

# Debunking the Myth of a Desperate Software Labor Shortage

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# 1 Overview and Executive Summary

“Vaporware.” That is the term used in the software industry when a firm announces a new product which actually does not exist. Extending the term a bit, one can say that the industry’s latest vaporware is the claim of a desperate software labor shortage. The fact is that there is no such shortage.

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, claiming desperate labor shortages in the information-technology field. Frantic employers complain that they cannot fill many open positions for computer programmers.

Note on terminology: I use the term *programmer* to include software developers having various job titles, including software engineers, system analysts and so on. Similarly I use the word *industry* to mean all employers of software developers, not just those in the high-tech field. Also, the reason for restricting attention to computer software is that that is where the jobs are; computer specialists outnumber electrical engineers among the foreign nationals hired under the H-1B work visa program by almost 15-to-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. Call any employer, and they will 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 blatant contradiction here. If employers were that desperate, they would certainly not be hiring just a minuscule fraction of their job applicants.

A summary of the situation is as follows:

- There is no desperate software labor shortage. Employers only hire about 2% of their software applicants.<sup>1</sup> If employers were so desperate, they could not afford to be so picky. Average wage increases for programmers have been mild (7% in 1997), and again contradict the claims of huge shortages. If employers were desperate, they would be willing to pay wage premiums much higher than 7%.
- The allegedly “desperate” employers are actually willing to hire only from three subgroups of the programmer labor pool:
  - New or recent college graduates, who are cheaper in salary than established programmers, cost less in terms of benefits because they are typically single, and whose single status facilitates working large amounts of unpaid overtime.
  - Foreign nationals on work visas, who often work for lower pay.
  - Those few mid-career programmers who are fortunate enough to have work experience in a currently-“hot” programming language.
- Age discrimination is rampant in the industry:
  - There is a reported 17% unemployment rate for programmers over age 50, in spite of employer claims to be “desperate” to hire. And this actually understates the problem, since many programmers simply leave the field when they cannot find programming work, so that they do not show up in unemployment statistics.

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<sup>1</sup>Sources for all statistics cited in this Executive Summary are available in the body of this paper.

As a stroll around any high-tech company will show you, most people who work in this field are young. Among graduates of college computer science programs, only 19% are still in the field 20 years after completing their studies, compared to 52% for civil engineering majors.

- Many industry officials have admitted they have shifted their hiring focus to new college graduates. Intel has such an interest in this group that its recruiting literature is riddled with the acronyms NCG and RCG, “new college graduate” and “recent college graduate,” respectively.
  - An official statement by Sun Microsystems, one of the major industry voices claiming a desperate labor shortage, classifies anyone with six years of experience—typically only of age 28—as the “Senior” level. This is common in the field. Cypress Semiconductor even advertised one “Senior” position for engineers with only three years of experience.
  - Intel has been a defendant in several age discrimination lawsuits, and reportedly sets policy on the basis of advice a management consultancy gave the firm to weed out the older workers.
  - Employers cite outdated technical skills as their reason for shunning older programmers. For many firms this is just a pretext for avoiding the older, more expensive workers. Moreover, even in the case of employers who sincerely believe that they must hire only programmers with a given software skill, this is an unreasonable practice akin to what would happen if Chevy dealers refused to hire seasoned mechanics with experience on Fords.
- Our educational system is producing sufficiently many graduates trained in computer science:
    - Contrary to industry claims that American students do not have the interest or qualifications to study computer science, university enrollment in computer science curricula exploded by 40% nationwide in 1996-1997, and then by another 39% in the 1997-1998 academic year. (Note: These students are Americans, not foreign students; foreign students comprise only 6% of undergraduate computer science majors nationwide.)
    - One does not need a college degree in computer science to be a programmer. Traditionally only about 25% of computer programmers have had such degrees. This is the same proportion we see today; it has not declined. And on the postgraduate level, we are actually overproducing Ph.D.’s in science and engineering.
    - In spite of the industry’s focus on hiring new college graduates, even there the industry is not casting its hiring net widely. For example, only a handful of the thousands of San Francisco Bay Area high-tech firms recruit at San Francisco State University, right in Silicon Valley’s backyard; Intel, for all of its emphasis on “NCGs” (see above), does not recruit there. Cypress Semiconductor, whose CEO TJ Rodgers has been most vocal in claiming labor shortages, admits that it only recruits engineers at 26 colleges in the nation, out of the 320 accredited engineering schools in the U.S. Even the ITAA has conceded that employers do not recruit at very many colleges.
  - By demanding that Congress increase the yearly quota for the H-1B work visa for importing foreign-national programmers, the computer industry is asking for an expansion of a program that is already overused and badly abused:<sup>2</sup>

