President Dan Mote's remarks at the USRA annual meeting, March 2008

Global Competitiveness

In the late 1990s, the Hart-Rudman Commission on National Security stated that "second only to a weapon of mass destruction detonating in an American city, we can think of nothing more dangerous that a failure to properly manage science, technology and education." The Council on Competitiveness, with a membership that includes some of the top business CEO's in America, has echoed this concern about the consequences of under-investing in science, technology and research, and how it will impact America's ability to compete in this century.

Several issues are driving this concern. Maintaining quality of life and security for Americans in the future is a top priority. But prosperity depends on individuals having high-quality, high-paying jobs. The American economy runs on paying for services and paying taxes. History has shown that creation of high-paying jobs is disproportionately dependent on being first in innovations that increase productivity and value.

There is a global understanding that leverage for high wage jobs in the world is a direct result of leading innovations in science and technology. According to China's President Hu Jintao, "The worldwide competition of overall national strength is actually a competition for talents, especially for innovative talent."

Science and technology has demonstrated its ability to significantly impact the economy. Eight studies conducted in recent decades indicate that public investments in science and technology produced annualized returns ranging from 20 to 67 percent. Advances in science and technology have contributed to about half the increase in gross domestic product during the past 50 years.

The United States is lagging when it comes to global competitiveness. Changes in the economy result in 29 million jobs, or 16 percent of total job, being destroyed each year, while 31 million new ones are created each year. This is a tenuous circumstance where small differences between large numbers control the outcome of the modern economy. A small percentage shift can have a big impact one way or another.

Alan Blinder, former vice chair of the Federal Reserve Board, estimates that 50 million U.S. jobs, or one-third of total jobs, are potentially exportable. Some think Blinder's estimate is low.

GE CEO Jeff Immelt points out that last year "we had more sports-exercise majors graduate, than electrical engineers." In his opinion, if the U.S. wants to be the massage capital of the world, it is well on its way.

One good example of the science and technology employment crisis is the engineering shortage. While a steady stream of engineers enter and are continuously present in the field, employers decry an engineering shortage. One reason for this is that technical

information doubles every two years – creating a demand for more and more employees to handle the increase. Another contributing factor is that the half life of information is three to six years. Specific knowledge imparted through formal studies has limited value after approximately five years.

The U.S.'s weak pipeline for science and technology careers is not helping the situation.

- Approximately 66 percent of 8th graders graduate from high school.
    - 60 percent of them go on to college; 50 percent earn bachelor degrees; 15 percent of them will be in engineering; of those who are U.S. citizens, 10 percent will become candidates for doctoral degrees; and 50 percent of them will earn their PhD.
    - 2,000 eighth graders yield 30 bachelor degrees and 3 engineering doctorates.

- Fewer than 2 percent of U.S. high school graduates earn degrees in engineering.
    - And less than 1 percent is women and minorities.

- Fewer than 15 percent of high school graduates have sufficient math and science qualifications to pursue a university engineering program if they wanted to.

- Internationally, in undergraduate natural science or engineering, South Korea has 38 percent; France has 47 percent; China has 60 percent; Russia has 31 percent; and Singapore has 67 percent.

- In the U.S., only 15 percent of undergraduates are studying natural sciences or engineering.

Making the problem worse, is that many engineering graduate are not working within their field.

- Over half of those holding bachelor of science degrees in engineering enter careers outside of engineering, including investment banking, law, and business.
- More top-500 CEOs hold engineering degrees than degrees in any other major field.
- Approximately 23 percent of all U.S. CEOs majored in engineering; 13 percent in economics; and 12 percent in business.

Over two decades, the number of bachelor's degrees in engineering has dropped 18 percent.

- Law degrees increased by more than 20 percent.
- MBAs increased 108 percent.

The number of U.S. citizens earning doctorate degrees in engineering dropped 23 percent in the past decade.

- Two-thirds of PhDs in engineering go to non-U.S. citizens.

- By 2010, 90 percent of all PhD holders in engineering and science will live in Asia.
- For every new U.S. PhD in engineering, there is: 1 new PhD in physical science; 18 new lawyers; and 50 new MBAs.

And the U.S. has not been able to keep its research enterprise up to date.

- In 2004, federal funding of research in engineering was less than 50 percent of what it was in 1970, as a fraction of GDP.
- The same is true for physical sciences research.

