House Committee on Science and Technology

Testimony on
Strengthening Regional Innovation:
A Perspective from Northeast Texas

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Chairman Gordon, Ranking Member Hall, thank you for the opportunity to testify today on *Strengthening Regional Innovation*. Texas Instruments appreciates the leadership of the Science and Technology Committee on so many critical issues, but particularly the landmark *America COMPETES* legislation and the *National Nanotechnology Initiative Amendments Act*.

TI also applauds the strong research investments provided in the *American Recovery and Reinvestment Act (ARRA)* and 2009 omnibus and thanks you for your continued leadership on research funding. Historically, the federal government has been the primary source of basic research funds for universities and plays an especially important role in supporting higher-risk, exploratory research for which the economic benefits may not be realized for decades.

TI has a nearly 80-year history of innovation. While our products have changed many times over the years, we have always fundamentally been a company of engineers and scientists. We have always looked to the future by investing in R&D. Based in Dallas, TI is the second largest U.S. semiconductor company and the world's fourth largest. While our headquarters and substantial manufacturing are located in Texas, TI derives 85% of its sales from overseas markets.

TI is focused on developing new electronics that make the world smarter, healthier, safer, greener and more fun. We make chips that can improve energy production, distribution, and consumption – such as applications for renewable sources, smart meters, and energy-efficient appliances.

In 2008, TI invested 15% of sales in R&D. Like most other high-tech companies, much of this was geared towards shorter-term product development, but this figure does include significant investments in longer-term research both in-house and in collaboration with universities.

I will focus my comments today on the research and education partnerships TI has formed within the North Texas innovation ecosystem. Quite simply, regional innovation capacity boils down to talent. A workforce educated in science, technology, engineering and math (STEM) is essential to the success of companies like TI and to overall U.S. innovation in a globally competitive environment. University research is a lynchpin for training graduate students and for enabling the breakthroughs vital to private-sector innovation.

TI Internal Labs

I direct the Digital Signal Processing Solutions R&D Center, which is the core technology that enables continuous real-world analog signals such as voice or images to be converted to digital form and interpreted. Our research has applications in communications, medical, video, vision and imaging, audio and voice. TI also recently launched in-house lab efforts focused on solar and light-emitting diode (LED) technologies.

I also oversee Kilby Labs – an exciting new initiative at TI. In conjunction with the 50th anniversary of the invention of the integrated circuit in 2008, TI launched Kilby Labs as a center of innovation designed to foster creative ideas for breakthrough semiconductor technology. The new labs build on IC inventor Jack Kilby's legacy of revolutionizing our lives through chip innovation.

The lab allows selected TI researchers to work full time on a high-risk, high-reward project for several months to a year. The research often involves collaboration with university professors and several graduate students are assigned to the lab through TI's co-op program. A board of business unit technical experts selects projects on a competitive basis from TI employee submissions. Selected projects must have financial sponsorship from a TI business unit. Currently, there are 7 projects selected from over 90 submissions. Several of the current projects are focused on power management critical to energy and medical applications, from chips that can better harvest energy to ultra-low power chips suitable for medical implantable devices.

Texas University Engagement

TI has special relationships with Texas universities. TI founders Eugene McDermott, Cecil Green and Erik Jonsson helped establish the University of Texas at Dallas (UTD) in 1969 by providing the vision of a local science, technology, and research institution and donating the land for the campus. In 1986, UTD's engineering school was named in Erik Jonsson's honor.

In 2003, TI announced it would build a new $3 billion manufacturing facility in Richardson, Texas. Although incentives were offered by sites around the world, one of the key factors was commitment by the State of Texas to invest $300 million at UTD to further develop research and engineering capacity and improve the innovation ecosystem of North Texas. Since that time, UTD's graduate engineering program has risen 20 spots in the *U.S. News and World Report* rankings, 20 new faculty have been added, and annual research expenditures have nearly doubled to $65 million.