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<sup>2</sup>It should be noted that this is not an issue of xenophobia. 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 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].” In my own case, I am married to a Chinese immigrant, am fluent in Chinese, and have been active in the Chinese immigrant community for more than 20 years, hardly the activities of a xenophobe.

- 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%.
- Employer hiring of foreign nationals, rather than being based on “need,” is often motivated by the fact that those workers will often take lower salaries. A number of independent academic studies, including one by a prominent immigration attorney, have shown that the H-1B workers are paid lower salaries, ranging from 15 to 30%.
- An audit by the Inspector General of the Department of Labor found rampant abuse in the program. It noted that applications for H-1B visas by U.S. employers are merely “rubber stamped,” and found that in 19% of the cases employers were not even paying the salaries they had promised in their applications, which as mentioned above are often low to begin with.
- Though I highly support facilitating the immigration of professionals who are of exceptional talents, the vast majority of H-1Bs are not in that category at all. A Hewlett-Packard executive admitted under oath in a lawsuit that his H-1B workers were not as good as his regular employees. Only a small fraction of H-1Bs have graduate degrees (and again, most of those who do have such degrees are not in the “outstanding” category). 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.”
- Though industry lobbyists dismiss the H-1B workers as comprising only a small fraction of their workforces, this is highly misleading, as it does not count the workers who first began work in the U.S. under the H-1B program but then were sponsored by the employers for permanent residence. About 35% of Silicon Valley programmers and engineers are foreign born, and most were originally hired via the H-1B program.

Moreover, the problems of age discrimination in the industry stem directly from the presence of the H-1B workers. Without the pool of foreign labor to draw upon, employers would be forced to pay more attention to the older workers.

Many critics believed in 1997 that access to cheap labor—both in the form of foreign nationals and new college graduates—was the “hidden agenda” behind ITAA’s campaign at the time to develop an image of a software labor shortage in the public consciousness. Though ITAA’s Harris Miller originally denied this in the case of foreign nationals (*Electrical Engineering Times*, December 8, 1997), the ITAA stated 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 of course 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. As stated above, that enrollment does in fact respond to market demands, 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.

Ironically, the worst victims of current hiring policies are the employers themselves. This is detailed in a later section.

## **2 There Is No Desperate Shortage of Computer Programmers**

There are a number of open positions,<sup>3</sup> but employers are not willing to fill them with most programmers who apply for them, as can be seen from the extremely low percentages of applicants whom they actually

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<sup>3</sup>Just how many openings exist is a subject of controversy. This will be discussed later.

hire, such as:<sup>4</sup>

American Management Systems	2%
Broderbund Software	1%
Deltanet	4%
ECbridges	2%
Flashpoint Technology	2 to 5%
Inktomi	less than 5%
Microsoft	2%
Qualcomm	4.5%

**There is simply no room for argument here—these low hiring rates (and low offer rates; see below) flatly contradict the industry claims of a desperate labor shortage. On the contrary, the fact that employers can be so picky in their hiring demonstrates an oversupply of labor.** Indeed, when asked about the author’s citing of a low 2% hiring rate, Microsoft admitted that it is “very, very selective.”<sup>5</sup>

It also should be noted 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.

