The Gathering Storm: Where Is The Next Generation Of Engineers and Scientists
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Good afternoon. Thank you for the opportunity to speak with you today.

I am a Rotarian. I believe in the work that Rotary is doing. Rotary efforts have important focuses on youth, education and international exchanges. That is why I have chosen this opportunity to talk with you today about the future of our nation and the dreams for our future.

We are at a crossroads in our nation as we enter a century that we know will be dominated by science, engineering, technology and education. A convergence of science, technology and engineering is taking place. And this convergence is about to change the world.

At Purdue today, we are working in the nanoscale in a brand-new $58 million nanotechnology center. Nanotechnology is a science in which new materials and tiny structures are built atom-by-atom, or molecule-by-molecule. We are talking about computers smaller than your wristwatch.

We have linked our nanotechnology center with a new $15 million bioscience center. In the biosciences we are talking about placing devices into your body that not only will determine what is wrong with you they will fix it! It is exciting and incredible!

And yet, at a point in time when science, technology and engineering are opening all these incredible potentials the United States is falling behind in the production of graduates in these fields. Indeed, if current trends continue, by 2010, only four years from now, more than 90 percent of all scientists and engineers in the world will live in Asia.

This is technology a deficit. It is being called a “gathering storm.” Just as people on our Gulf Coast must prepare for a gathering hurricane before it makes landfall we must address this technology deficit before it is too late.
And the force for strengthening our nation in this gathering storm lies in education. We think of the United States today as the land of promise and opportunity. And it is. Education is the cornerstone of that promise and opportunity. But it has not always been within the grasp of common men and women. In the 18th century, when this nation was founded, educational opportunities were limited. The real promise and opportunity that are the hallmarks of this nation emerged from a consensus that grew among the people to make higher education available to everyone.

In the mid-1800s, Justin Morrill, a Vermont congressman, led a movement that believed higher education should not be limited to an elite group defined by wealth. Morrill, and others like him, believed higher education should be available to all the masses of people.

It was a turning point in history when President Abraham Lincoln signed the Morrill Land-Grant Act of 1862. That act provided the means for states to create new universities dedicated to learning, discovery, and engagement — all for the public good. Within eight years, 37 states had initiated these institutions of higher learning, among them, Purdue. Today, there are more than 100 land-grant colleges and universities swept across the breadth of this great country offering promise and opportunity to all.

But still, by 1940 only two out of five Americans had been educated past the eighth grade. In 1940, only 16 percent of Americans 18 to 21 years of age were enrolled in universities. Today, almost 67 percent of U.S. high school graduates from the class of 2004 enrolled in colleges and universities.

This dramatic change in higher education was sparked by the G.I. Bill at the end of World War II. The G.I. Bill provided funds making it possible to educate huge numbers of individuals who never before even considered attending college. The G.I. Bill educated a generation. The enormous economic growth and social advancements that fueled the 20th Century took place predominantly after World War II. That is when the G.I. Bill educated people in the emerging technologies of the day.

Who were these people? They were people like Kenneth Johnson, who grew up on remote farms in Arkansas and Missouri and went to a one-room school-house surrounded by mud. He came to Purdue on the G.I. Bill, graduated with a degree in engineering, and went on to help revolutionize airplane engine technology working for General Electric.

They were people like Billy Christensen, who finished his studies at Purdue in 1950 on the G.I. Bill and took a job with a punch card company. He went on to become vice president and general manager of the international arm of that company — IBM.

They were people like Bill Rose, who barely survived the Depression before he went to war and then came to Purdue on the G.I. Bill fresh out of the Navy. He graduated and took a job in the Joint Long-Range Proving Ground, at the Banana River Naval Station. We know it today as the Kennedy Space Center.
The G.I. Bill was an investment in people and education that has paid for itself many times over. The Morrill Land-Grant Act of the 19th century and the G.I. Bill of the 20th were education-focused legislation that changed America. And there was one more.

