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Quality vs. Quantity in Engineering

Every spring, Jitendra Malik, chair of electrical engineering and computer science at the University of California at Berkeley, has a sitdown with students who have been accepted to the College of Engineering and are mulling over whether to attend.

Malik has noticed a recent theme in the questions he gets from students, and especially from their parents. “They have concerns about how good an engineering or computer science career will be over the next decade,” Malik said. They want to know if they’re entering careers destined to be outsourced. Why might students admitted to one of the nation’s top engineering programs be worried about being getting a good job? And if students with enough ability to get into Berkeley engineering are afraid of enrolling, is the debate over increasing the number of engineering graduates nationwide missing the point?

To understand the student fears, turn on the television and catch Lou Dobbs on CNN doing his nightly “Exporting America” segment — now available in book form — where he rails against outsourcing. “The shipment of American jobs to cheap foreign labor markets threatens not only millions of workers and their families, but also the American way of life,” reads the official [book blurb](#).

Then there’s the vast army of politicians, press releases and articles that tell students that “last year China’s schools graduated more than 600,000 engineers and India’s schools produced 350,000, compared with 70,000 in America,” as Margaret Spellings, the U.S. secretary of education pointed out in an [op-ed](#) in Newsweek. Politicians on the right and the left — including [Ted Kennedy](#) and [Newt Gingrich](#) — have cited those figures, as have the [National Academies of Science](#) in a press release for the “Rising Above the Gathering Storm” report, the National Academies report that seems to have put the fear of a flat world into the White House.

But a study by two Duke University faculty members suggests that the oft-cited figures are misleading, and some experts say that, not only is outsourcing not ushering in the demise of America, but that sounding the alarm about U.S. engineering is giving students pause, rather than pushing them toward the discipline.

In a report that hasn’t gotten nearly as much Capitol Hill play as “Storm,” the Duke faculty members sought the reality behind the graduation data. Vivek Wadhwa, executive

in residence at Duke's Pratt School of Engineering, and an author of ["Framing the Engineering Outsourcing Debate,"](#) said that the tale of the 600,000 Chinese engineers goes as far back as 2002. Ray Bingham, then-CEO of Cadence Design Systems, used the number in a speech. "People are still citing the same numbers, and they weren't accurate then," Wadhwa said. The Duke report, which uses data from the National Center for Educational Statistics, the National Association of Software and Service Companies, and the Chinese Ministry of Education, put the number of American degrees in 2004 in engineering, computer science, and information technology at 222,335; Indian degrees at 215,000; and Chinese degrees at 644,106.

But even those figures don't tell the story, Wadhwa said. A key factor is often left out of the doomsday prophesying: quality. Over 290,000 of the Chinese degrees, and 103,000 of the Indian degrees are "subbaccalaureate." In the United States, 84,898 of the engineering degrees awarded were associate degrees. When it comes to per capita engineering graduates, the race isn't even close. The U.S. awarded 758 degrees per million citizens. China gave 497 degrees per million citizens, and India 199. The report adds that the Chinese figures, which collect numbers from different provinces that have no standardized definition of engineering, likely includes "the equivalent of motor mechanics and industrial technicians."

The report goes on to classify engineers into two types: "dynamic," and "transactional." Transactional engineers are those who generally do "rote and repetitive tasks," the report reads, and frequently have less than a bachelor's degree. "Those are the people whose jobs are in danger from outsourcing," Wadhwa said, not graduates of Berkeley's College of Engineering. In other words, it's the people on the other end of the customer support line whose jobs are in jeopardy, not their bosses. Wadhwa said he feels for those people, but that painting a picture of an "exported America," like Dobbs, is doing more harm than good by making top students worry that no prospective career in science or engineering is a safe one. "We have to do a better job, starting in K-12 [training people in danger of losing jobs to outsourcing for higher quality jobs]. But what bright students are beginning to hear is that American education is inferior, and if you come to engineering, your job will be in trouble," said Wadhwa, who added that he regularly gets questions of concern from Duke students.

In talking about the Republican science and technology agenda recently, Rep. Dennis Hastert, the speaker of the House, explained that "America needs an education system that produces the most qualified students in the world." Wadhwa is adamant that America is producing the most qualified students in the world. "China and India are third world countries. They have massive poverty and infrastructure problems. The infrastructure in India is pathetic," he said. Besides, he added, India and China need more engineers than the United States just to handle their own infrastructure issues. The important battle, Wadhwa said, is for quality, not quantity, and that means not scaring away bright students, foreign and domestic.

Along with Hastert at the recent press conference, several Republican Congressmen invoked "the seven campuses of the [India Institute of Technology]," as Rep David

Dreier a California Republican, put it, referring to India's top institution. A 2003 "60 Minutes" [piece](#) on IIT opened: "Put Harvard, MIT and Princeton together, and you begin to get an idea of the status of IIT in India." And yet, Wadhwa said that he has "checked with professors. They say that students that come here from IIT are very bright, but so are the best students here. They're equal, not better."

According to a 2005 McKinsey and Company Global Institute labor study, only about 10 percent of China's engineers, and 25 percent of India's, can compete in the global market. That [report](#) found that a higher percentage of engineers in low-wage nations like Poland, Hungary, the Czech Republic, and Malaysia, than in China and India, are competitive in the global job market. In fact, of the nations surveyed, China tied for last with Russia, behind Brazil and the Philippines, for the percentage of engineers that can compete in the global market. And yet, Hungary and the Philippines have not garnered a mention in the blitz of press conferences about American competitiveness.

Critics of the Congressional focus on the engineering statistics tend to be scientists themselves, almost all of whom believe strongly that the United States does need to do better in math and science. What they are bothered by is the emphasis on poorly understood data that may be discouraging students — and shifting attention away from the big problems getting more elementary and high school kids ready to even consider careers in science.

The goal, Wadhwa said, must be to ready Americans for the higher quality jobs that have limitless demand, and to continue to draw some of the world's brightest foreign students who help drive innovation. Currently, foreign students have to declare their intent to return home after graduation when they apply for a student visa. That policy, combined with the increased difficulty of getting a visa since 9/11, has caused many Asian students to stay home, or to study at European universities, which are increasingly competing for Asian students. "When we make it harder for them to come into the country, and make it less welcoming for them, and give them incentives to study elsewhere, the loser in that deal is the U.S.," said Victor C. Johnson, associate executive director of NAFSA: Association of International Educators. "We're not only disadvantaging our own schools," which need foreign students to fill engineering programs, "but our economic and scientific leadership."

Like Wadhwa, Johnson suggested that the recent emphasis on increasing the number of engineers in America should take a back seat to promoting quality. "The fact there may be X, Y or Z number of [science and engineering graduates] floating around, doesn't necessarily speak to the question of does that represent the actual high level high skill innovative talent American industries are looking for," he said.

While the State Department has been issuing reassurances that the visa process is back on track, Johnson, pointed to the decision last month to deny a visa to Goverdhan Mehta, a prominent Indian chemist and president of the International Council for Science. "Anybody who says [visa policies] are OK just hasn't been awake the last couple weeks," Johnson said.

Though the tactic in many press releases has been to invoke the specter of the 600,000 Chinese engineers, some politicians are now realizing that the emphasis on numbers may not get to the heart of the matter. Rep. Howard McKeon, a California Republican, took a trip to China last year with David Baltimore, the president of the California Institute of Technology. “He told me that one great scientist is worth 1,000 good scientists,” McKeon said.

Or as Wadhwa put it: “China has more dentists than the U.S. too. But so what?”

— [David Epstein](#)