

# The Tidal Wave

By Robert Mote, P.Eng

A few years ago, a study carried out by Duke University researchers tried to define two terms that are crucial to their interpretation of market conditions and the United States' unique advantage in science and engineering innovation. Consistent reporting of problematic engineering graduation data has been used to fuel fears that America is losing this technological edge. Typical articles have stated that, in 2004, the number of undergraduate engineers was 70,000 in the U.S. vs. 350,000 in India and 600,000 in China. The big headline was that the combined number of graduates from India and China was running five to eight times greater. This has been going on year after year.

Some tried to argue that engineers from different countries could not be compared as "apples to apples". The rational case was presented using the terms "transactional engineers" and "dynamic engineers." This is an interesting defensive position. Let me explain.

#### Transactional Engineers:

- May possess engineering fundamentals, but not adequate experience.
- Lack the expertise necessary to apply this knowledge to larger problems.
- Are typically responsible for rote and repetitive tasks in the workforce.
- Often receive associate, technician or diploma awards, rather than a bachelor's degree.

#### Dynamic Engineers:

- Are capable of abstract thinking and high-level problem solving.
- Thrive in teams.
- Work well across international borders.
- Have strong interpersonal skills.
- Can translate technical engineering jargon into common diction.
- Have four-year engineering degrees from nationally accredited or highly regarded institutions.

The overarching conclusion was that dynamic engineers lead innovations, and all will be well because the U.S. produces dynamic engineers by virtue of their training and education.

Given the definitions above, based on my experience within the oil and gas sector, I

would say that we are all transactional engineers in reality! True dynamic engineers work in teams and use them to create the innovations that result from the interaction. Think of Steve Jobs and his Apple® iPod. He did not do it all by himself, did he? He needs the team to push and respond to the highest standard. He gave his team the command to do their best and go beyond the minimum. I do not see that happening in our profession, generally. I see optimized or innovative solutions shelved to preserve and maximize corporate profits.

Innovation is born of inspiration more than education. Invention is born of perspiration and adversity more than interpersonal skills. The quality of education is not a paramount condition, but rather the opportunity of the mind. It does not matter whether you are American, Indian, Chinese or from Mars. It knows no boundaries.

Let us re-examine the numbers and try to find a reasonable method to determine the approximate number of dynamic engineers from our large pool. I recall reading somewhere a biological equation where the square root of one percent of the population has the power to produce systemic changes. Applying this rule suggests that there are perhaps 26 dynamic engineers produced every year in the U.S. vs. 59 in India and 77 in China.

Every year, year after year, we see the potential for new ideas multiplying outside the U.S. The U.S. has an advantage in the implementation of funds, resources, marketing and developing ideas; but for how long? The Indian steel giants turned car makers, Tata, have released the world's least expensive car. Daewoo and Hyundai build their own submarines; Japanese industry is a world-class model of quality. The Chinese have their own space program.

Perhaps you think that I am an alarmist; I am not. We are in a global economy; we relocate engineers from India to do work in Canada and the U.S. because we do not have enough engineers available locally, and in some cases they are also more cost-effective. It is a wake-up call for American businesses, politicians and engineers. I believe that there is plenty of engineering talent to drive innovation and economic

growth for a long time in the U.S., but we can and must do better.

What will it take for American industry and engineers to lead in traditional engineering amidst our crumbling infrastructure? Any number of options exist; here are a few:

- Go metric. Imperial measurement has no future. The world is trending towards globalization, which will lead to better innovation and cross-pollination of experiences.
- Go green. The drive to change the biggest inertial system in the world is impressive and wonderful news for the globe.
- Improve recognition of engineers' role in society. Increase pay and showcase their contributions. It does not need to be the space program; the recent infrastructure spending is long overdue, and new projects should be executed with much fanfare.
- Improve work processes for engineers. Increase their productivity, and lead in education and quality presentations.

As an example, in the oil and gas sector, calculations are the bedrock of the civil and structural engineering disciplines. Depending on the project size, calculations can take from days to months to prepare. Typical quality assurance processes require key project calculations to be easily presented and understood during subsequent reviews and approvals by senior engineers, project leads and clients. What is commonly produced is specialized, exclusive, voluminous and hard to read. This is typical from an American consultancy, and the workshare companies borrow these practices as their go-by without questioning it. I believe that this moribund state of affairs is inspired by the imperial system, poor reporting facility and a lack of personal responsibility for the quality of the calculations.

As I point out to engineers who express indifference, if we cannot produce magazine-quality calculations that inspire the team to do better, how can we call ourselves dynamic? In a multi-billion-dollar job, these calculations have incredible

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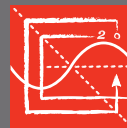
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value, yet you would ask for your money back if your bestselling paperback had three spelling mistakes in it! The calculations have value in the time that it takes to prepare them such that they are readable, actively useful within the team, checkable and educational for graduates and the client.

These mediocre calculations are produced by highly qualified and trained engineers, but the product is hardly the stuff of dynamic engineers. In a business where 80% of engineers spend 80% of their time doing calculations and 80% hate it, I cannot see the source of pride, innovation and dynamism for the future. Engineers should not simply complain about the situation in which they find themselves, because they can change it – if only they will recognize that it is time for change.

Innovative processes are available for engineers to expand their perception of their work, improve their roles and more than double

their productivity. We have a lot of work to do to reclaim our dynamic status. This is why I train engineers to produce quality calculations. It may seem like a tiny contribution, but as the prism explodes the focused beam of light into the colors of the rainbow, so do quality calculations expand the horizon of the engineer's skill set positively. If engineers accept this 'value' in their work, the change is profound – far beyond merely producing calculations. They are working with the team to lead and becoming dynamic.

Dynamic engineers ask hard questions and find answers within the team. Transactional engineers shrug their shoulders and say, "What can we do?" Dynamic engineers are capable of profound changes in the way they work; transactional engineers simply follow the leader. In a world economy that is currently changing the landscape as at no other time in modern history, the reality of the workforce is far removed from the academic vision of self-

congratulation. In other countries, they are rising to the challenge of the economy and the future. They are willing to learn, improve team-building cohesion and gather confidence for whatever lies ahead. I see great potential for dynamic engineers in emerging economies to become a tidal wave. What are we going to do about it?\*

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