderson as paying fair wages to foreign nationals, has boasted of hiring programmers in Russia at “bargain prices.” (*Los Angeles Times*, November 15, 1993, and also July 15, 1996.)

Joseph Costello, then-CEO of Cadence Design Systems, a leading CAD software firm, stated that when Cadence was considering setting up a development branch in India, a bullet item in a slide presentation on the proposal listed “salary savings” as an inducement for the move.³⁷

9.2.5 Severe Problems in the Concept of “Prevailing Wage”

H-1B law requires the employer to pay the foreign worker the “prevailing wage,” which industry lobbyists have cited as “proof” that the H-1Bs are not exploited. But this law is riddled with loopholes.

Even if an H-1B employer pays a prevailing wage determined by a government survey, that wage will usually be lower than the market rate for the job’s skill requirement, as follows. As explained earlier, the

³⁷Panel discussion at a conference on immigration, Hoover Institution, Stanford University, October 18, 1996. Costello quickly added that he had rejected cost as a criterion. However, though he and two other Silicon Valley CEOs on the panel (Dado Banatao of S3 and Phil White of Informix) claimed that their only criterion for setting up foreign development branches was the existence of “pools of talent,” it certainly is no coincidence that the sites they chose were almost all in low-wage countries.

only programmers who are enjoying large increases in salary as those with “hot” skills, say Java. H-1Bs are brought to this country ostensibly for those skills. **Yet an employer need only pay the prevailing wage for programmers in general, rather than the prevailing wage for, say, Java programmers. Thus the employer gets a Java programmer for the price of a generic programmer—all while technically complying with the prevailing-wage requirement of the law.** As noted by immigration attorney Donna Fujioka of Oakland, California (interview with the author, March 5, 1998),

[The prevailing wage law] takes a meataxe approach...It doesn't appreciate how hot a skill is [such as SAP]...This is great if you are an attorney representing an SAP programmer.³⁸

Note also that many H-1B workers have stated that after they are hired, they become “indentured servants” (see below) and do not get raises in salary like U.S. citizen/permanent resident workers do. Thus even if their original salary was on par with the Americans, employers save money by not increasing their salaries later on.

Another common ruse is to underclassify an H-1B worker, giving him/her a job title at a level lower than that of the work he/she is performing, in order to make a low salary comply with the prevailing wage.

Moreover, Department of Labor regulations allow the employer to provide his/her own data on prevailing wages, such as listing typical salaries in his/her own firm, rather than being determined by the DOL, clearly producing enormous potential for abuse.

Another major problem with relying on “prevailing wages” is that this does not account for age discrimination. As shown earlier, employers wish to hire younger American workers, since they are cheaper than the older ones. When the supply of young American workers is exhausted, the employers then turn to young foreign workers, shunning the older American workers. So again an employer could be paying his/her young foreign workers the same as his/her American ones and yet still be abusing the H-1B program with the goal of saving on salary costs.

The fact that the employers are turning to young foreign workers when they run out of young American workers is reflected in the age-distribution data presented in *Foreign-Origin Persons in the U.S. Information Technology Workforce* (IT Workforce Project, March 1999), from the 1998 Current Population Survey. They found that 75% of the foreign-born software developers were under age 40, compared to only 58% for the native ones. If data were restricted to H-1Bs,³⁹ the disparity between the two figures would be even greater.

9.2.6 The Indian View

Since the largest nationality among the H-1Bs is Indian, it is not surprising that Indians, who see the situation at close range, are among the most critical of the program.

An industry analyst in Bangalore, India quoted by MSNBC News in August 1997 also says that Indian programmers imported to the U.S. under the H-1B program make 30% less than their American peers.⁴⁰ A

³⁸Fujioka did counter that by complaining that the new DOL regulation implemented in 1998 sets up two only categories for prevailing wage, Entry Level and Experienced, asserting that this was unfair since the worker with five years of experience will be measured against a prevailing wage calculated on a group that includes people with 25 years of experience. But as seen in my “short-lived career” data above, almost no one lasts 25 years in this field, so the point is moot.

³⁹The same report does include data for Temporary Residents, but the source is the NSF SEASTAT data, which only include workers who have earned a college degree in the U.S., which most H-1Bs have not done.

⁴⁰He does believe they catch up within five years. However, since programming careers only last about 10 years anyway, even a five-year period of low pay would indicate very substantial salary savings for employers.

financial newspaper in India, the *Business Standard* (May 27, 1998), noted that if Congress were to truly enforce the prevailing-wage law, then

This step is significant because this will act as a counterweight against the brain drain fear expressed in some quarters. If the smaller Indian firms have to pay higher salaries, their cost advantage does not remain as strong—and Indian firms have traditionally relied on lower labour charges to bring down costs.

Dinesh Gandhi, a naturalized U.S. citizen, was featured in an article in the *San Jose Mercury News*, September 27, 1998:

Gandhi, 32, calls the hiring practices “discrimination [against Americans]...The way they handle American engineers is a nightmare,” he said.

Gandhi was in the job market earlier this year, and found himself competing against an H-1B mechanical engineer with the same credentials –even down to their college, San Jose State University.

The H-1B worker got the job, Gandhi said—at an annual salary of \$45,000. “No master’s graduate would work for that salary,” he said.

Gandhi ended up taking a job with a Santa Clara chip maker for \$60,000 a year. “It’s not great, but I’ve got to feed the family.”

Kumar Babu, another naturalized U.S. citizen, told the NBC Nightly News (June 14, 1998) that “The main [employer goal] is to depress the wages of the rest of the people.”

9.2.7 Views of Other Immigrant Communities

Immigrant computer programmers encounter the same age discrimination when they reach age 35 or 40 that natives do. As pointed out by Shankar Lakhavani, chairman of the workforce committee for the the Institute of Electrical and Electronic Engineers (IEEE) and a Pakistani immigrant, “There are many immigrants like me who are American citizens, and they would like a crack at these jobs [which are going to H-1Bs].”

I am married to a Chinese immigrant, am fluent in Chinese, and have been active in the Chinese immigrant community for 25 years. Most of the Chinese immigrant programmers and engineers that I know strongly feel that the H-1B program is very badly abused.

