

REMARKS BY G. WAYNE CLOUGH  
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The Moles 2005 Awards Dinner  
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It is a great honor to be here and to join the long line of distinguished Principal Speakers who have been featured at this auspicious event. As I looked over the imposing list of the national leaders who have preceded me in this role, I took comfort in the realization that I may be one of the few who actually knew about The Moles before I was invited to speak. And it has been delightful to have this opportunity to catch up with old friends and acquaintances from my consulting work in geotechnical engineering over the years.

In former days, I was fortunate to be able to apply what I have in the way of talents to challenging underground projects. For the past decade or so, my duties have limited my involvement with what I always found a fascinating career. At the same time, the things I learned from working on underground problems prepared me well to be a university president. After all, finding out your football coach booted one of your major donors out of his office is not much different than learning the street just caved in over your tunnel heading. Or, being told that a group of your students just streaked a prayer meeting is similar to hearing your excavation caught on fire due to an unexpected gas pocket. And, just like working underground, being a university president means a call at night is probably not good news.

So I am grateful for my experience as an underground engineer, and it is a special pleasure this evening to join you in celebrating the recipients of some of your prestigious awards for outstanding career accomplishments. I want to begin by offering my congratulations to the awardees and thanking you for your leadership. Our nation has benefited from your contributions. The construction industry is an important part of our nation's economy, making up around 5 percent of the labor force and composing upwards of 6 percent of the GDP or over \$680 billion. Many, including those here tonight, have seen to it that our construction industry is one of the world's best.

Indeed, we can be proud that in the past our nation's economy has been the most responsive and resilient in the world for many decades. And we can be pleased with the significant role of engineers in this endeavor. However, as we all know, what worked in the past, does not necessarily work in the future, and I would like to spend a little time this evening thinking with you about what we need to do to succeed and thrive in the economic environment of the 21<sup>st</sup> century.

This is a gathering of "Who's Who" in the construction industry. Everyone in this room is engaged in major projects across the country, and even as I am speaking, I know there are those who are checking your Blackberries and other personal wireless devices, keeping up with business. But those devices, along with a lot of other technology we use daily and take for granted, did not even exist just 20 years ago. The computer of 20 years ago featured a nine-inch text-only display, had no hard drive, and cost more than \$4,000. Cell phones were hard to carry around and none of them did text messaging or took digital pictures. In fact, there were no digital cameras. There was no commercial Internet, and no dot-com economy to boom or bust.

Technology is not the only thing that changed rapidly during the past two decades. Twenty years ago the Berlin Wall was still standing, and the world was dominated by two political power blocks – the communist world of the East, anchored by the Soviet Union, and the democratic world of the West, anchored by the United States. Then the Cold War ended in late 1991, and the Soviet Union broke into its component republics. The political barriers that had separated the world rapidly dissolved and trade barriers between many nations came down.

At the same time, the proliferation of telecommunications technology and the development of the commercial Internet opened new avenues of inexpensive, real-time communication. Emerging nations like India and China began developing technology-based economies. These nations, together with Japan and the European Union are looking to compete with the United States in fields where engineering and technology forms the backbone, and they are making inroads. Their rapidly growing economies are also placing increasing pressure on resources we have taken for granted, from fossil fuels to building materials like steel.

The surging economies in places like China and India are driven to some extent by the disparities in wages compared to the United States, but they also reflect the growing size of the skilled technological workforces in these nations. They are investing heavily in quality education programs in science and technology, and the National Science Foundation estimates that China, India, and the European Union each now graduate more engineers than the United States. They are also investing in the kind of R&D that drives economic futures.

Craig Barrett, the recently retired CEO of Intel, says it this way: “The U.S. is not graduating the volume of scientists and engineers, we do not have a lock on the infrastructure, we do not have a lock on the new ideas, and we are either flat-lining, or in real dollars cutting back, our investments in physical science and engineering. The only crisis the U.S. thinks it has today is the war on terrorism. It’s not.”