In 2005, the State of Texas created a $200 million Emerging Technology Fund which has been a wonderful tool for incentivizing research and innovation in Texas. The fund has three goals: invest in public-private endeavors around emerging scientific or technology fields that are likely to enhance the competitiveness of the state; match federal and other sponsored investment in science; and attract and enhance research talent superiority in Texas.

In addition, the State of Texas Legislature recently approved resources to grow additional Tier 1 research capacity in the state, which TI strongly supported – The Texas Research Incentive Program (TRIP). Tier-1 is defined as a non-medical research university that supports more than $100 million annually in research expenditures. Texas currently has three Tier-1 research universities: UT Austin, Texas A&M, and Rice. The Legislature identified seven Texas universities[1] that have made good progress towards this Tier-1 goal, and plans to make $25 million available to these institutions to match research gifts they receive. This mechanism enables these universities to leverage state funds based on new gifts that TI and others provide. As a result, these institutions will be better able to drive expansion of their own capabilities.

On September 1, the University of Texas at Dallas announced it had received 16 philanthropic gifts, totaling more than $16.8 million that were motivated in part by the availability of matching funds through TRIP.

In greater Dallas, TI has a tremendous resource in the research community right in our backyard. TI has provided financial and technical support for medical electronics research involving collaboration among UTD, UT Southwestern, and UT Arlington. We also are working closely with Baylor Health and Texas Health Resources. An early success story comes from UTD, where TI-sponsored research resulted in wireless medical sensors that are now being commercialized through a start-up company. The sensors use wireless technology to remotely monitor vital signs and transmit data. The larger MobileLab project on wireless health care at UTD has now received follow-on funding from Ericsson, Research in Motion, Samsung, and Apple.

Semiconductor Research Corporation

The Semiconductor Research Corporation is a consortium of semiconductor companies that collaboratively funds pre-competitive university research in semiconductor technology and design.

TI participates on technical advisory boards, routinely attends university research reviews and adds technical relevance to research efforts. TI's annual contributions in the past five years averaged well over $10 million, enabling SRC to fund more than $70 million of semiconductor research and support more than 1,000 science and engineering graduate students annually. I will highlight three SRC programs as model collaborations:

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[1]UT Arlington, UT Dallas, University of North Texas, Texas Tech, UT El Paso, UT San Antonio, and University of Houston

TxACE, the Focus Center Research Program, and the Nanoelectronics Research Initiative (NRI).

TxACE
TI led an effort within SRC to establish a $16 million collaboration center at UTD that focuses on research in analog and radio frequency technologies to address challenges in such areas as energy efficiency, health care, and public safety, which are uniquely reliant on analog technology. The center involves Southern Methodist University, Texas Tech, Texas A&M, and UT Austin, as well as universities outside Texas including Stanford and UC Berkeley.

TI is providing $1 million to endow an analog design chair to serve as TxACE Director, is providing $500,000 to endow an analog design graduate student fellowship for the program, and has committed $2.7 million for research projects over three years. The SRC is providing an additional $1.2 million per year for three years, UTD and the UT System providing $3.7 million over three years with the State Emerging Technology fund matching $4.5 million over three years. This collaboration of academia, industry, and government is an excellent example of how regional innovation is created.

Focus Center Research Program
The Focus Center Research Program is a partnership between the semiconductor industry and the Defense Department (DARPA) to fund university research on semiconductor technology challenges at 38 institutions nationwide. All funding goes directly to universities, and supports research centered on the key technical challenges to extending and moving beyond current chip-making process technology (CMOS). Federal funds are leveraged through an industry match, which is very rare for a basic research program. Participating Texas schools include UT Austin, UTD, and Texas A&M.

Nanoelectronics
As my colleague Bob Doering testified before this Committee in April 2008, the NRI is recognized as a model collaboration that leverages funding and expertise from industry, the National Science Foundation, and the National Institute of Standards and Technology (NIST), and contributions from state and local governments.