The Independent Federation of Chinese Students and Scholars (IFCSS) did not engage in lobbying in favor of the 1998 bill to increase the H-1B quota. This is in stark contrast to the massive, masterful lobbying campaign they waged in favor of the 1992 Chinese Student Protection Act, which gave green cards to students from China studying in the U.S. during the 1989 student protests in Beijing. Apparently the IFCSS’ inaction in 1998 stemmed from the perception that the bill would harm IFCSS members who already had green cards or citizenship, again illustrating the fact that immigrants feel their access to jobs needs to be protected just as much as that of natives.

The Organization of Chinese Americans, also extremely active in lobbying in favor of liberal immigration policies, also chose not to take a stand on the 1998 bill which proposed increasing the H-1B work visa quota.

9.2.8 False Claims of High Legal Fees

Industry lobbyists say that instead of employers saving money by hiring foreign nationals, it actually costs them more to hire the foreign nationals because of the legal fees involved. This is one of their most misleading arguments.

First of all, filing for an H-1B is quite simple and cheap; and **the typical legal fee for it is only about \$1,500 for small employers who hire only a few H-1Bs, and down to about \$700 for large employers who file many H-1B applications.** A *Computerworld* article (March 8, 1999) reported, “Congress instituted a \$500 fee when it raised the H-1B cap last summer...Additionally, employers pay a \$110 filing fee plus attorneys’ costs. All told, companies estimate the cost of obtaining an H-1B visa under the new regulations will range from \$1,300 to \$2,500, including attorneys’ fees.” I have interviewed numerous immigration lawyers on this point, and they all confirm this fee range. For example, an employer in Washington DC told the author in December 1997, “Most attorneys around the U.S. charge \$1,000 to \$1,500 for an H-1B petition.” An attorney in Oakland, California put the typical figure at \$1,200 to \$1,500 in a discussion with the author on March 5, 1998. Robert Baizer, a San Francisco immigration attorney, in an interview with the author also on that date, gave \$1,500 to \$2,000, and also is the source of the \$700 figure above. See also similar data in David North, *Soothing the Establishment: the Impact of Foreign-Born Scientists and Engineers on America*, University Press of America, 1995, p.52.⁴¹

This is far less than the \$10,000 the ITAA claims for the H-1B. In a different category, that of employer-sponsored green cards, the fees do tend to be around \$10,000.⁴² However, it should be noted that **many employers have the foreign employees pay the legal fees for green cards themselves, and even when employers foot the bill, the cost is usually less than they save in salary.** Recall that if an H-1B is sponsored for a green card, he/she will often get no raises during the five years or so it now takes for the green card application to be approved; the employer can be saving \$50,000 in salary during that time, so that a \$10,000 fee for the green card is more than compensated by the salary savings.

Note also that an employer who rents an H-1B from an agency avoids the fee a recruiter would charge in a regular hire, which is considerably more than \$10,000.

9.3 “Indentured Servants”

Note that an H-1B employee is essentially immobile during the years while the green card is pending, thus refuting ITAA’s argument that H-1Bs who are exploited in terms of salary can simply move to another job. The workers certainly do not want to start the green card process all over again.

It is crucial to keep mind the implications of this “indentured servitude” aspect of the H-1B: Not only does it allow unscrupulous employers to give the H-1Bs smaller raises than they would get out on the open market, but even more importantly, it gives employers a sense of “security”—by hiring H-1Bs, they don’t have to worry that the H-1B will suddenly jump ship, leaving the employer in the lurch, and possibly taking

⁴¹After industry lobbyist claims of the \$10,000 attorney fees for H-1Bs was exposed, the lobbyists tried a new tack, claiming relocation expenses from abroad for the foreign programmers and their families swelled the cost of hiring an H-1B. But according to a Department of Labor official, the vast majority of H-1B visas are granted to workers who are *already* in the U.S. The workers move from job to job; when one job ends, rendering their current visa invalid, the worker finds another employer, who then sponsors them for a new visa. This is why the industry pushed Congress so hard in 1997 regarding the “245(i)” clause in immigration law; Congress wanted to make it more difficult for foreign nationals to stay in the U.S. after their visas expire, and the high-tech industry strongly objected, in order to retain their access to the “floating population” of H-1Bs which they employ.

⁴²This difference between two visa categories was often confused, sometimes deliberately, during the 1998 congressional debate on whether to raise the H-1B quota.

company secrets with to some other firm. **For many employers, this “security” aspect is even more important than the issue of salary.**

In a July 13, 1999 column by Nathan Cochrane in an Australian publication, *Fairfax IT*, computer graphics guru Carsten Haitzler noted, “Be wary of H1-B visas in the USA - you basically get shackled to a company...Being a non-American in the USA is almost like being a second-class citizen.”

The anonymous author of an op-ed piece in *TechWeb News*, March 16, 1998, wrote,

I am an immigrant from India...the H-1B visa allows someone to work only temporarily at a high-tech job for a few years. An employer has to sponsor one for an H-1B visa. These engineers cannot switch jobs at will. To do so requires a new H-1B visa.

Companies love these H-1B workers, as they are eager to please their sponsors [in the hope] that they can be sponsored for green cards. These engineers are virtually “indentured slaves” of their sponsors.

Once a company initiates the process of sponsoring a candidate to green card, it can currently take three to four years. [As of late 1998, the typical waiting time had lengthened to five years, often more.—NM] Companies love this and frequently delay the process on purpose. Some big companies have this delay built into their sponsoring process. During this period, candidates are virtual slaves. They are forced to work long hours at low wages. And usually they do not get good raises or promotions...

I myself left my company when I got a green card and I got a raise of 40 percent.

Department of Labor statistics show that many of the H-1Bs do leave their employers soon after they get their green cards, just like the case of the anonymous author above. The Inspector General’s report (*The Department of Labor’s Foreign Labor Certification Programs: The System is Broken and Needs to be Fixed*, Final Report No. 06-96-002-03-321, Joseph Fisch, Assistant Inspector General for Audit) found that

...many left the employer who sponsored them shortly after obtaining permanent [i.e. green card] status: 8 percent left within 90 days, 17 percent left within 180 days, and 33 percent left within 1 year.