The situation is typified by the fussy John Otroba (*Washington Post*, November 30, 1997), 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 college graduates, who have cheaper salaries.
- Foreign nationals on work visas, who have cheaper salaries.
- 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 my own interviews, for instance, I was 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. The

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<sup>4</sup>Microsoft: Associated Press (*Tacoma News Tribune*), May 13, 1997; Deltanet: Patrick Schmidt, interview by the author, November 5, 1997; ECbridges: Raymond Lim, interview with the author, November 7, 1997; Flashpoint: Francine Beanan, interview with the author, October 31, 1997; Broderbund: Mary Bjornstad, interview with the author, October 31, 1997; American Management Systems: *Washington Post*, November 30, 1997; Inktomi: Amy Hanlon, interview with the author, February 26, 1998; Qualcomm: *San Diego Union Tribune*, March 7, 1998.

<sup>5</sup>*Boston Globe*, March 8, 1998.

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.

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, few 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.

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 typically performed a mini-interview with the applicant by telephone. Here are some typical offer rates:<sup>6</sup>

American Management Systems	under 25%
Broderbund	30%
City of San Jose (civil service)	10%
Deltanet	possibly as much as 40%
ECbridges	20%
Flashpoint Technology	25 to 30%
high-tech job fairs	as few as 6%
Inktomi	50%
Microsoft	25%
Quintet	under 5%

**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 we saw that its hiring rates are typical for the industry.**

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.

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). The methodology underlying these claims has been criticized by the General Accounting Office<sup>7</sup> and the Bureau of Labor Statistics. However, as Urban Institute/American University economist Robert Lerman pointed out in his testimony before the Senate Judiciary Committee on February 25, 1998,<sup>8</sup>

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<sup>6</sup>Microsoft: Microsoft recruiting head David Pritchard, ABC Nightline, January 1, 1998; Deltanet: Patrick Schmidt, interview with the author, February 26, 1998; Flashpoint: Francine Beanan, interview with the author, February 26, 1998; AMS and job fairs: *Washington Post*, November 30, 1997; Inktomi: Amy Hamlin, interview with the author, February 26, 1998; Quintet: Ali Moussi, interview with the author, February 26, 1998; Broderbund: Jennifer Ranghiasi, interview with the author, February 26, 1998; City of San Jose: Debi McIntyre, interview with the author, March 5, 1998; ECbridges: Raymond Lim, interview with the author, March 5, 1998.

<sup>7</sup>*Washington Post*, March 23, 1998.

<sup>8</sup>Dr. Lerman’s testimony is available at

**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.** Instead, Dr. Lerman points to wages, whose mild rate of increase does not indicate a massive labor shortage.

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.<sup>9</sup>

### 3 Rampant Age Discrimination—at Age 35

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

There are two underlying factors here:

- Older workers often lack the most up-to-date software skills.
- Employers like to hire new or recent college graduates, 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.<sup>10</sup>

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:

- FACE Intel, an employee activist group, discovered last year that Intel policy had been that 70% of its engineering hires would consist of new graduates.
- 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.”
- 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 literature.

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

<sup>9</sup>Interview with the author, March 5, 1998.

<sup>10</sup>The 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.

In a television debate between the author and Intel representative Coeta Chambers,<sup>11</sup> the author offered to give Intel a list of mid-career unemployed or underemployed software specialists who are seeking jobs. Intel declined the offer.

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,<sup>12</sup> 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:

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[ ] Entry Level (0 2 years )  
[ ] Intermediate (3 5 years )  
[ ] Senior (6+ years )
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In other words, if you are 28 years old, six years out of school, Sun classifies you as "Senior"! A position for Senior Software Engineer posted on Intel's employment Web site<sup>13</sup> sets the cutoff at five years of experience. The author debated the issue of the alleged labor shortage with Warren Leiden, president of the American Immigration Lawyers Association.<sup>14</sup> Leiden was one of the 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."

Employment agents tell the story clearly. Andrew Gaynor notes<sup>15</sup> that anyone with 10 or more years of experience without currently-"hot" skills "is at a complete disconnect" in finding work. Susan Miller says<sup>16</sup> 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,<sup>17</sup> "In 1988 the employers would have retrained [mid-career] people but *they're not desperate enough to do so today.*"

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 mid-career programmers and hiring cheaper workers. Age discrimination is rampant in the industry, as more and more employers focus their hiring on the cheaper new college graduates. We have seen this above for Intel, for instance. It 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,<sup>18</sup>

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

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<sup>11</sup>Bay TV, San Francisco, March 3, 1998.

