



The U.S. Needs More Engineers

STATE SCHOOLS LACK FUNDING.
WHO LOSES? WE ALL DO.

Jack McGuinn, Senior Editor

From the boardroom to the employee lunch room, discussion continues unabated in the world of manufacturing and elsewhere regarding the outsourcing of engineering capabilities and a host of skilled positions that go unfilled. All of which typically lead to the questions, why don't we make things here anymore? Or perhaps more accurately, who cares?

But perhaps something even more sinister is at work here.

Suspend your disbelief and consider for a moment the fall of the Roman Empire. You recall from your history classes that the proud Romans, had become collectively fat and lazy. By the fourth century, they were relying more and more on slave labor and mercenaries to do the work they no longer cared—or forgot how—to do. Very long story short, we all remember how that worked out.

Sound familiar? If you think it's a stretch, think again about the owner of a gear company or job shop, for instance, in need of hiring young gear designers or skilled machinists. Much has been reported—here and elsewhere—on the lost generations of potential mechanical engineers coming out of school over the

last 30 years or so who have instead chosen to find work designing video games or iPods. Understand, it is not that “kids today” don't want to make things; it is that they simply don't seem to have much of an interest in designing and seeing built the space shuttles, bridges, locomotives and other essential needs of today and tomorrow.

And so given the state of U.S. manufacturing today, it may come as a shock to learn that many state-funded universities across the country are now charging student engineering majors higher tuition and fees—in some cases as much as \$2,000 more per year. It's what is known in academic circles as differential tuition, the practice of charging higher tuition and fees for various majors such as engineering, business and science, for example. (*Ed. Note: The schools that agreed to talk to us for this article impose differential tuition, but the upcharge is minimal in comparison to others.*) Granted, the cost to the university is higher for these programs as opposed to, say, the social sciences or English literature. But it begs—or screams—the question: What is wrong with this picture?



A telling omen of things to come? Comparisons to Rome's demise aside, the United States' future role in the global economy might be dictated by a seeming intent to opt out of its once-held role as the world's manufacturing leader.

At a time when NASA in particular, or the aerospace and defense industries in general, are desperate for an infusion of eager, well-educated young people to come and continue the work of their retiring predecessors, should we be making it even more difficult for them to do so?

Likewise, while a little appreciated but absolutely essential industry such as gear design and manufacture goes begging for new talent, we as a nation continue to ignore the fact that our children in grade and high schools across the nation are not receiving the encouragement needed from teachers to inspire them to want to design and build things for the common good.

So what happened?

Remember the social contract? "We're moving from a sense that higher education is supported as a public good to something that you're purchasing as a service or investment," says Robert Gustafson, associate dean of the college of engineering for undergraduate education and student services at Ohio State University. "And if you look at what's happened in higher education in the shift from state support to tuition-and-fees support, the clear message you read from that is that education is not as strongly considered as being in the public interest as it once was.

"As a society, it's a real issue. How do we get the message out to value science and technology careers? Because right now, the message is—don't go there."

Mark Kushner, dean, college of engineering at Iowa State University (which imposes a modest hike in engineering-related tuition and fees), is of the same mind.

"I think it's a philosophical issue at work, which is difficult to quantify," he says. "There was a time in public education that acknowledged that the public education of a single individual is in the public good. (Graduates) go out to be school teachers and engineers, doctors and lawyers, journalists and engineers. And they sort of make society work and that's a good thing."

According to Kushner, "what happened" was that "During the difficult budget times between the mid- to late-'90s, that philosophy changed to the public education of an individual is good because they go out and get a job and make a comfortable living. So if they're getting that direct benefit, they should pay for it."

Indeed, just about everyone interviewed for this article pointed to cuts—or a deceleration—in school funding for state universities. That in itself is a major indicator as to where our priorities as a country reside. After all, if there's a shortfall in a state's higher education funding, you can always raise tuition and fees. Or put another way, you can borrow from Peter to pay Paul. But who pays for the long-term consequences? We do. In some cases, says Kushner, it is a matter of world view and experience.