Presumably many of the remainder who stayed beyond a year did so only after negotiating a large pay increase, by threatening to leave.

An in-depth article in the *Washington Post* (July 26, 1998) noted,

According to foreign workers, recruiters and U.S. officials, the high-tech braceros generally earn less than their American counterparts, despite laws requiring employers to pay them “prevailing wages.” The workers are beholden to the employers who sponsor their visas in what the system’s critics describe as a form of indentured servitude. If they wish to move to another company, they not only must obtain a new work visa, but often must pay a penalty of \$10,000 to \$20,000 to their original employer.

To keep them from seeking higher pay elsewhere, employers frequently dangle the promise of sponsoring them for “green cards,” denoting much-coveted status as legal permanent residents. This gives the companies enormous leverage, since the process is a lengthy one and must be started over from scratch if the worker moves to another employer...

Besides receiving lower starting pay, H-1B workers complain of getting fewer and smaller raises, remaining mired in relatively menial jobs and, as salaried employees, having to work long hours without overtime.

Immigration attorney Jose Latour admitted this problem of “indentured servitude” on his Web page,

<http://www.usvisanews.com/fasttrack.html>

in discussing National Interest Waivers (NIW). NIW is a “fast track” to a green card, in which the foreign national applies on his/her own, rather than the employer applying on his/her behalf. Latour cites the benefits of NIW as opposed to the ordinary green card route:

The applicant sponsors himself/herself based upon his/her abilities, education, and experience. This means that present employment is not required, and if the applicant is employed, the employer does not have to get involved in the process. Why is this important? FREEDOM! The applicant does not have to stay with the employer for a certain number of years while the process is undertaken. Second, **permanent residency** [i.e. the green card—NM] **is taken away from the employer as a bargaining chip in the employer/employee relationship.**

(Emphasis in the word *freedom* was Latour’s; emphasis on the last two sentences was added by me.)

Another immigration attorney, Sherry Neal, made similar comments in an article in the *Dayton Daily News*, July 11, 1999:

Neal said foreign nationals may appear to be more loyal workers because they aren’t as mobile as other in-demand tech workers. The Immigration and Naturalization Service must give approval before foreign nationals change jobs—a process that can take six weeks. “Some of the U.S. workers, they get a job offer and they are gone in a week,” she said.

Similarly, *Workforce Magazine*, a publication for HR executives, noted in its May 1999 issue that

...There are two good things about H-1Bs. First, they allow you to travel the globe while you identify technical professionals who want to work in the United States. Second, the H-1B is valid only for the employer who arranges it. If you bring a technical professional into the country and he or she decides to jump ship, its likely that the ship he or she will have to jump on is the one thats going back to the home country. If the person wants to come back, he or she has to start the immigration process all over again. As a result, most H-1B visa holders demonstrate remarkable loyalty.

This use of the euphemism *loyalty* for the indentured status of H-1Bs is also used repeatedly by an international recruiting firm, Hi-Tech US (<http://www.innes-consultancy-plus.co.uk/whoarewe/hitechus.htm>), whose Web page notes:

There are also a number of other additional benefits in recruiting outside the USA:

Loyalty: Research has demonstrated that foreign nationals prove to be more loyal and will not jump from company to company. Coupled with the fact that most tend to be tied to a 3-year work Visa.

Control wages: Unrealistic wage increases can be brought back under control by recruiting outside the USA as you are helping the critical resource shortage not adding to it.

Reduce Relocation costs: Research has shown that the cost of relocating a foreign national is typically less than relocation someone within North America. When considered with the loyalty and control of wages above then the cost saving can be significant.

The dissident organization FACE Intel (Former and Current Employees of Intel) states that

[Intel] HR representative Donna Hasbrouck presented to Microprocessor Technology (MT) staff, while J.C. Cornet (VP of MT) and Joseph Krauskoph (Director of Test) [were] present, as how to hire foreign students.

Ms. Hasbrouck told the MT group “after hiring the foreign student, delay the immigration paper work process, because when they get their green card we lose them to companies like Sun Microsystems and Silicon Graphics, they pay them about 30% more.”

9.4 A Bogus Threat

Industry lobbyists have threatened that if the yearly cap on H-1B work visas is not raised, employers will ship software work to foreign countries, where the labor is even cheaper. Yet such extortionary language is not backed by action, and in fact will not be in the future either. While it is true that some companies are experimenting with having work done abroad, this will not escalate to become the major mode of operation of the industry. The misunderstandings caused by long-distance communication, the problems of highly-disparate time zones and so on result in major headaches, unmet deadlines and a general loss of productivity. See the author’s analysis at

<http://heather.cs.ucdavis.edu/pub/Immigration/ImmigAndComputerIndustry/SVReport.html>

for extensive details on this point, including many quotes from industry figures.

For example Bill Gates says (*San Jose Mercury News*, March 9, 1997):

For a company like Microsoft, it’s worth a real premium for us to have very strong collaboration. We have found projects that make sense to do other places, in Israel, in Tokyo for example. But it makes sense for the bulk of our operations to be in one location and for the foreseeable future we’re going to stick with that. We will spend what is necessary to have most of our development groups at our headquarters and have them meeting face-to-face every day. We want to make sure there is a place where customers can come in and talk to us in person and make sure the products fit together in the right way.

These problems are so severe that Northwest Airlines, which had experimented with offshore software development, decided to move operations back to the U.S., according to a November 1, 1999 report in *CIO Magazine*. NWA’s vice president for information services, said “It can be difficult to work through language barriers and time-zone differences.”

Symmetrix CEO Paul Hiller is engaged in a joint venture with a company in India. He said that the problems of long-distance communication had really impeded progress on the project. He added, “You really need to be able to talk [about the project] face to face.” (Interview with the author, July 20, 1995.)