In 1957 the Russians beat us into space with Sputnik. Many of you remember this and the widespread fears of the time that America was falling behind in science, engineering and technology. In response to this the United States launched a satellite in 1958 and also determined to put a man into space. The space race was on. But we did more than that. We invested in education. We invested to ensure that a generation of young people – people like you and me – would be sparked by the potentials and possibilities that emerge from science, technology and engineering.

In 1958 Congress passed the National Defense Education Act. The National Defense Education Act included:

• support for loans to college students,

• the improvement of science, mathematics, and foreign language instruction in elementary and secondary schools,

• graduate fellowships, and

• vocational-technical training.

What was the impact of all of this? Several years ago, the National Academy of Engineering listed the top engineering achievements of the 20th century. They are a stunning glimpse into the progress of human civilization. Purdue engineer Neil Armstrong was the keynote speaker when the list was announced.

Here are the top achievements that changed the way we lived and worked in the 20th century:

• electrification,

• automobiles,

• airplanes,

• water supply,

• electronics,

• radio and television,

• agricultural mechanization,
• computers,
• telephones,
• air conditioning,
• interstate highways,
• the Internet,
• imaging,
• health technologies,
• petrochemical technologies,
• lasers and fiber optics,
• nuclear technologies, and
• high-performance materials.

Close your eyes and try to imagine our world today without these contributions from engineers as well as those from scientists. These are advancements that took us from the horse-and-buggy age at the dawn of the 20th century to the space age and the exploration of Mars and other planets at the dawn of the 21st.

It is clear that American investments in higher education – and most especially investments in science, math, engineering and technology – played a major role in creating this great nation and all the comforts and benefits that we enjoy.

But we have lapsed, and lapsed dramatically in a remarkably short period of time. Twenty years ago, the United States, Japan and China each graduated a similar number of engineers and more than twice the total coming out of South Korea. By the year 2000:

• Chinese engineering graduates had increased 161 percent to 207,500;
• Japanese engineering graduates had increased 42 percent to 103,200;
• South Korean engineering graduated had increased 140 percent to 56,500;

• and credible and in fact very conservative estimates place India’s production of engineers today at more than 100,000 per year.

Meanwhile U.S. engineering graduates have declined 20 percent – to 59,500.
A recent study out of Duke University has challenged some of these statistics by comparing quality of education and the number of years of training to receive an engineering degree in various nations. But it has not challenged the heart of this message: We are falling behind in the production of people in science, engineering, technology and math, which is at the core of all three.

Our middle school and high school students are unprepared in math and science and correspondingly uninterested in these careers. Of the nearly 1.1 million U.S. high school seniors who took the college entrance exam in 2002, less than 6 percent had plans to study engineering. That is a 33 percent decrease from 10 years earlier. Meanwhile, more than 50 percent of the current U.S. science and engineering workforce is approaching retirement.

What is the impact of this? New York Times columnist and author Thomas Freedman writes that a new world has emerged a “flat world,” leveled by technology. Norman R. Augustine, retired Chairman and Chief Executive Officer of Lockheed Martin Corporation chaired the Committee on Prospering in the Global Economy of the 21st Century. This was a committee of the National Academies, the advisors to the nation on science, engineering and medicine. Here are some of the points made by Norman Augustine in his testimony October 20 to the U.S. House of Representatives Committee on Science:

- “U.S. companies each morning receive software that was written in India overnight in time to be tested in the U.S. and returned to India for further production that same evening—making the 24-hour workday a practicality.

- “Drawings for American architectural firms are produced in Brazil.

- “U.S. firms’ call centers are based in India — where employees are now being taught to speak with a Midwestern accent.

- “U.S. hospitals have X-rays and CAT scans read by radiologists in Australia and India.

- “Accounting firms in the U.S. have clients’ tax returns prepared by experts in India.

- “Visitors to an office not far from the White House are greeted by a receptionist on a flat screen display who controls access to the building and arranges contacts. She is in Pakistan.

- “For the cost of one engineer in the United States, a company can hire eleven in India.

