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'Double Decline' Forecast for U.S. Engineers #22

By WILLIAM MATTHEWS

It's spring. Time for college seniors to start looking for jobs. Time for companies to begin recruiting. Time for the annual story about the shortage of engineers.

Except there really isn't a shortage of engineers in the United States. At least not yet.

Nevertheless, aerospace and defense companies are sounding the alarm over shortages they fear is coming. "There are nowhere near enough engineers in the pipeline," warns the Aerospace Industries Association.

NASA, the Defense Department and the defense industry have too few systems engineers to oversee big, complicated programs, the National Academies of Science complains.

Lockheed Martin, the nation's largest defense company, needs to hire about 9,000 engineers a year, including 3,700 new graduates. Lockheed worries that its need for engineers is increasing, but the pool of engineers is not.

At the Pentagon officials worry about a double decline.

"The number of engineering graduates from U.S. universities is declining," and at the same time, "data indicate a decline in the number of clearance-eligible [U.S. citizen] individuals within this shrinking pool of graduates," said William Rees, deputy undersecretary of defense for laboratories and basic sciences.

Rees cites findings from "various reports, including National Science Foundation survey data."

But not all of the numbers agree. According to the Bureau of Labor Statistics, the number of U.S. engineering students has been steadily increasing since 2000.

The number of unemployed engineers is abnormally high, says demographer Michael Teitelbaum. A shortage would produce nearly full employment among engineers.

And the most telling number, perhaps, pay for engineers is not rising rapidly, as it did during previous shortages.

So why all the worry?
A couple of reasons: Engineers now in the workforce are aging — right now 19 percent of the engineers in the aerospace industry are retirement age, said Linda Olin-Weiss, Lockheed's director of staffing.

Equally worrisome, the engineers now in college seem a lot less interested in working for big aerospace and defense companies, say officials in industry and academe.

Unexciting Work?

"Kids today are very interested not in going to work not for the biggest companies they can, but for the smallest," said Jeremiah Gertler, vice president of the Aerospace Industries Association. "They're really interested in startups."

One appeal of smaller companies is the possibility of receiving stock options that may make them rich if the company develops valuable new technology. Many new graduates "prefer high risk and possibly high reward over going with an established, steady employer," Gertler said.

Annalisa Weigel, an assistant professor of aeronautics, astronautics and engineering systems at the Massachusetts Institute of Technology, observes the same phenomenon.

"I can't begin to count the number of students" who return from internships with major aerospace and defense companies disillusioned with their experience, she said. "It takes too long to get things done, the bureaucracy is too big, the workforce is too old, the working conditions are dull, the offices are unexciting — those are common complaints."

By contrast, students thought it was exciting and "cool" to intern with companies like Blue Origin, a small, seven-year-old Seattle-based company building a three-man spacecraft and aiming make space flight affordable.

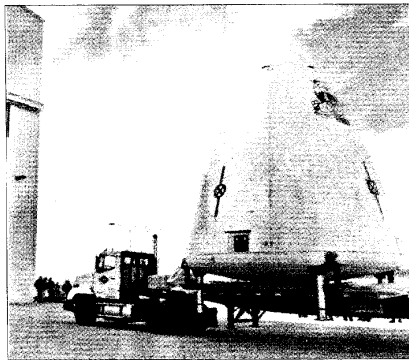
"This generation is just a little different," Weigel said. "They are more interested in problems on a large scale that have a human connection."

Many of them are drawn to engineering challenges in health, the environment, biomedicine, pharmaceuticals and pollution control more than to defense, she said.

Having grown up during the technology boom with laptops, the Internet and iPods, today's engineering students aren't all that interested in "simply going higher, faster, and farther for the sake of advancing technology," she said.

Even President George W. Bush's 2004 vow to return Americans to the moon and then go on to Mars hasn't been much of a motivator for engineering students. For one thing, it's seen as "going back to where we've been," Weigel said.

For another, it has never been adequately funded. "The defense and space world has lost a little bit of cachet," concedes Nannette Bouchard, vice president for engineering and mission assurance at Boeing's Integrat-



Attractive Work: The first development vehicle in Blue Origin's New Shepard vertical take-off, vertical-landing vehicle program returns to its building after a successful launch at Goddard Space Flight Center Nov. 13. Engineering students are drawn to internships in small innovative firms like Blue Origin, which aims to make space flight affordable.

ed Defense Systems.

"Some of the other professions are perceived to be a bit more exciting — information technology and communications — that's a perception we are struggling against," said Bouchard, who oversees a 32,000-person engineering team.

"Part of it is we're a victim of our own success," Gertler said. "In the '60s and '70s we watched every launch and recovery" of a space vehicle. "Space was cutting-edge."

Then NASA designed the shuttle and flight into space became routine — and less interesting.

There are other problems as well, Weigel said. "There are issues with the way the industry is organized," it's big, bureaucratic and agonizingly slow. "There are no quick projects, people don't get to see the fruits of their labor — that's discouraging to the video game and Internet generation," he said. Today, "we're really lucky if we get one new aircraft in a decade. You can't get new engineers interested in programs that won't be completed until their children go off to college."