This point is made quite forcefully in UC Berkeley Professor AnnaLee Saxenian's study of the computer industry, *Regional Advantage* (Harvard University Press, 1994, pp.156ff). For example, she quotes Tom Furlong, former manager of Digital Equipment Corporation's workstation group in Palo Alto as saying, "Physical proximity is important to just about everything we do...The level of communication is much higher when you can see each other regularly. You never work on the same level if you do it by telephone and airplane...An engineering team simply cannot work with another engineering team that is three thousand miles away, unless the task is incredibly explicit and well defined—which they rarely are."

Just look at Silicon Valley. This is the most "wired" place in the world, yet those massive Silicon Valley freeway traffic jams arise because very few programmers telecommute. They know that face-to-face interaction is crucial to the success of a software project.

In the May 29, 1998 issue of the *Raleigh News and Observer*, an article describes Rila Software, a firm in Bulgaria hoping to do software subcontracting work for American companies. Again it shows why this will not become a major mode of operation:

Still, Triangle companies involved in Year 2000 solutions say that hiring Eastern Europeans is not a panacea to any labor shortage. Mike Pileggi, a manager who helps distribute Sapiens International N.V.'s Year 2000 correction product, said foreign software shops are not always as quality-driven as domestic ones. And it can be harder to supervise their work. Sapiens uses a group of 30 to 40 programmers in Russia, but it took significant time and investment to give them the adequate training. "They have some very key core skills [in Eastern Bloc countries]," Pileggi said. "But even at the discounted rates, it can end up costing you more in the end."

A CNN television report on February 7, 2000 reported:

[Internet entrepreneur Joe Kraus] knows why Internet services, which by their nature can operate anywhere in the world, still cluster in Silicon Valley.

"It is ironic that the Internet is a global phenomenon—yet if you're not in Silicon Valley, it's really hard to get a sense of the pace and the connections between those companies. So many of the ideas get transferred in hallway conversations, meetings over lunch and the casual interactions of the companies that are proximate," said Kraus.

There's a lot of idea-sharing across the backyard fence and at other social gatherings in the valley. The ambiance alone, he said, helps drive the industry.

"I think it's very difficult to be a successful Internet company that isn't based in Silicon Valley," said Kraus.

In an October 9, 1995 *Wall Street Journal* article, William Schroeder, chief executive officer at Diamond Multimedia Systems says "There is a 'natural limit' to how many skilled jobs can be moved abroad because of the costs of communication and other factors."

9.5 Most H-1Bs Are Ordinary Workers, NOT the "Best and the Brightest"

It is my opinion that in the case of foreign nationals of extraordinary talent, our immigration law should indeed facilitate the ability of employers to hire such workers. I personally have helped a number of extremely bright foreign students, mainly Chinese and Indians, find jobs with Silicon Valley employers, and

have strongly supported making offers to many outstanding foreign applicants for faculty positions in our Computer Science Department at UC Davis. However, **workers of extraordinary talent comprise only a small fraction of the overall population of H-1Bs and employer-sponsored green cards.**

The industry lobbyists say that the H-1Bs are needed to retain the industry's technological edge, but the fact is that the vast majority of technological advances in the computer field have been made by U.S. natives. This can be seen in rough form, for example, in the fact that (as of 1996) of the 56 awards given for industrial innovation by the Association for Computing Machinery, only one recipient has been an immigrant. Of 115 U.S. recipients of computer-related awards given by the Institute of Electrical and Electronic Engineers, only nine of the recipients have been immigrants.

Yet quite contrary to industry's claim that the H-1Bs are "the best and the brightest," in an article in the September 1999 issue of the American Society for Engineering Education's magazine *Prism*, an engineering professor in China warns his nation that the engineers being produced by Chinese universities are not good enough for China to compete in the global high-tech market. The U.S. industry also claims that the imported professionals are better trained than the Americans. Yet again to the contrary, Professor Chen Lixun complains in the article about China's "obsolete teaching content and materials. Professor Chen says the educational system in China produces students who cannot think independently or creatively, and cannot solve practical problems. He writes that the system "results in the phenomenon of high scores and low ability." Many other academics have written about this problem, and the governments of China, Japan and South Korea all have made attempts to remedy it.

Dept. of Labor official Raymond Uhalde testified to the U.S. Senate in February 1998 (see also House Report 657 on the bill HR 3736, 1998, <http://rs9.loc.gov/cgi-bin/cpquery/z?cp105:hr657:>) that **79% the H-1Bs make salaries under \$50,000, hardly what "geniuses" are paid in this field, where a top programmer can earn a salary approaching or even exceeding \$100,000.** (See similar figures, more occupation-specific, in *Characteristics of Specialty Occupation Workers (H-1B)*, U.S. Immigration and Naturalization Service, February 2000.)

Mary Dumont, a Palo Alto attorney representing Californians for Population Stabilization in a lawsuit against Hewlett-Packard's hiring of Indian engineers via the Tata Corporation. Dumont describes the judge's questioning of a Hewlett-Packard representative. When the judge asked about the quality of the imported Indian workers relative to American students (citizens and permanent residents) from, say, the nearby University of California at Berkeley, the Hewlett-Packard executive conceded that the UC graduates were better.

Recall that Sun Microsystems, which claims to scour the globe for "the best and the brightest," seems to be also interested in the cheapest; it boasted to the *Los Angeles Times* that it had employed programmers in Russia "at bargain prices."

Though not specifically addressing H-1Bs, computer science professor Dr. Howard Rubin of Hunter College has claimed that programmers in India are more productive than American ones. (*Computerworld*, April 15, 1999.) Rubin is a prominent ITAA ally who is a consultant paid by the industry. His analysis is questionable in many different ways—any manager at Microsoft would be outraged by Rubin's counterproductive suggestion that the manager work to maximize the numbers of lines of code written per day—but what is more interesting is what Rubin omitted from the information he gave *Computerworld*: In his analyses he also found that software written by U.S. programmers has the lowest defect rate in the world. (Rubin newsletter, distributed at the Stanford Computer Industry Project conference, February 19, 1997.)