<sup>12</sup>As of March 14, 1998.

<sup>13</sup>As of March 14, 1998.

<sup>14</sup>KQED-FM, San Francisco, March 6, 1998.

<sup>15</sup>Interview with the author, July 1, 1996.

<sup>16</sup>Interview with the author, June 26, 1996.

<sup>17</sup>Interview with the author, June 26, 1996.

<sup>18</sup>March 28, 1997.

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.

Prominent software project management guru Edward Yourdon comments, "...a lot of [mid-career] 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 mid-career workers with "cheap, young C++ programmers."

A July 14, 1997 article in the *Washington Times* reported:

Lockheed Martin Federal Systems of Gaithersburg...is working hard to nab its share of qualified graduates from area schools. By the end of this year the 2,300-employee defense contractor will have hired about 500 people, two-thirds of them recent college graduates. Next year the company, which focuses on computer systems integration, software development and technical systems for satellite navigation and surveillance, expects to hire the same number, but officials hope about 90 percent will be recent graduates.

The article then quotes NeuroSystems CEO Ed Robertson as to why the new graduates are so attractive: "If we go out to the marketplace and find a 40-year-old software engineer, we'll have to pay that individual more."

One CEO (Bob Forman of IMI Systems) 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 mid-career people who don't have hot skills. My company is anxious to hire as many programmers as it can get."<sup>19</sup> I then suggested that my wife, a software engineer with 15 years of experience, send his company 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 perceives that her 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.

As a result, most careers in the programming field are short-lived. Below are 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:

yrs after B.S.    % working as progrs

6.5	57%
8.5	57%
10.5	47%
12.5	42%

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<sup>19</sup>Forman is also quoted in a similar comment in *Computerworld*, January 19, 1998.

14 . 5	37%
16 . 5	34%
18 . 5	29%
20 . 5	19%

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 mid-career programmers.

As noted earlier, because people who cannot find programming work leave the field, unemployment statistics for programmers are meaningless. The former programmer who becomes an insurance agent counts in government statistics as an employed insurance seller, not an unemployed programmer, so unemployment rates do not give an accurate picture of the employers' general refusal to hire the mid-career workers. Nevertheless, it is significant that there was a high 17% unemployment rate for programmers over age 50 as of August 1997.<sup>20</sup>

As a stroll around any high-tech company will show you, most people who work in this field are young. It should be noted that other technical fields do not show this rapid decline of work in their field. 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%. **True, Some computer science majors eventually go into management, start their own consulting firm and so on, but the same is true for civil engineers.** 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 that chance.

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*.

After seeing me quoted in the press on this topic, many mid-career 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 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 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

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<sup>20</sup>*Computerworld*, January 12, 1998). This 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. However, I have checked with the author of the *Computerworld* article, Laura DiDio, who explained 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.

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 Seattle:) 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 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 graduated three years ago:) [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.”

(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 and *Wired Online News*, February 25, 1998.)

University students are beginning to be aware of this problem, and though 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.”

**It is crucial to keep in mind that the plight of the mid-career 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.** As noted by software employment agent Maryann Rousseau, “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?

## 4 Trends in University Computer Science Enrollments

The ITAA claimed throughout 1997 computer science enrollments are declining, and is calling 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 computer science enrollments from the late 1980s to 1994. But computer science enrollment reversed its declining trend in 1995, increasing by 5% in 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.<sup>21</sup> Taking into account “compound interest” effects, this means that **enrollment in computer science has nearly doubled nationwide in the last two years.**

This information (the original 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

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<sup>21</sup>*Computing Research News*, March 1997 and March 1998; see their Web page, [www.cra.org](http://www.cra.org).

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,<sup>22</sup> 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.

Moreover, even industry representatives (including ITAA) 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) 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.**

Those new computer science students are at the advanced stage of the pipeline, and are graduating now. In 1996-1997, the year of the 40% increase in enrollment, there was already a 10% increase in the number of computer science graduates, according to the Computing Research Association.