To see where our problems are coming from, take a look at the annual federal investment in research. The total annual combined investment in physical sciences, mathematics and engineering is equal to the increase in U.S. health care costs every six weeks. The NSF funds one in five proposals deemed meritorious. Physical science, math, and engineering research have been flat funded at NSF for more than two decades, when inflation was adjusted. And basic research at DoD has been flat for the last 30 years, when adjusted for inflation. This is not good as global competition increases over the past two decades.

How globally competitive is the U.S.?

Intel spokesperson Howard High said, “We go where the smart people are. Now our business operations are two-thirds in the U.S. and one-third overseas. But that ratio will flip over the next ten years.”

General Motors spokesperson Greg Martin said, “We’re a global car company that happens to be based in the U.S.” It is worth noting that GM just opened a plant in Uzbekistan. The Uzbeks are already assembling Chevrolets out of kits purchased from South Korea.

In 2004 John Chambers, CEO of CISCO, said, “What we're trying to do is outline an entire strategy of becoming a Chinese company.”

- The World Economic Forum dropped America to seventh place from first in its ranking of preparedness to benefit from advances in information technology.
- The remnant of the legendary Bell Labs was sold to the French.
- The largest IPO in history was conducted by a Chinese bank.
- Last year foreign automakers sold more cars in America than U.S. manufacturers.
- Toyota has more than 5 times the market capitalization of GM and Ford combined.
- Between now and 2015, half the construction on earth will be in China – building 22 billion square feet per year and mostly commercial.
    - Total U.S. commercial space covers 60 billion square feet, just about three times China’s annual increase.

    - Research centers in China rival the size of US cities.

- Building economic barriers to protect Americans will ensure isolation and irrelevancy as the world moves forward.

    - China tried this strategy in the 15th and 20th centuries with predictable results on both occasions.

The National Academy of Science has issued a report of the topic – "Rising Above Gathering Storm"

Where did it come from? The National Academies was asked by several senators and congress people, including Senator Lamar Alexander, to respond to several queries about how science and technology could be enhanced in the US, in order that the US compete and prosper internationally in the 21st century.

1. To answer these questions, National Academy of Science formed the Committee on Prospering in the Global Economy of the 21st Century (June 2005): prosperity and security were of primary importance. The 20 person committee included Nobel Prize winners, industry CEOs, university presidents, and specialists whose knowledge and training could contribute unique insights. The report *Rising Above The Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, was delivered in October and was mentioned in the President's State of the Union in 2006.

2. **Norman R. Augustine,** Retired Chairman and Chief Executive Officer
Lockheed Martin Corporation, chaired the Committee on Prospering in the Global Economy of the 21st Century, Committee on Science, Engineering, and Public Policy Division on Policy and Global Affairs, the National Academies of Science. Norm Augustine presented the report on Oct. 20, 2005 to the Committee on Science in the U.S. House of Representatives.

What does it address and how?

- Maintaining a secure and high quality of life for Americans.

- High paying jobs for Americans in a globally competitive world where value is created through innovation.

- A leading position in Science and Engineering in a highly innovative framework.

The four main points of the report are:

- Move the US K-12 education system to a leading position among global standards especially in preparation for science and technology careers.

- Double real federal investment in basic research in mathematics, physical sciences and engineering over 7 years while maintaining the recently doubled spending in biosciences.

- Inspire more Americans to careers in sciences, engineering and mathematics. Make the U.S. the most attractive setting in which to study and perform research so that we can develop, recruit, and retain the best and brightest students, scientists, and engineers from within the U.S. and throughout the world.

- Rebuild the national competitive ecosystem for innovation around patents, immigration, tax-credits and litigation policies.

What will it cost and can we afford it?

- It will cost $9 billion the first year and $19 billion each year after full development.

- Raises the question - can we afford *not to do it*?

    - Other things that we are able to afford as a reference:

        - $7 billion gambling on the Super Bowl.

        - $13 billion on porn.

        - $17 billion on Valentine's Day.

        - $32 billion on movies and DVD's.

        - $120 billion in Iraq and Afghanistan

        - $250 billion on farm subsidies.

    - Federal budget is $2,800 billion and GDP is $13,000 billion. We can afford it if it is a priority.

The irony is that America's leaders seem convinced about the importance of fixing our preparation for competitiveness and innovation through K-12 math and science education and increasing government investment in basic research. This is demonstrated by the President's specific proposal in his 2006 State of the Union address, as well as the resulting authorization in the America Competes Act passed in the House with unanimous consent in the Senate.

The America Competes Act:

- Keeps research at NSF, NIST and the DOE Science on a near-term doubling path over 10 years.

- Authorizes $43.3 billion over FY 2008 - 2010 for science, technology, engineering and mathematics (STEM) research and education programs across the federal government.

