Boom-Bust Cycles: A New Paradigm for Electrical Engineering Employment
Ron Hira, Ph.D., P.E.,
Center for Science, Policy, and Outcomes
Columbia University
rh2107@columbia.edu
www.cspo.org
and
Chair, R&D Policy Committee, IEEE-USA
http://www.ieeeusa.org/committees/RDC/index.html

The debate in Washington about whether the U.S. is producing and importing enough scientific and engineering talent will be on the legislative agenda this year, with issues like setting the H-1B quota level and homeland security research and development high on the list. There are those who believe that the U.S. has an acute shortage of technically trained talent and even worse, the “pipeline” of future scientists and engineers is in jeopardy. While some claim a shortage, others, such as recently minted Ph.D. life scientists, are frustrated by a job market which seems to only offer endless post-doctoral fellowships.

This debate is not a new one, in fact it is the subject of discussion seemingly every business cycle. Daniel Greenberg’s recent book, Science, Money, and Politics: Political Triumph and Ethical Erosion, is an account of the debate that ensued in the early 1990’s. During that time, the National Science Foundation reported that there would be significant shortfall of engineers and scientists in the coming decade. Skeptics, including current House Science Committee Chairman, Representative Sherwood Boehlert (R-NY), responded harshly when it came to light that internal NSF analysts had doubts about the bases of the claims. The problem with the shortage claims was methodological in nature – it was purely based on supply side demographics, based on the baby bust generation entering college during the 1990’s. One could claim that in fact the NSF reports were correct, and that the shortage was compensated by importation of technically trained talent through large increases of foreign graduate students and H-1B visa holders.

But the story is much older than that though. My late father, who was an electrical engineer, often told me the story of “Ph.D.’s driving taxis” during the early 1970’s. In fact, the careers and public policy division of the IEEE, IEEE-USA, was created in 1972 in large part because of the high unemployment amongst electrical engineers in the late 1960’s and early 1970’s. See http://www.ieeeusa.org/intro/history.html for more information on IEEE-USA’s founding.

So, who is correct about the debate over the quantity and quality of the U.S. scientific and engineering workforce? This is a question that requires a complex and nuanced answer, and one that I cannot answer in this piece. Instead, I will present short term and long term employment statistics for Engineers, with a particular focus on Electrical Engineering and Computer Science.
At a recent National Academies’ symposium on Information Technology Workforce, a number of speakers acknowledged that current demand for workers was very soft, but most predicted spectacular long term growth in demand. When it was time for me to speak on the last panel, I began by recalling the story of how John Maynard Keynes responded to the group of economists who advocated that markets are self-correcting in the long-run. Keynes quipped in response that, “In the long-run we’re all dead.” The point is not that the long-run doesn’t matter, but that the short-run affects long-run outcomes.

IEEE-USA has been concerned that the current high-levels of electrical engineering unemployment are causing many experienced engineers to permanently leave the profession. At the same time, industry is lobbying Congress on the shortage of qualified domestic electrical engineers and computer scientists. Industry lobbyists have crafted this message because they believe the shortage argument resonates well with the corporate executives who write the checks for their efforts. An influential industry lobbyist recently responded to IEEE-USA’s concern about unemployment by saying, “But one should not confuse short-term dislocations with a long-term structural problem. …the overall weakness in U.S. engineering education & people production suggests that IEEE has not been a strong group (in addition to many other reasons). Now they’re focused on short-term pain for some members vs. long-term growth.”

**Short Term Pain**

The unemployment rates for electrical engineers and computer scientists have risen above 4% in the first three quarters of 2002 for electrical engineers and computer scientists. The unemployment numbers in Table 1 suggest that they have been hit harder than comparable professionals such as natural scientists, other engineers, and managers and professionals. They suggest something that most working electrical engineers and computer scientists already know - the job market is not very favorable.

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Electrical Engineers</th>
<th>Computer Scientists</th>
<th>Engineers</th>
<th>Natural Scientists</th>
<th>Managers/Professionals</th>
<th>All Workers</th>
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<tr>
<td>00Q1</td>
<td>1.3%</td>
<td>1.9%</td>
<td>1.4%</td>
<td>1.2%</td>
<td>1.7%</td>
<td>4.2%</td>
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<tr>
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<td>1.8%</td>
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<td>3.6%</td>
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<tr>
<td>00Q3</td>
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<tr>
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<tr>
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<tr>
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<td>4.8%</td>
<td>3.6%</td>
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<tr>
<td>02Q2</td>
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<td>3.4%</td>
<td>5.3%</td>
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**Table 1 Recent U.S. Unemployment Rates by Occupation**