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 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.<sup>23</sup>

It should also be noted that most firms recruit at only a few colleges. 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.<sup>24</sup> Even Intel, with its heavy emphasis on new or recent college graduates, does not recruit there.<sup>25</sup>

At the University of Nebraska, Microsoft does engage in on-campus recruiting, but very few other high-tech firms do.<sup>26</sup> TJ Rodgers of Cypress Semiconductor, testifying in support of claims of an engineering labor shortage,<sup>27</sup> stated his firm recruits at only 26 colleges nationwide, out of the 320 which have engineering programs accredited by ABET; Cypress was not listed in the yearly recruiting schedule posted at the Massachusetts Institute of Technology, the nation's premier engineering school.

Indeed, even the ITAA's Harris Miller has admitted this to *Tech Week*' Umberto Tosi:<sup>28</sup>

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<sup>22</sup>*San Francisco Chronicle*, January 8, 1998.

<sup>23</sup>*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.

<sup>24</sup>Interview by the author with the Computer Science Department Chair, Dr. GERAL EISMAN, June 1996.

<sup>25</sup>Meeting with Intel college-relations staff, January 1998; see also Coeta Chambers, Intel lobbyist, *Take Issue*, Bay TV, San Francisco, March 3, 1998.

<sup>26</sup>Discussion 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.

<sup>27</sup>Senate Judiciary Committee hearings, February 25, 1998.

<sup>28</sup>February 13, 1998. See <http://www.techweek.com>.

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.)

The ITAA also claims that American students do not study computer science because (a) they think it is “nerdy,” and (b) the lack math skills. But **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 software development in the first place.<sup>29</sup>

## 5 Salaries

In very narrow segments of the programmer labor market, some salaries have indeed risen substantially. 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. both the ones who have currently-“hot” skills and the “ordinary” programmers—rose about 7% from 1996 to 1997, compared to about 3% for all American workers. 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.

The ITAA criticizes the BLS data as being inaccurate, yet TJ Rodgers, CEO of Cypress Semiconductor, testified before the Senate Judiciary Committee on February 25, 1998, said he is raising salaries by 6%, quite in line with the BLS figures.<sup>30</sup>

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 (and somewhat lower) figures were found for other regions of the country in the Datamasters survey, cited in the same article. This survey also features detailed salary information yearly from 1990-1998, extremely useful. It is available at <http://www.datamasters.com/dm/survey.html>.

Salaries for new college graduates in computer science rose 3.9% during 1996-1997.<sup>31</sup> Qualcomm, another firm which insists there is a high-tech labor shortage, admits that its starting salaries have only be rising

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<sup>29</sup>The reader can verify this by picking up any book on, say, Java programming at a local book store.

<sup>30</sup>Rodgers 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.

<sup>31</sup>*Software Workers for the New Millennium*, National Software Alliance, Arlington, VA, January 1998.

about 4% per year.<sup>32</sup> Starting wages for new computer science graduates of UC Berkeley have been rising at the rate of 5% yearly.<sup>33</sup>

And in spite of wild newspaper stories about new Bachelor's graduates getting salaries approaching six figures, the going rate is in the low \$40,000 range.<sup>34</sup>

The ITAA says that salaries are less relevant because of nonsalary compensation such as bonuses. Yet most programmers do not get bonuses, and those that do average about 5% of their salaries. (See the Datamasters surveys cited above.)

Moreover, the ITAA made no claims that nonsalary compensation is rising at more than the 7% rate we see in salaries. The key point is not that there are 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.

In this regard, of particular interest is a special kind of bonus, the “bounty” paid to an employee who introduces a friend to the firm and who is 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.

## 6 On Skills Requirements

Employers claim, “We cannot hire ‘just any programmer.’ It is crucial that the programmer have experience in a specific software technology.” But this is quite incorrect. What counts is general programming talent, not experience with specific software technologies.

Bill Gates has described Microsoft hiring criteria thusly: “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.”

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<sup>32</sup> *San Diego Union-Tribune*, March 7, 1998.

<sup>33</sup> Letter to the editor to the *San Francisco Chronicle*, April 4, 1998, by Professor Randy Katz, chair of the UCB CS Dept.

<sup>34</sup> *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.

**Programmers can become productive in a new software technology in a month or so.** 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.”<sup>35</sup>

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.