- Establishes an Advanced Research Projects Agency for Energy (ARPA-E), a nimble and semiautonomous research agency at the Department of Energy to engage in high-risk, high-reward energy research.

- Expands early career grant programs and provides additional support for outstanding young investigators at both NSF and DOE; and

- Strengthens interagency planning and coordination for research infrastructure and information technology (i.e. high-speed computing).

- It did not do anything for NASA.

Where are we now?

Conflict over the total appropriation for 2008 led to an avalanche of 12,000 earmarks and an FY08 omnibus budget act that failed to address America's competitiveness in any meaningful way. It failed in FY07 too – making it two consecutive failing years. Congress scrambled to place $168 billion into the economy to shore it up but the issues that stand behind the call for this fix, and those fixes yet to come, went largely untreated.

A disappointing FY08 budget did include:

- 2.6% for DOE after earmarks, thus losing ground to inflation.

- 2.5% for NSF, losing ground to inflation.

- 2.3% for NIST research, losing ground to inflation.

What's next?

A continued push on Congress and the Executive, with more sectors engaged is needed. America Competes is returning for a third try, many speculate there will not be a 2009 budget passed outside of defense appropriations until after the new administration is assembled next February.

The proposals for the 09 budget that the president has put forward are:

- NSF: 16% increase over FY08 to $5.59 B
- NASA: 1.8% increase over FY08 to $17.6 B
- DOE: 18.8% increase over FY08 to $25 B
- NIH: no change: $29.23 B but NIH will lose 1/7 of their purchasing power due to inflation
- NIST: 16% decrease over FY08, to $638 M.

We need the USRA and all bodies to become active. It should not sit on the sidelines. Tenets of the issues are central to the USRA: Make the United States the most attractive setting in which to study and perform research so that we can develop, recruit, and retain the best and brightest students, scientists, and engineers from within the United States and throughout the world.

The USRA can also speak to what is needed to attract the best and brightest young space scientists and engineers, such as the hands-on training provided by sounding rockets, balloons, and other small missions. These space professionals are going to be an ever more crucial component of the U.S. workforce, security and prosperity going forward.

We must all fight the pressure toward isolationism – "bring back the jobs" is heard in increasingly supporting tones during the presidential campaigns in Ohio and Michigan. These are tones of the death knell for our country if we go in that direction. We can succeed only by competing not by protecting.

I do not see that the UAW was able to save either the U.S. auto industry or the quality of life for auto workers.

Role of the USRA

The USRA might consider taking a broader view of its role in promoting space and earth sciences. By looking beyond contracts, USRA can engage Universities, University consortia, government, and private sector. Partnerships could be formed with government, university and industry organizations, resulting in fewer sectors remaining isolated and highly-connected partnerships on global scale, such as:

- National Oceanic and Atmospheric Administration's National Center Weather and Climate Prediction, National Aeronautics and Space Administration , Department of Energy, University of Maryland , and foreign governments.
- Intelligence Advanced Research Projects Activity -IARPA; Center for the Advanced Study of Language, Joint Quantum Institute, Study of Terrorism and Responses to Terrorism (START at UM), all security agencies under the Office of the Director of National Intelligence
- Joint Quantum Institute –National Institute of Standards and Technology, Laboratory for Physical Science, University of Maryland

Partnerships can lend broader support for the 2007 USRA Council resolution urging that "… *the United States Government and others to implement and facilitate a plan to provide space flight opportunities that enable the hands-on training for graduate and undergraduate students*."

A few suggestions about the USRA role in facilitating the expansion of opportunities for students to engage in space flight opportunities and Space missions are:

- Make the most of opportunities and resources at hand to give developing space professionals the hands-on experience you seek for them.
    - While small-mission opportunities (sounding rockets) are limited, opportunities for graduate students to be responsible for some hardware in missions can be expanded.
    - Their hands-on training is essential for our national capabilities and their recruitment.
- Press the case to Congress and government agencies for the need to sustain small space missions that inspire and train budding space professionals.
- The draft resolution on future NASA budgets that call for "…competitive opportunities for university missions on sounding rockets, high altitude balloons, remotely piloted vehicles, emerging commercial suborbital flights, and university class space flight missions" seems right on target.
- Workforce rejuvenation is highly commendable. Nothing replaces being engaged.

In conclusion, the USRA needs to engage on issues if it expects to influence the outcomes. No engagement equals no action. It is said that there are three types of organizations in the world. Those that make things happen. Those that watch things happen. And those that ask what happened. Which type of organization is the USRA?