Not All Bad

That raises questions about the future, but for now, "there are still sufficient numbers [of engineers] to fill our needs," Lockheed's Olin-Weiss said.

She said her main worry is that "not as many people are entering the fields of engineering and science as a whole, particularly aerospace, and that impacts our industry."

The view is the same from Boeing's Integrated Defense Systems offices in Seal Beach, Calif. "Right now we are able to attract sufficient engineers, but we're concerned about declining numbers in colleges," Bouchard said.

The DoD was concerned enough in 2005 to establish the SMART (science, mathematics and research for transformation) scholarship program for science and engineering students. It pays college expenses plus stipends ranging from \$22,500 to \$38,000 a year depending on whether students are undergraduate, graduate or doctorate students.

More than 1,000 students applied for this year's 50 scholarships, said Rees, the deputy undersecretary.

There are other indications that trends are not all grim in engineering. In a report released in January, the NSF said 64,675 students graduated with bachelor's degrees in engineering in 2004 — the highest number since 1989.

That's not as high as the peak year, 1985, when the nation's colleges graduated 77,572 bachelors of engineering. But its more than the 58,258 who graduated in 2001.

The number of master's degree engineering graduates has increased steadily, from about 21,000 in 1985 to almost 34,000 in 2004. And the number of doctorates in engineering increased from about 3,200 in 1985 to nearly 5,800 in 2004, the NSF says.

The same trend is evident in aerospace engineering, said Nicholas Terrell, an analyst at the Bureau of Labor Statistics.

The number of bachelor's degrees in aerospace engineering increased from 12,067 awarded in 2000 to 23,053 in 2004 — almost double, Terrell said.

The 2004 number falls short of the 1992 crop of 29,061 aerospace engineers, he said, but the current trend is hardly gloomy.

Nevertheless, defense firms and some in the Pentagon complain. A lot of those new engineers are off limits to U.S. defense companies and government service on sensitive programs because they are foreign nationals.

Typically, an engineer must be a U.S. citizenship and be able to qualify for security clearance in order to work on military programs, said Gertler of the AIA.

"Twenty percent of engineering students go home (to other countries) the day after they get their diplomas," he said. And the percentages of foreign students are substantially higher at the graduate levels.

That's a problem for U.S. defense companies, agreed Lawrence Jacobson, executive director of the National Society of Professional Engineers.

"Is there a shortage of all types of engineers? Probably not. But if you ask in this bandwidth is there a shortage, yes, there probably is," Jacobson said.

What defense companies want "aren't garden variety engineers, they are U.S. citizens from top schools who can get clearance," he said. "These are rare birds."

Salaries Inch Up

But "rare" doesn't translate into "raise" when it comes to engineers' pay. Salary increases for aerospace engineers have been modest, according to Terrell. Average pay was \$69,000 in 2000 and about \$84,000 in 2004.

That's for all engineers, not just new graduates, he said.

These raises — about 4 percent a year — indicate "there's no general shortage of engineers," said Vivek Wadhwa, an adjunct professor at Duke University.

"The best indicator of a shortage is rising salaries," he said. "During the dotcom days, there was a big shortage of engineers in the tech sector and you saw salaries rising through the roof."

That's not happening now. In fact, "a lot of really qualified engineers are unemployed," Wadhwa said. "If there was a shortage, [companies] would be taking every available hand."

That could change.

Over the next 18 months, "27 percent of the engineering work force will be eligible for retirement," said Gertler. Those are the baby boomers who were inspired to become engineers by the Soviet launch of the world's first satellite, Sputnik, in 1957, and the U.S. decision to send men to the moon during the 1960s.

"They won't all retire instantly," Gertler said. "The companies are working to make sure they don't."

But eventually they will go, and that is a source of great anxiety among aerospace companies.

"Failure to increase the number of engineers would severely constrain our industry's ability to create innovative technical solutions that contribute to our nation's defense," Robert Coutts, head of Lockheed's \$11 billion electronic sector, said in a 2005 address.

Coutts's cry of alarm is reminiscent of an earlier warning.

In 1955, Assistant Defense Secretary Donald Quarles identified a danger he called "potentially a greater threat to national security than any aggressor weapons known," a nationwide shortage of engineers.

Engineer shortages were reported again in the 1970s, and again during the tech boom of the 1990s.

So how did a nation that seems to be chronically short of engineers manage to go to the moon, invent the personal computer and the Internet, build stealth aircraft, invent the cell phone and build a reusable space shuttle?

"I don't think it's a chronic shortage; engineering is very cyclical," said Teitelbaum, a demographer at the New York-based Alfred P. Sloan Foundation.

Big spending increases on defense during the Reagan administration during the 1980s and on information technology in the 1990s prompted greater numbers of students to go into engineering then, he said.

But the Reagan defense boom was followed by the end of the Cold War and the "procurement holiday" during the first half of the 1990s, and suddenly companies like Boeing and Lockheed were laying off engineers, Teitelbaum said.

Similarly, when the "technology bubble" of the mid and late '90s was deflated by the "dot com bust" of 2001, "Silicon Valley companies were laying off people they had just hired a year ago," he said.

With those sort of cycles of hiring and firing, it should not be surprising if there are periodic shortages and surpluses of engineers, Teitelbaum said. ■

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