9.6 The Vast Majority of H-1Bs Are NOT PhD Graduates of U.S. Universities

Industry lobbyists have often told the press that most of the H-1Bs are foreign students newly graduated from U.S. university PhD programs. This is completely false. Although as discussed in the section on education earlier in this paper, it is true that 40% of U.S. computer science Ph.D.'s are awarded to foreign students, **computer science foreign students comprise only a small proportion of the H-1B population.** To illustrate this, we will use *Characteristics of Specialty Occupation Workers (H-1B)*, U.S. Immigration and Naturalization Service, February 2000, which will be referred to here as *CSOW*.

According to *CSOW*, only 7.6% of the H-1Bs have a PhD. That figure is already small, but in fact for computer-related H-1Bs the figure is even smaller, since the 7.6% statistic includes postdoctoral researchers in university biology programs, and so on. Here is how the true figure for the computer field can be determined:⁴³

CSOW reports that 56.7% of the H-1Bs are in computer-related occupations. At current levels (Spring 2000), this translates to approximately 60,000 computer-related H-1Bs. Yet only about 344 foreign students in U.S. (and Canadian) universities were awarded PhDs in computer science and computer engineering in 1999. (See *Computing Research News (CRN)*, March 2000.) That works out to be a figure of only 0.6%.

In other words, fewer than 1% of the computer-related H-1Bs have PhDs from U.S. universities.

If one then turns attention to Master's graduates, the above analysis cannot directly be extended to them, since the *CRN* data are only for PhD-granting universities. However, *Educational Statistics Quarterly*, Spring 2000, reports that in 1997 there were 10,098 Master's degrees in computer science awarded in the U.S., and if we take *CRN*'s figure showing that 45% of Master's degrees are awarded to foreign students, that would be about 4,500.

In other words, only about 7.5% of the computer-related H-1Bs have Master's degrees from U.S. schools.

Even the congressional sponsors of a 1999-2000 bill to exempt foreign graduates of U.S. schools from H-1B quotas estimated that only a small proportion of H-1Bs would be affected. (CNet News, October 1, 1999, http://abcnews.go.com/sections/tech/CNET/cnet_gradtech991001.html) It should be noted, though, that if such a law were to be enacted, it likely would create its own demand. Employers, seeing "free" H-1B visas, may wish to hire non-computer science majors for programming jobs at low salaries, e.g. hiring a mathematics graduate who has taken some programming courses but paying him/her a math-graduate salary, which would be much lower than a CS-graduate salary.

9.7 H-1B Fraud

Far from being the top-quality programmers claimed by the industry, many of the H-1Bs do not even have the qualifications claimed for them by their employer sponsors. *Computerworld*, May 10, 1999, reported:

Officials from the U.S. Immigration and Naturalization Service and other agencies last week called for tighter controls over issuing H-1B visas after testifying before a House subcommittee meeting about growing abuses.

William Yates, acting deputy commissioner at the INS, told the subcommittee that 21% of more than 3,200 H-1B visa applications that were filed during the past year through the American

⁴³This excludes electrical engineering, but our available data on foreign students is only for computer science, and electrical engineers comprise only 4.9% of the H-1Bs anyway.

consulate in Chennai, India, and audited were found to be fraudulent. The INS began working with the consulate last year to detect H-1B visa fraud. The consulate processed 20,000 H-1B applications last year, mostly for computer programmers.

More detail was given in the *Baltimore Sun*, February 21, 2000:

[Upon arriving in the U.S., an H-1B programmer] learned that his resume, the one officially submitted to U.S. officials as part of his visa application, listed training in several areas that he never had received.

“I saw this resume only after coming to the United States. When I saw it I was shocked for a minute, as it contained stuff that I never worked on. I was told not to worry about it,” he said, “as it was done ‘to get me here.’ ”

...

In another Mastech lawsuit, a former [H-1B] employee said company officials “tailored and tampered” with his resume to get him an assignment at an accounting firm. Srinath Nagabhirava said he was placed in “a totally new environment in which I haven’t had any skills or experience.”

9.8 Immigrant High-Tech Entrepreneurship

A 1999 study by UC Berkeley professor AnnaLee Saxenian, *Silicon Valley’s New Immigrant Entrepreneurs*, detailed entrepreneurship by Asian immigrants in Silicon Valley.⁴⁴ The study has been cited by industry lobbyists as “showing” that rather than displacing U.S. citizens and permanent residents from jobs, the high-tech immigrants are creating jobs. Yet the fact is that the study’s own findings show this to be false.

Saxenian’s data show that *the rate of immigrant entrepreneurship is no higher than, and in fact is likely less than, the immigrant proportion of the workforce*. In other words, **the immigrants are creating fewer jobs than would be created if natives were in the positions in the workforce held by the immigrants, a net job loss**. Saxenian finds that the Asian immigrants comprised 21% of the technical workforce in 1990, but comprised only 19% of the new business during 1985-1989. In the late 1990s, Valley sources estimate that the Asian-immigrant proportion of the workforce exceeded 50%,⁴⁵ while their proportion of new business was lagging behind at 29%, according to Saxenian’s data.

Moreover, the situation is even worse when one notes that the immigrant entrepreneurs—and for that matter, immigrant managers in nonimmigrant-founded firms—tend to hire from their own immigrant ethnic groups.⁴⁶ Those jobs are largely not open to natives. This is discussed in the following subsection.

Lastly, it must be pointed out that these firms may not employ many programmers and engineers anyway. For instance, according to Saxenian, 36% of the Chinese-owned firms are in the business of “Computer Wholesaling,” meaning that they are simply assemblers of commodity PCs, with no engineering or programming work being done.

⁴⁴See www.ppic.org The study was funded by the Public Policy Institute of California. It is suspected but not yet verified that the computer industry originally proposed this project and donated money to PPIC. As noted earlier, the industry has stated before that one of its tactics is to “commission academic studies to support its position.”

⁴⁵Saxenian herself states that the proportion had grown quite a lot by that time, though she does not have data for this yet.

⁴⁶This fact is also alluded to by Saxenian herself.

9.9 H-1B Hiring by Fellow Immigrant Ethnic

One major factor underlying the large demand for H-1Bs is that, as noted by UC Berkeley professor AnnaLee Saxenian in her paper *Silicon Valley's New Immigrant Entrepreneurs*, immigrant entrepreneurs, as well as immigrant managers in nonimmigrant-founded firms, tend to hire from their own immigrant ethnic groups.