- “Chemical companies closed seventy facilities in the U.S. in 2004, and have tagged forty more for shutdown. Of 120 new chemical plants being built around the world with price tags of $1 billion or more, one is in the U.S. --

- and fifty are in China.

- “The United States today is a net importer of high-technology products.”
Just as there is a convergence of technologies, there is a convergence of four trends impacting our nation today. First, we are experiencing a decline in the number of American students enrolling in our engineering and science programs.

Second, we are experiencing a decline in federal research support for engineering and the physical sciences. Since 1970, U.S. funding for basic research in the physical sciences has declined by half as a percentage of the gross domestic product.

Third, since 9-11 we have experienced a decline in international enrollment. We are losing many top students from the around the world who not only have invigorated our academic programs but have challenged and motivated our American students.

And fourth, other nations — especially in Asia — are aggressively increasing research funding, enrollments and the quality of programs at universities. China, for example, plans to increase the proportion of science spending devoted to basic research by more than 200 percent in the next 10 years.

At Purdue we had the first computer science department in the nation. Undergraduate enrollment in that program has dropped 47 percent in four years. Purdue is a top 10 engineering college. Every year applications to our engineering graduate programs decline another 25 to 30 percent.

The shortfall of U.S. students and workers in science and engineering has traditionally been met by internationals who studied in the U.S. and often joined our workforce. Where would we be without them?

Thirty percent of Purdue faculty members are foreign-born — including 47.9 percent of our engineering and science faculty. In a post-9-11 world, the way people in other nations perceive us, coupled with our immigration policies, is negatively impacting international enrollment and the U.S. international workforce. International enrollment, after many years of steady growth, dropped 2.4 percent two years ago and 1.3 percent last year. The decline in international enrollment now seems to be slowing. We are hopeful we have turned the corner.

Purdue ranks third in the nation in international enrollment behind only the University of Southern California and the University of Illinois. But even as we work every hard to increase our international enrollment, we continue to face enormous competition for international students from Great Britain, New Zealand, Australia and Canada. I have also been to India and China in the past year to see the tremendous advances in their universities and research.

The speed of change abroad, especially China and India, is quite amazing. At Tsinghua, the MIT of China, a whole new south campus is being built with both government and private resources. Similar changes are taking place at Fudan and elsewhere. And these universities are hiring Chinese and others from the United States. The first Western department head at Tsinghua is a Purdue faculty member.

Purdue and other universities have implemented programs reaching out to high school,
junior high and grade school students to interest them in science and engineering. We have launched programs to increase the number of teachers in these fields and to improve our curricula. We are looking at the engineering needs of the 21st century and will redesign our program to train that person.

The National Academies report, “Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future,” proposes a number of initiatives to meet the technology deficit. The recommendations include awarding scholarships to recruiting science and mathematics teachers.

In return for the scholarships, the students would commit to five years of teaching in public K-12 schools. Other proposals call for programs to upgrade the skills of current math and science teachers. The recommendations include strengthening our commitment to long-term basic research. The recommendations also suggest investments in “high-risk, high pay-off” research.

In spite of all these concerns, American higher education continues to be the best in the world. We can meet and overcome these challenges. It is not too late. We can maintain our worldwide lead even as other countries invest heavily to build up their own high-technology sectors. We absolutely can do it.

But to succeed, we will need a national consensus, just as we needed popular support for the Land Grant Act, the G.I. Bill and the National Defense Education Act. We can inspire a whole new generation of young people to the incredible opportunities in science, engineering, technology and math. And the returns on our investment will be gigantic. It will be a stronger nation and a world filled with breath-taking advances in medicine, science and engineering – breakthroughs that are beyond our dreams today.

President Dwight Eisenhower was not an engineer. But he certainly understood the importance of engineering in everything from the D-Day invasion to building the interstate highway system, which he launched in the 1950s. President Eisenhower said: “Engineers build for the future, not merely for the needs of men (and women), but for their dreams as well.”

The dreams for the future of America are studying in our schools today. It is our job to inspire and to provide them with the resources they need to succeed. We must begin building for tomorrow — today! With your help we will succeed.

Thank you.