Source: BLS and IEEE-USA
For new graduates, the market in 2002 was quite soft. The National Association of Colleges and Employers (NACE), which tracks the employment fate of new graduates, reports that “Electrical engineering grads weren’t so lucky: Their average offer dropped off 3.3 percent to $50,391. Just a few years ago, computer science grads had their pick of jobs; 2002 computer science grads, however, saw demand wane, with starting salary offers declining 5.8 percent for an average of $49,413. Still, some computer science grads did very well: Those with jobs in software design and development got an average offer of $53,524.”¹ NACE also reported that hiring of new college graduates by employers will continue to decline for 2003.²

Employment data for Ph.D. engineers and computer scientists is too old to determine the current market, but as Finn pointed out in the May-June 2001 issue of RTM leading indicators like R&D spending may be a good predictor of the future labor market. As I discussed in my last article, top industry R&D spenders are beginning to slow their spending in 2002. This probably indicates a softer market for science and engineering doctorates in the near term. The slow-down in industrial R&D spending is being offset to an extent by increases in government R&D spending, which will hit an all time high of approximately $115 billion in FY’03 once Congress passes all of the appropriations bills. Of course, the doctorate market varies greatly amongst sub-disciplines. For example, the telecommunications industry has been devastated, but emerging areas such as nanotechnology exhibit strong demand. Another emerging trend that will affect the domestic doctorate market is the degree to which R&D centers move offshore.

I have discussed the unemployment rates for technology workers with a number of people at various conferences, and surprisingly enough the response is more often than not, “four percent, that’s much less than the national average.” In other words, things must be going well for electrical engineers since their unemployment rate is lower than the national average. In order to get a better perspective on the current situation, it is useful to examine longer term trends.

Long Term Trends

Figure 1: U.S. Civilian vs. Electrical Engineering Unemployment Rates 1972-2001
Source: BLS and IEEE-USA

Figure 1 shows the unemployment rates for the U.S. civilian workforce versus electrical engineers from 1972-2001. The unemployment rate for electrical engineers was never greater than 3% until the recession in the early 1990’s. Even during the deep recessions of the early 1980’s, when the general unemployment rates hovered near 10%, electrical engineers seemed immune with their rates never rising above 2%. During the past decade, when there was a clear secular trend of lower unemployment rates for the U.S., electrical engineering unemployment have become significantly more volatile. There has been a structural shift in the unemployment patterns of electrical engineers in the past decade, and the prior stability in employment demand has disappeared. We have entered a period of boom-bust cycles for electrical engineering employment.

Policy Implications

Boom-bust cycles for technology employment create significant challenges for policymakers, especially when the lead time for training is so long. There will be times when employers find it difficult to find technology workers, and times when technology workers are laid off en masse. The question is how this new set of labor market signals affects the decisions of mid-career engineers as well as those young people deciding which profession to enter. One of the major advantages of a career in engineering, stable
employment, seems be eroding. While wages for engineers have risen, it’s not clear that they have risen to mitigate the higher risk of entering the profession.

Many employers believe that this short-term pain will pass, and that the U.S. will face severe labor shortages again once the economy picks up. While demand may well pick up, there are also new sources of supply entering the market. Companies are increasing the amount of work they perform offshore to reduce costs and new trade agreements such as the World Trade Organization’s General Agreement on Trade in Services will make it much easier for companies to bring in temporary non-immigrant workers to the U.S. While the size of the foreign labor supply is often vastly exaggerated (e.g., one CEO was recently quoted in a Fortune article as saying that China produces 600,000 engineers every year, when the NSF’s best estimate is that the number was 195,354 in 1999), it is clear that companies are becoming savvy about how to utilize foreign talent either by importing it or by setting up facilities abroad.

The new career paradigm for engineers requires new institutions to support life-long learning. Long talked about, life-long learning appears to be nothing more than rhetoric at this stage, with no clear means or ends defined. Many employers (rightly) believe that workers have to take on more responsibility for training; however, workers have not had the appropriate support from government and non-governmental organizations. I believe government should provide the means with financial support for continuing education as well as the appropriate incentives for the current educational infrastructure to respond to it. Government should evaluate whether the current educational infrastructure, which is primarily focused on degrees, is capable of responding to the needs of mid-career engineers. If not, then it is time to augment that infrastructure with new institutions. Non-governmental institutions, such as IEEE-USA, need to take on more responsibility of helping its members better understand the labor market and technological trends. IEEE-USA, while it provides employment assistance to displaced members, has been reactive rather than pro-active in responding to the labor market ups and downs. Employers also need to take on more responsibility. There has been a dangerous trend for industry to view engineers as merely another commodity that they can import when times are good and dispose of when times are tight. Industry’s arguments about scarcity of domestic talent would resonate if it was accompanied with equal conviction about how to solve the short-term pain that many engineers are feeling right now. Finally, engineers have to increasingly view their careers as an independent consultant does. This shift provides substantial rewards, but also far greater risks and responsibilities.