Pauline Lo Alker, herself a Chinese immigrant and Silicon Valley CEO, notes that “There is a high tendency to surround themselves with people they are comfortable with.” (*New York Times*, January 14, 1992.)

The Chinese Software Professionals Organization now even holds its own job fair, separate from the large “mainstream” job fairs such as Westech.

Melanie Erasmus points out that “at Cadence Design Systems, a software company, foreign-born Chinese-American engineers may represent as many as 80 percent of the technical staff.” (“Immigrant Entrepreneurs in the High-Tech Industry,” in *Reframing the Immigration Debate*, published by Leadership Education for Asian Pacifics, 1996, p.180.)

On July 19, 1995 I interviewed Isaiah Choo, manager of the El Cerrito Computer Company (San Francisco Bay Area), whose classified ad for a software engineer I had seen in the July 15 edition of the Chinese-language *Sing Tao Daily*. When I asked in which newspapers Choo had placed an ad, he replied that the only other paper was also Chinese-language, the *World Journal*. He admitted, “Yes, we are looking for a Chinese programmer...No, it is not because of language. We don't care what language the programmer speaks as long as they get along. Well, I'm just following the instructions of the Taiwanese owner.”

On August 22, 1995, Xin Ye of New Era Technologies posted a programming job advertisement in soc.culture.china, a newsgroup on the Internet read by many students from or in China. But the ad was not posted to the newsgroup read by the general public for job postings, misc.jobs.offered (most of whose job listings are for positions as programmers); apparently Xin Ye too wanted to hire only a “Chinese programmer.”

But even more importantly, Xin Ye's ad shows that the company especially targets foreign nationals who are seeking an employer to sponsor them for immigration: “If you have just graduated from school but think you can be a quick learner or have significant coding experience in school, we would be glad to consider your experience. We hope you have [a] temporary working visa (practical training, H-1B temporary visa) so you can start with [the] project. We'll take care of the visa issue after a short period of service.”

The April 16, 1999 edition of the *San Jose Mercury News* ran an in-depth analysis of the situation, in an article titled, “Divisions: Segregation Trends Emerge in High-Tech Industry, Experts Say.” Though the analysis was broader than just the area of engineering and programming, the article noted that

...even among engineering professionals, subtle ethnic division is part of the valley's culture.

A half-dozen university researchers studying the valley's workplaces say the segregation patterns are disturbing.

“You're seeing more and more firms that are homogenous ethnically, from the entrepreneur all the way down to the production worker,” said Edward Park, a University of Southern California sociologist who has visited dozens of Silicon Valley firms over the past decade.

9.10 Highly Deceptive Proposals Involving a Master's Degree or a \$60,000 Compensation Floor

In 1999 Senator Phil Gramm and Representative Zoe Lofgren introduced bills which would allow an unlimited number of foreign high-tech workers to be brought to the U.S. Though they differ in some details, after negotiations the likely conditions set for this new category would be that the worker have a Master's degree or equivalent, or be offered compensation of \$60,000 or more.

(Gramm's bill actually stipulates that both the degree condition AND the salary condition must hold. However, during negotiations on these bills, employers in low cost-of-living regions will likely demand that the provision "Master's degree AND \$60,000" be changed to "Master's degree OR \$60,000." They would argue such a change is needed because the \$60,000 cutoff is unreasonably high relative to salaries in their regions. They would also point out a precedent, in that the condition "Master's degree OR \$60,000" appears in the definition of "H-1B dependency" in the 1998 law.)

Though the authors of these bills try to justify the establishment of this special category by claiming that workers who satisfy these conditions are of outstanding talent—Lofgren calls them "geniuses"—the fact is that the conditions are essentially meaningless.

Here is why these conditions seeming to guarantee high quality are actually a sham:

- The \$60,000 level is nowhere near genius-level salaries for this profession, which approach and often exceed \$100,000. On the contrary, the proposed \$60,000 threshold actually matches the median salary nationwide in 1998 for professional staff in information technology (IT), according to the annual Datamasters survey. And this median includes all education levels; the figure for those with a Master's degree would be significantly higher.
- As pointed out earlier, in terms of specific technological skills acquired, a postgraduate degree is not needed in order to do work in the computer industry. Though research experience gained at a top university has some "cultural" value, for most students at most schools a Master's degree does add much value to a worker's productivity. Microsoft founder Bill Gates does not even have a Bachelor's degree, let alone a Master's. The same is true for Oracle founder Larry Ellison, Apple/Pixar founder Steve Jobs, and countless others. (I was a software developer in industry, and later became a computer science professor conducting research and teaching in the field, and yet have no formal training in computer science at all.)
- One certainly need not be a "genius" to earn a Master's degree. On the contrary, most holders of Bachelor's degrees in computer science would qualify for hundreds of Master's programs nationwide, if they were interested in advanced study. Therefore, a Master's degree does not signify special talent.
- Salaries in the high-tech professions have been rising at a rate of nearly 10% per year. Yet these legislators have not included any provision in their bills to adjust the \$60,000 threshold as nationwide salaries rise. The \$60,000 level would be the equivalent of less than \$50,000 within two years, and would continue to erode after that.
- Employers in regions with high costs of living would have especially high potential to exploit the foreign workers. Assuming that Lofgren's bill is indeed changed to conform to Gramm's, the proposed legislation would be of huge benefit to employers in Lofgren's Silicon Valley district, which has an astronomical cost of living. It is so expensive to live there that a four-person family there actually qualifies as low-income for the purposes of federal housing assistance if its income is as much as

\$53,100⁴⁷—not far below the \$60,000 threshold Lofgren describes as “genius” pay. Lofgren herself has stated that the mean high-tech salary in Silicon Valley is in the mid-\$80,000 range, and her own press secretary blurted out that \$60,000 is considered just “peanuts” wages in that region.⁴⁸

- Gramm and Lofgren define their \$60,000 level not just in terms of salary, but also including “cash bonuses and similar compensation,” and Lofgren’s includes “stock options, bonuses and other similar compensation.” Capers Jones, a well-known analyst of software development economics, estimates that nonsalary compensation is on the order of 30% of base salary.⁴⁹ Thus the \$60,000 level corresponds to a salary of only about \$46,000.