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.<sup>36</sup> 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.

Note that the Boehm reference and the Kamra quote above, as well as numerous others in my long Web document referenced earlier, demonstrate that programmers in general learn quickly, not just the programmer “superstars.”

## **7 On the General Unwillingness of Employers to Retrain Mid-career Programmers**

After Senator Alan Simpson introduced his 1995 bill to tighten up our policy on high-tech hiring of foreign nationals and employers protested that they need the foreign workers to fill a software labor shortage, Secretary of Labor Robert Reich 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, the fact is that most employers are not willing to retrain their programmers and engineers. As mentioned earlier, Kim Lee, of the Network Connections employment agency in the Silicon Valley has noted that<sup>37</sup> “In 1988 the employers would have retrained [mid-career] 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.<sup>38</sup> 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

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<sup>35</sup>Interview with the author, March 24, 1998.

<sup>36</sup>Interview with the author, August 24, 1995.

<sup>37</sup>Interview with the author, June 26, 1996.

<sup>38</sup>Interview with the author, June 26, 1996.

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.

Andrew Gaynor, another employment agent, called the industry "very short-sighted" in this regard.<sup>39</sup>

The industry has 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.

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.<sup>40</sup> 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.

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.

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

For this reason, **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 have 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.<sup>41</sup> These don't help employers fill the engineering and programming positions they say they are desperate to fill.

The retraining programs may not be so beneficial to the engineers and programmers either, since the jobs are often lower-paying and of a nature that the participants in the programs could have obtained on their own, without the programs. Gene Nelson, for example, had been making \$46,600 as a programmer before being laid off, and now makes only \$23,000 staffing a software help desk. These programs are analogous to what would occur if there were unemployment among doctors, and they were "retrained" for paramedic positions.

**Anyone who thinks that "education is the answer" should consider the case 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.

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<sup>39</sup>Interview with the author, July 1, 1996.

<sup>40</sup>*Wall Street Journal*, December 1, 1997.

<sup>41</sup>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.

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 has done “all the right things,” everything society told him to do, and yet he could 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 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 only half what an engineer makes.<sup>42</sup>

## 8 The Role of Imported Workers

As we have seen, industry employers tend to shun mid-career 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 are foreign-born, most of them sponsored for immigration originally by employers.<sup>43</sup>

Without the foreign-national labor supply, employers would be forced to use the existing domestic labor pool of mid-career 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/svreport.html> for extensive details.)

It is easy to see that there is something very wrong with the H-1B program, in that its growth rate is far out of balance with the growth rate of 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%.<sup>44</sup> The “country of choice” among employers importing this labor is currently India.

Many employers find foreign-national programmers and engineers attractive because they will accept lower salaries and poor working conditions. The Department of Labor has found widespread abuse of the work-visa program.<sup>45</sup> 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

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<sup>42</sup>Qualcomm 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.

<sup>43</sup>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 employers for green cards.

<sup>44</sup>*Software Workers for the New Millenium*, National Software Alliance, Arlington, VA, January 1998.

<sup>45</sup>*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.

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.

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.”

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 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.”

A researcher with the pro-immigration Carnegie Endowment for International Peace put it this way:<sup>46</sup>

“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%.

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.

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 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 the 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 complying with the prevailing-wage requirement of the law. As noted by immigration attorney Donna Fujioka of Oakland, California,<sup>47</sup> “[The prevailing wage system] 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.”<sup>48</sup>

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

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<sup>46</sup>*Kansas City Star*, July 16, 1995.

<sup>47</sup>Interview with the author, March 5, 1998.

<sup>48</sup>Fujioka 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, or even close to it, so the point is moot. Moreover, the salary curve is steepest in the first few years of experience.

native counterparts, and that the gap took 20 years to close.<sup>49</sup> And though Ong hypothesized various factors, he noted that “Companies took advantage of immigrants.”<sup>50</sup> 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.<sup>51</sup>

The author’s 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 the author 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. The author 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.

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.”<sup>52</sup>

It is ironic that even a *Wall Street Journal* article<sup>53</sup> 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.

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.”