"The (members of) legislatures tend to be less from engi-

neering and more from the service side (lawyers, entrepreneurs, etc.) of the economy,” says Kushner. “So they may not have an appreciation for what it takes to develop the technologies that make their lives what they are.”

Kushner adds, rhetorically, “It’s terribly difficult for states to decide where you have to balance your budget every year. (If you have overflowing prisons, you have absolutely no choice but to build more and bigger prisons. You have to get the money from someplace; well, you can always raise tuition at a state university. I’m not implying it’s prisons versus universities, but universities are a little bit more unique in publicly funded projects.”

Just to provide a snapshot of our country’s priorities regarding education, consider this. According to Kushner’s “back-of-the-envelope calculation,” the yearly undergrad tuition for every engineering student in America totals roughly \$2.5 billion; the war in Iraq is costing us \$1 billion per day.

Colorado State University is another school with differential pricing for certain majors, including engineering. The upcharge is modest, about \$200 over an entire year, but needed, according to Sandra Woods, dean of engineering.

“A lot of state universities have employed differential tuition for programs that are very expensive to deliver,” she says. “Engineering is probably one of the highest-cost programs because of our faculty salaries, and also the large number of laboratories that we deliver for technical programs. So that is when we made the decision to implement differential tuition, just to reflect the cost of the program.”

The good news, according to Woods, is that every dime is

invested back into the engineering department to cover costs and, most importantly, to hire more teachers. Woods adds that the school was able to hire three more faculty members for the department—thus reducing student-per-instructor ratios—a distinct learning advantage. Woods also points out that professors of engineering command higher pay because it is a given that they can make much more money in the private sector.

“It’s the market,” Woods says. “If you compare hiring a mechanical engineering faculty member and an English or social sciences professor, it may be a 50 percent increase in salary that you need to pay in order to recruit the best faculty.”

At Pennsylvania State University (home of the Gear Research Institute) there is no differential tuition; merely computer and lab fees, according to Suren Rao, institute director. He also states that while there has not been a cut in financing in his state, “The rate of growth of state funding has declined.” Some would interpret that as a cut, but it apparently is not affecting undergraduate enrollment.

In the final reckoning, differential tuition and the schools that impose it are not, ultimately, the real issue. That is simply nibbling around the edges. And it is not as if one can point a finger at any one sector of our society in identifying why there is a brain drain and a lack of will to regain our nation’s manufacturing and technology preeminence.

But one place to start—as has been pointed out in this publication before—is the primary and secondary schools. It is while young people are of that certain age that a seed can be planted and nurtured in encouraging a career in engineering and the sciences. And, according to most of the people interviewed for

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this article, that nurturing and inspiration have, over the past 30 years, not been forthcoming. The end result is a general ignorance and lack of regard for the engineering profession itself.

Respect in short supply. “There is a respect issue,” says Iowa State’s Kushner. “In places like Korea, China, India, it is the parents’ purpose or goal to work with their children to get them into the best science and engineering schools there are, because it is considered such a crowning achievement and is so beneficial to the country.

“Here, for whatever reason, academics and the technically educated are not held in particularly high esteem. If a person has a medical degree, you call that person doctor. If you have a Ph. D. in physics, you’re called mister. In the scheme of things, maybe that’s not so important, but it is delivering a message to young people that says, ‘Where am I going to go to get respect?’

“I give a lot of rotary-type presentations, and when I ask the audience, ‘Have any of you benefitted from the work of an engineer since you got up this morning?’ Nobody raises their hand. We would all be standing naked in open fields if there were no engineers.”

Angel Otero, chief of space operations at the NASA Glenn Research Center in Cleveland, has one son in engineering at Ohio State and another on the way. His concern is the absence of new blood that will be needed to help the agency in its goal to get back to the moon in the next 10 years.