And how is total compensation for a foreign worker to be calculated under these bills? The values of bonuses and stock options are unpredictable. Bonuses may or may not materialize, and stock options could end up worthless. Thus employers would have to be allowed to merely estimate the values of such compensation. Given the industry’s abysmal track record—an audit by the Department of Labor found that a fifth of H-1B employers were not even paying the salaries they had promised in their applications for the visa⁵⁰—we can be sure that many employers would make greatly exaggerated “estimates” for such nonsalary compensation, in order to meet the magic number of \$60,000.

- The language in Gramm’s legislation is actually “Master’s degree *or its equivalent*,” not just “Master’s degree.” (Again, such language has a precedent in the H-1B dependency section of the 1998 law.) An employer could state that two years of work experience are equivalent to a Master’s.

So, quite contrary to the legislators’ claim that the special, unlimited-numbers categories they propose will apply only to those workers who are of especially high quality, the practical effect could be merely that the worker have at least two years of experience.

10 Employers Are Shooting Themselves in the Foot with Their Hiring Policies

10.1 The Employers Are Harming Their Own Firms’ Profitability

The fact is that the industry lobbyists are not doing right even by their industry constituents, because under current hiring policies the employers are shooting themselves in the foot:

- **Employers are shooting themselves in the foot by driving up salaries in certain narrow segments of the market.**

Employer obsession with specific software skills is resulting in sharp increases in salaries within the very narrow segments of the software labor market corresponding to those highly-specific skills. (Again, programmers outside of those narrow segments are not experiencing sharp increases in wages.)

It is simply not cost effective to pay someone \$10,000-15,000 more in salary simply because he/she knows Java, given that any competent programmer can learn Java and be productive in it within a couple of weeks.

⁴⁷ *San Jose Mercury News*, August 15, 1999

⁴⁸ *Red Herring* magazine online, August 9, 1999

⁴⁹ *Software Workers for the New Millennium*, National Software Alliance, Arlington, VA, January 1998.

⁵⁰ *The Department of Labor’s Foreign Labor Certification Programs: The System is Broken and Needs to be Fixed*, Final Report No. 06-96-002-03-321, Joseph Fisch, Assistant Inspector General for Audit.

A March 16, 1998 article in *US News and World Report* reported that

[Recruiter] Susan Miller, notes that while pay scales for programmers with hot skills have reached “insane heights,” much of the money is spent “stealing people” from other companies. “Everybody wants the same person,” Miller says. “This is one of the problems in Silicon Valley that’s making me rich, as a matter of fact.”

- **Employers are shooting themselves in the foot by causing crippling high turnover rates.**

The fact that the industry pays a premium for certain skills is resulting in frequent job-hopping by programmers who are out to maximize their salaries. Employers say they place high value in finishing projects under deadline. Yet if a programmer who knows a project inside out suddenly leaves the employer in the lurch by jumping to another company, clearly this has a sharply adverse effect on the first employer’s ability to complete the project on time. In fact, Jim Finkelstein of Arthur Andersen consulting has calculated that each time a worker leaves a firm, the overall cost to the firm is a staggering \$150,000. (*San Jose Business Journal* Power Breakfast, June 24, 1999.)

So here too, employers are shooting themselves in the foot under their current policies.

- **Employers are shooting themselves in the foot by often failing to hire the most talented workers.**

By using unimportant skills as their re’sume’-screening criteria, employers are not using the criterion which far outweighs any other: General programming talent. The best way to ensure success of a software project—finishing under a short deadline, minimizing the number of program bugs, maximizing innovation and so on—is to hire talented programmers, not people with specific software skills.

A good account of this is given, for example, in *Peopeware: Productive Projects and Teams*, by Tom DeMarco and Timothy Lister (Dorset House Publishing Co., 1987, pp.44ff). These studies show a dramatic 10-to-1 variation in programmer productivity, by virtually any criterion—time to finish a product, number of errors, and so on. In other words, the best programmers work 10 times faster, produce 10 times fewer errors, and so on, than the worst ones. One oft-cited study even found a 20-to-1 ratio. In other words, raw analytical talent, not paper credentials, is what really counts.

So again employers are shooting themselves in the foot under their current policies, missing many of the smartest people.

- **Employers are shooting themselves in the foot by unnecessarily leaving jobs open far too long.**

Employers, by unnecessarily overspecifying job requirements, are leaving many jobs open for several months (recall that 30% of the position are open for more than six months)—absolute dead time in terms of productivity, and thus a major loss to the firm.

As pointed out in a *Dallas Morning News* article (June 2, 1999),

“A lot of employers don’t consider the opportunity cost of holding a position vacant,” said Ed Rankin, president of People Solutions, a Las Colinas human resource firm.

Recall the similar comment made by recruiter Andrew Gaynor (*US News and World Report*, March 16, 1998, shown more fully here than in our earlier citation):

This [obsession with skill matches] leads some hiring managers to let vacancies go unfilled for months, says Andrew Gaynor, a headhunter based in Redwood City, Calif., rather than consider an applicant who, with a little training, “could easily come up to speed in a few weeks.”

The fact is that although employers shun the older programmers in favor of new college graduates and foreign nationals in an attempt to reduce personnel costs, **if the employers were to utilize a more broad-based hiring policy, then their overall costs (not to mention headaches) would actually decrease.**

Perhaps worst of all, university students are beginning to be aware of the age discrimination problem, and though as shown earlier in this report, computer science enrollment trends are currently on the upswing (more details below), in the future this may deter many of them from pursuing computer science majors. An article in the January 13, 1998 edition of the *New York Times* says that

[current Stanford computer science student Graham Miller] is already thinking about an exit strategy [from the computer field]. “Programmers only last up to 10 years or so,” Miller said. “After that, you need to find something else to do.”