Amazingly, policy makers in a federal agency, the National Science Foundation (NSF), actually planned for 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. The NSF, by the way, is one of the chief architects of the modern H-1B program. Dr. Weinstein’s paper on this scandal is available at

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<sup>49</sup>*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.

<sup>50</sup>*Electronic Engineering Times*, July 18, 1994.

<sup>51</sup>He does believe they catch up within five years, rather than the 20 years found for engineers by Ong. 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.

<sup>52</sup>*Los Angeles Times* (November 15, 1993, and also July 15, 1996.

<sup>53</sup>January 8, 1998

The industry lobbyists say 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 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.<sup>54</sup> This is far less than the \$10,000-\$20,000 ITAA claims for the H-1B.<sup>55</sup> Second, many employers have the foreign employees pay the legal fees (for both kinds of processes) themselves, and even when employers foot the bill, the cost is often less than they save in salary.

Note that an H-1B employee is essentially immobile during the two or three 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. 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. 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.

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. Yet such extortionary language is not backed by action, and in fact will not be in the future. While it is true that some companies are experimenting with having work done abroad, this will not 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/svreport.html> for extensive details on this point, including many quotes from industry figures. For example, Bill Gates says,<sup>56</sup>

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

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<sup>54</sup>This is based on conversations with various lawyers. Here are some examples. 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 the San Francisco Bay Area 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 on March 5, 1998, gave \$1,500 to \$2,000, and also is the source of the \$700 figure. See also David North, *Soothing the Establishment: the Impact of Foreign-Born Scientists and Engineers on America*, (University Press of America, 1995, p.52.

<sup>55</sup>The latter figure is fairly accurate in the case of employer-sponsored green cards, but not for H-1Bs; this is yet another ITAA obfuscation.

<sup>56</sup>*San Jose Mercury News*, March 9, 1997

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.

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 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.

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 natives 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."

Lobbyists also point to the fact that about 40% of U.S. Ph.D.'s granted in engineering go to foreign students. (Note: Some 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 undergrads nationwide are foreign students. (*Computing Research News*, March 1998.)) But this ignores the fact that we are overproducing Ph.D.'s in the first place. 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,<sup>57</sup> finding for example that we are overproducing Ph.D.'s in electrical engineering by 44%.<sup>58</sup>

Again, we do not need to produce so many Ph.D.'s in the first place. However, it is interesting that the National Science Foundation actually promoted policies which they knew would result in low enrollments of domestic students in Ph.D. programs. Recall our earlier discussion of NSF's plan to hold down wages by bringing in a glut of foreign scientists and engineers. The NSF documents acquired by Dr. Weinstein 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.

Another class of foreign nationals sponsored for H-1Bs consists of university instructors and researchers. While this is outside the scope of our report here, I wish to point out that there is no shortage here either—

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<sup>57</sup>Stanford Institute for Higher Education Research, Stanford University, July 1995.

<sup>58</sup>See much more detail on Ph.D. overproduction in the author's report on foreign nationals in the computer industry, available at the Web site stated earlier.

our Computer Science Department has been receiving approximately 400 applicants each year for faculty positions (for typically two or three openings).

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 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, that they are not seeking H-1Bs as a source of cheap labor, etc.

## 9 Employers Are Shooting Themselves in the Foot with Their Hiring Policies

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:<sup>59</sup>

- Employer obsession with 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.

So employers are shooting themselves in the foot under their current policies.

- 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.

So here too, employers are shooting themselves in the foot under their current policies.

- 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.

So again employers are shooting themselves in the foot under their current policies.

The fact is that although employers shun the mid-career 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.**

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<sup>59</sup>One might ask, "How can the hiring policies of the industry be 'wrong,' in view of the great success the industry has enjoyed?" The answer is that since most employers use the same hiring policies, a poor policy does not give any of them a competitive disadvantage. Moreover, the industry is not good at management, such as in assessing employee talent. Studies have shown that programmers who are twice as productive are paid only 10% more. (*Peopleware: Productive Projects and Teams*, by Tom DeMarco and Timothy Lister (Dorset House Publishing Co., 1987.)

## **10 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; see

<http://heather.cs.ucdavis.edu/itaa.others.html>