“The aging (of existing engineers) is a big problem with NASA because a lot of our folks retire at a fairly young age. With civil service, they can retire at 55 and then go to work for a (NASA) contractor for a few years and retire again. And we are not getting the influx of young people to come in behind them to bring the energy, the new ideas, things like that.”

Asked where he sees things 10 years out, “It could be an interesting situation,” he cautions, with a discernible note of dread in his voice. “We will have less and less of a properly skilled workforce to handle getting ready to go back to the moon, for example. We need to be hiring right now.”

Speaking of aerospace, there is another parallel to be drawn; this one dating back to 1957, when the Russians successfully launched Sputnik. That served as a national wake-up call to the nation that our space program was lagging and that we needed to get back to sharpened pencils and slide rules.

“We need to make this (lack of young engineers, etc.) our generation’s Sputnik,” says Niel Tebbano, vice president of operations for Project Lead the Way (PLTW), a highly regarded nationwide foundation that exists to enlist young people in tomorrow’s engineering challenges. “We’re shortsighted if we don’t do something about it.”

The good news is that some people are, mostly at the grassroots level. In Montana, Democratic Senator Max Baucus has proposed free—let me repeat that—free tuition for math and science majors as part of his Education Competitiveness Act initiative in the state. His intent is to better prepare students for college and to help the U.S. stay globally competitive with countries such as China and India. In return, engineering, math, and science and technology graduates agree to work or teach in a related field for four years.

And in addition to groups like PLTW and the Austin Polytechnical Academy in Chicago (a technical-based high

school created in 2007 to help students across all demographics along the path of high technology and learning), there are numerous companies in the private sector with programs and competitions created to encourage participation in the technical sciences and engineering.

“It is my opinion that major corporations do provide support for undergraduates in a variety of ways,” says the Gear Institute’s Rao. “The co-op programs are the most valuable. Where they provide minimal support is in the graduate programs for research. In the past, faculty could cheaply hire foreign graduate students who went on to stay in the U.S.

“However, today many of these students from Korea, China and India go back home and the U.S. is not producing enough graduates with advanced degrees in engineering to keep us on the cutting edge. More support from corporations for research would help in recruiting native-born students into (graduate programs).”

But in the final analysis, the consensus seems to be that more—much more—is needed from lower education and government if we are to have any hope of creating a groundswell of interest in the hard sciences among young students. That’s because right now, it’s not happening. Consider Otero’s telling example of a Dad’s Day experience he once had.

“When my son was in grade school, I took a NASA spacesuit to his class so the kids could touch a real spacesuit and ask questions, and you could see the excitement on their faces. But then when he got to junior high, I never got a call. The teachers didn’t have the same enthusiasm at that level.”

“What your country can do for you”—if willing. As for governmental involvement, Tebbano at PLTW believes the states need to lead the charge, especially given the lack of direction from Washington.

“I think the states need to understand that there’s a direct relationship between their ability to produce a qualified future workforce and their own goals related to economic development and so on. What they’re really doing (by not adequately funding schools) is exacerbating an existing problem. There already is a dearth of young people entering these fields, as we know. They’re really not doing anything to contribute to solving the overriding issue, which is where are we going to get the quality, quantity and diversity for our future engineering and technical workforce?”

Revisiting the earlier Sputnik reference, Tebbano reminds those of us old enough to remember—not a problem, unfortunately, in the gear industry—how the Sputnik success spurred government to action.

“When Sputnik went up, the federal government responded with the National Defense Loan System, and they waived certain percentages of student loans for young people entering science and education. That had a huge effect on choices that young people made at that time, and I can speak to that because I took advantage of that program as a college student. So do incentives have an impact on some of that?—absolutely.

“Using that logic, doing the opposite (reduced funding; differential tuition) would in turn have the opposite effect. If a young person considering college has a choice between paying \$5,000 to go into liberal arts, and \$7,500 to go into engineering or science, if they’re on the fence you know which way they’re going to lean.”