Once word gets around among the students about the short-lived careers in this field, employers may well find in the coming years that their current hiring policies deter students from majoring in computer science. If at the same time, the world supply of H-1Bs decreases due to development of software industries abroad (as predicted by the Stanford Computer Industry Project), U.S. employers will indeed have shot themselves in the foot.

10.2 “But Don’t the Employers Know Best?”

Such is the mystique enjoyed by the high-tech industry in this country that many people have difficulty understanding how employers in the field could have policies which are actually harmful to their firms’ profitability. Yet, a closer look shows that they are not very good in handling employment matters after all.

Studies have shown, for example, that programmers who are twice as productive are paid only 10% more. (*Peopeware: Productive Projects and Teams*, by Tom DeMarco and Timothy Lister (Dorset House Publishing Co., 1987).

And 1997 Rep. Lamar Smith uncovered significant degrees of fraud in the H-1B program, with large numbers of H-1B programmers having been found to lack the credentials claimed for them in the H-1B applications. Yet apparently the employers could never tell the difference; the employers never noticed that the H-1Bs did not have competence in the areas they were supposed to have.

And the industry is far from the perfect competitive market taught in economics course. The best products in this industry do not necessarily rise to the top. Intel’s processor chip was once called “brain-damaged” by Bill Gates, and IBM’s engineers had favored using other chips in the PC, yet Intel of course has been the market leader. The same is true for labor—the best workers do not necessarily rise to the top, because the employers are not good at identifying them.

11 What Should Be Done

<p>Technology will continue to change rapidly in the coming years. Therefore unless employers abandon their current obsession with specific software skills, the perceived/claimed labor “shortage” will be permanent.</p>

Here is what should be done:

11.1 Legislative

Unless Congress finally is able to resist the huge pressure imposed on it by the industry lobby, the H-1B program will continue to grow indefinitely, until all new programming jobs go to H-1Bs. Strong action should be taken.

The solution which I believe would be best for society, the economy and the industry itself would be:

- The yearly quota for the H-1B program should be drastically reduced, say to 15,000 per year. It should be geared mainly to hiring “the best and the brightest,” as was the case for the original H-1 program which preceded H-1B. Standards should be high, similar in stringency to those currently in place for the EB-1 National Interest Waiver green card program, which provides those of truly outstanding talents a fast track to permanent residency which does not depend on sponsorship by an employer. Thus for example, the mere possession of a graduate degree or publication of jointly-authored research papers would not be treated as sufficient evidence of outstanding talent.

Failing that ideal solution, I recommend the following:

- Employers who wish to hire an H-1B worker should be required to demonstrate that they made good-faith efforts to find a U.S. citizen or permanent resident to fill the position. Most importantly, they should not be allowed to require overly specific skills in their review of citizen/permanent resident applicants.

To this end, the legislative language used would be along the lines of the following:

An employer who petitions to hire an alien under the H-1B visa must specify a job category from the list used by the Bureau of Labor Statistics, such as Computer Programmer. The employer must state the number of applicants who were available for the position in question who have substantial experience or qualifications in that general job category, and among these, the number interviewed and the number offered the position. The petition will be granted if these data indicate that the employer has not failed to hire U.S. citizen/permanent resident applicants with general competence (not competence in a particular skill within that category) in the given job category. The data regarding numbers of applicants, interviews and offers, as well as listings of the salaries, degrees and years of experience for each H-1B hired, must be made readily available to the public on the World Wide Web, with individual files subject to Department of Labor audit for firms hiring more than 15 H-1B workers per year.

- Remove programmers and engineers from the Exempt category regarding overtime. In other words, programmers and engineers should be paid for overtime work. This provision is important because a major reason employers find younger and/or foreign workers attractive is the perception that they are willing to work large amounts of unpaid overtime.
- The government should NOT set up retraining programs for programmers to learn new software skills. These are unnecessary and wasteful of taxpayer money, since a programmer can learn quickly on the job.

11.2 Employers

As shown in Section 10, it is in employers' best interests to re-examine their hiring policies.

- Hire on the basis of general programming talent, not specific skills. As shown above, the employers are shooting themselves in the foot with their current obsession with skills.
- Do not shunt competent programmers (old or young) into positions like customer support or software testing. Those jobs can be done just as well, maybe better, by people with other backgrounds.
- Place far less emphasis on grades and prestige of institution when hiring new college graduates to fill programming positions. Grades are affected by too many factors unrelated to the programming talent, such as the need for some students to work part-time (in many cases even full-time) while in school. And though there is some correlation between prestige of institution and a student's potential as a worker, that correlation is far from perfect, and every school has a number of students who would make fine programmers.
- Greatly expand college internship programs. Observing a student "in action" is a far better way to assess his/her potential as a permanent worker than is scrutiny of his/her grades. Furthermore, the internships should involve at least some "real" programming work, not just something like software testing.

Here is what universities should do:

- Strive toward making sure that every student works in at least one internship during his/her college career.
- Monitor the "outcomes" of the undergraduate curricula. Strive to determine the job status for every graduate three months after graduation—not only whether they are employed, but also what kind of work they are doing.
- On the one hand, continue to make sure curricula include "practical components," including both extensive programming assignments but also assignments which develop *practical* insight into computer infrastructures (computer architecture, operating systems, networks).
- On the other hand, resist the pressure from industry to offer courses in all possible software technologies (Visual BASIC, MFC, SAP, Oracle, etc., etc.). There are literally hundreds of these, and what satisfies one employer would be unacceptable to another, and it would be impossible to teach them all.
- Return research to its tradition role of scholarship, rather than its current role as a university "revenue enhancer." Scale back graduate programs to levels needed by industry and society.

12 Author's Background and Further Reading

Dr. Norman Matloff is a professor of computer science at UC Davis, and was formerly a statistics professor at that institution. He is also a former software developer in Silicon Valley. For his bio, see

<http://heather.cs.ucdavis.edu/pub/MyBio.html>

This document will be frequently updated; see

<http://heather.cs.ucdavis.edu/itaa.html>

A wealth of further information is available via Web links at

<http://heather.cs.ucdavis.edu/itaa.others.html>