So, how are we to survive and thrive in this new environment where many of the natural advantages we used to rely on can no longer serve their former purpose? The answer it seems to me largely lies in one word, innovation. As a nation we have been known for innovation and a willingness to find ways to implement those developments that are at the cutting edge. We have used our ability to innovate to keep our economy robust so it provides good wages and a high standard of living. Looking to those nations that are moving to build economies in the innovation space, we cannot fault them for working to improve their own standard of living. But that means we need focus more deliberately on being ahead of the game and insuring we will have our fair share of the economic returns in the future.

“Innovation” has become a buzzword these days, and it is often used interchangeably with the word “invention.” But they are not the same thing. Invention can be done by the lone genius tinkering away in the garage or garret. Innovation is a much more social activity that emerges at the intersection of science and technology with business and the marketplace.

Innovation begins with research that generates breakthroughs in science and technology, opening new fields of endeavor and changing the way we live our lives. But scientific discoveries and new technology by themselves are not enough in this new, interconnected global economy. Innovation requires that we not only discover new knowledge and technology, but also that we anticipate ways to put it to work within a complex legal, political, social, and economic landscape. To win in the competitive marketplace of the 21<sup>st</sup> century, our solutions must offer value that makes them worth

the cost. Our competitive edge will lie in the application of leading-edge technology in creative ways to solve the problems and serve the needs of society. At its most fundamental level, innovation done right will lead to new products and new companies, and maintain a high standard of living for the United States.

Over the course of the past 15 months, I was privileged to serve as co-chair, together with IBM CEO Sam Palmisano, of the National Innovation Initiative, sponsored by the U.S. Council on Competitiveness. We involved 400 of the nation's best minds from academia, industry, and government in developing an action agenda to help the United States build an economy based on innovation. The vision statement for the National Innovation Initiative reads as follows: "Innovation fosters new ideas, technologies, and processes that lead to better jobs, higher wages, and a higher standard of living. For advanced industrial nations no longer able to compete on cost, the capacity to innovate is the most critical element in sustaining competitiveness."

The National Innovation Initiative generated 30 recommendations that we grouped under three broad topics. The first is talent, which is the human dimension of innovation. One of the most important things we have to do to generate innovation is replenish the pipeline of scientist and engineers who can discover the new ideas and invent the new technology that form the raw materials for innovation. As I noted, we are being out produced today by any number of other nations, and if we don't do something about it, the businesses that thrive on talent will follow it wherever that takes them.

The second broad area of recommendations is investment, which is the financial dimension of innovation. Today we enjoy the benefits of a wide range of technologies – from the Internet to magnetic resonance imaging in medicine – that emerged as applications from fundamental, exploratory research begun decades ago. And it is critical to keep that research pipeline flowing. But over time, the federal R&D portfolio has lost balance, and today there is clear need to improve funding for engineering and the physical sciences. If we do not, in the long run it will come back to haunt us.

The term investment also relates to the venture funding available to energize the entrepreneurial sector of our economy. This type of funding is in short supply in many areas of our nation. This partly derives from the bursting of the dot com bubble, and a greater than ever emphasis on short-term results epitomized by the emphasis on quarterly performance reports. That mindset will stifle innovation, so we need to broaden our investment horizons again to become more accommodating of risk.

And, the third topic of the National Innovation Initiative recommendations is infrastructure. The first thing that comes to mind when someone says the word "infrastructure" to this crowd is tunnels, bridges, and other water, transportation, and energy systems. And no one knows better than you that our physical infrastructure needs improvement. In addition, we also need more powerful national IT networks to handle the explosion of new users and new devices that we have experienced.

As we look to implement the recommendation of the NII, we should acknowledge that innovation is not a linear process. There is no single "master stroke" that will insure we can succeed in the days ahead. Nor is there one single entity that can provide the answers. I would be so bold as to say to you here this evening, we have a stake in this as well and you need to be proponents in helping us get the needed work done. I will come back to this later.

What I would like to do for the remainder of my remarks is to drop below the 40,000 foot level and focus on a few key issues related to the role of engineering and the engineering profession in shaping the innovative landscape of our nation. As I noted earlier, the construction industry is a major force in the U.S. economy, and this does not even count the service sectors of engineering design and planning. Yet over the past decade we have seen federal funding for R&D in engineering and construction decline, a trend that is well documented by the National Research Council. Not surprisingly, it has become increasingly difficult to recruit U.S. students into the pursuit of advanced studies in engineering because of a lack of fellowship and research assistant support. And, not surprisingly, too few of the innovations that are driving our construction industry and engineering practice are originating in the United States. This needs to change if engineering and construction are to be part of the innovation agenda and the competitiveness of our nation in the future.

A number of entities have called for an effort to balance the R&D funding portfolio of the federal government and to achieve this not by cutting support for fields like medical research but by bringing up the support for engineering and physical sciences. Two recent reports by the President's Council on Science and Technology made recommendations to this effect. If this were accomplished, would this result in direct funding for research in construction? No, but it is the right way to start. Begin with a larger objective that supporters can rally around and then build a case for more specific objectives. Now, many of you in this room support political campaigns or contribute to PACS which means you have influence with our elected representatives. I would urge you to become informed and weigh in on the issue of improving the R&D funding for engineering and fellowships for U.S. students to undertake advanced studies in engineering. To do so is to act in the best interest of our nation and the young people who deserve the opportunity many of us had when we were students. Please use your influence to make a difference before it is too late.

Engineering as a profession, and its closely related sibling, engineering education, also need to do their part to respond to the need for change. For too long engineering and engineering education has changed only after external events forced the change. We need today to anticipate change and be ready for it. This approach is reflected in the Engineer of 2020 Initiative of the National Academy of Engineering, which I have the honor to chair. Our hope is to sort out the issues and opportunities that lie ahead so that engineering education can adapt ahead of time to produce the curricula and processes that will allow us to graduate engineers prepared for the environment in 2020.

This Initiative has been underway for three years. The report for Phase I is now available through the National Academy of Engineering and it addresses the circumstances that are likely to be important for engineering in 2020. It also goes a step beyond by identifying aspirations for engineering and engineers so that the profession will be able to re-establish a place of respect in our society and be able to attract our share of the best and brightest students.

In reviewing the context for 2020, the Phase I report comments that basics, like access to fresh water, energy, medical care and housing, will be at core of the problems we will face, particularly as we add two billion more people to the world. While these issues will grow, we are fortunate that new breakthrough technologies coming from fields like nanotechnology and biotechnology will offer entirely new approaches to tackle our challenges. However, if we are to make the transition to a new toolkit, it will take a significant effort on the part of engineering and engineering education to insure engineers are up to the task and on par with those from other nations.

But it is not enough to just prepare for technological proficiency. Engineers will need to be educated as innovators, calling for students to see more direct exposure to cross disciplinary topics and the

workings of an entrepreneurial economy. They will need to learn to appreciate the role of public policy and the importance of engineers to help set the local, regional and national agenda here. Engineering students will also need to have the opportunity to study abroad and learn to appreciate the cultures of other nations so they can function readily within the global economy. Finally, we will need to enhance positive interactions between our students and faculty with the engineering profession and industry.

Can we accomplish these ambitious goals? Admittedly, this will not be easy, and the question is being addressed in Phase II of the Engineer of 2020 Initiative. We held a summit last summer in Washington DC with some of the best minds in engineering and engineering education to address the issues. There were many good ideas presented and these are being documented in a report that will be forthcoming in late spring. The NAE is now undertaking a strategically designed effort with the goal of bringing as many engineering educators and members from industry and engineering practice as possible into a dialog on the challenges that lie ahead.

How can you help? Many of you serve on advisory boards of engineering departments and colleges and those of universities and colleges. Become informed and push for these entities to get on the bandwagon. We need your support particularly because you have influential advisory roles. What we are doing at the NAE level is a pull strategy; we need you to push and encourage those you work with to be willing to undertake thoughtful change.

I would argue that while the issues that face us are large, now is the time for thinking big, working together to set goals for where we want to be, and taking actions that one by one will get us there. I close with a quotation from Theodore Levitt who is Edward W. Carter Professor Emeritus at Harvard University. He said, "Just as energy is the basis of life itself and ideas [are] the source of innovation, so is innovation the vital spark of all human change, improvement, and progress." If we in engineering and construction can be more innovative in developing new ideas and technology and applying them in creative ways to solve the problems and serve the needs of society, we will help our nation compete and shape a healthy, prosperous future for ourselves and for generations to come. I have indicated important areas where you can help. Get involved, get informed, and get to work! We need your help!