NRI supports basic university research in nanoelectronics at four regional centers involving 35 universities across 20 states. NRI efforts are primarily focused on finding a new switch with improved speed, energy efficiency, and/or cost compared to the field-effect transistor, which is today's workhorse for processing information.

The NRI started as a result of the U.S. semiconductor industry recognizing that university research in nanoelectronics must be accelerated to retain technical leadership and capture the economic benefits. In 2005, six semiconductor companies, including TI, agreed to provide industry funds to form a consortium that would fund university research in nanoelectronics. From the beginning, it was clear that the scope of the challenge and basic science questions involved would require engagement and resources from the federal government, and conversations began with the NSF and NIST.

The third regional NRI center, the Southwest Academy of Nanoelectronics (SWAN) is based at UT Austin and involves UTD, Rice, Texas A&M, as well as other universities outside Texas. In establishing SWAN, the State of Texas, the University of Texas System, and Texas industry collaborated to establish a complementary package of leveraged support. The resulting $30 million of matching funds is focused on attracting and supporting top academic researchers in nanoelectronics. Specifically, this is a three-way match, with the State of Texas contributing $10 million from the Emerging Technology Fund, the University of Texas System matching with $10 million, and the remaining $10 million being contributed by Texas industry for endowed chairs, including $5 million from TI.

The other regional NRI centers provide similar state and local leverage to industry, NSF, and NIST funds. While the states have provided these resources to the four regional NRI centers, it is important to note that the regional centers are "virtual" and involve researchers from several universities outside these states, thus the local investments benefit research on a national level.

STEM Education

Talent is needed to sustain innovation in Northeast Texas – whether at TI, other innovative companies, or at our local campuses. It is critical that we both welcome talent from around the world and build the pipeline of U.S. students in the STEM disciplines.

Education is the highest priority for corporate philanthropy at TI – a heritage of involvement that traces back to the company's founders. Each year, TI and its corporate foundation make financial contributions totaling millions of dollars in grants and other gifts to schools, educational programs, and universities. TI seeks opportunities for fundamental change by developing and supporting programs with measurable success that can be replicated elsewhere. A full description of TI's community education involvement is attached to this testimony in Appendix 1 & 2. I'd like to highlight a recent announcement and a promising initiative in mathematics.

Teacher Effectiveness

Last week, the TI Foundation announced a $3 million investment to advance the effective, innovative teaching of STEM subjects. Two major grants of $1.5 million each will go to proven, successful programs:

- Laying the Foundation (LTF), to provide training and professional development for current math/science teachers in three Dallas-area school districts (Dallas, Richardson and Garland school districts), and
- UTeach, to train new certified math/science teachers, in conjunction with the National Math and Science Initiative and three area universities (the University of North Texas, UT Arlington and UTD).

LTF is a non-profit that provides a comprehensive pre-Advanced Placement training program including resource and planning guides, in-district training, summer institutes, conferences, and online resources. The goal is to support teachers as they prepare students in grades 6-11 to excel in AP and other college-level courses.

UTeach is an innovative teacher preparation program that recruits, prepares, and retains STEM majors to become qualified math, science, and computer science teachers. The grants will fund additional master teachers at two existing UTeach programs at UNT and UTD and will establish a new program at UTA, bringing the total number of UTeach universities to 14 nationwide.

This local investment will increase the output and effectiveness of qualified math and science teachers required in the Dallas area now and in the future.

MathForward
Math is the fundamental skill for science and engineering. It is easy to get students excited about science and engineering, but this opportunity to attract students is wasted if they cannot do the math. TI's Education Technology business developed and implemented *MathForward***,** a research-based program that combines instruction, professional development, curriculum integration and classroom technology to help middle and high school students build confidence and achievement in mathematics, particularly focused on algebra and algebra readiness. The intervention program has proven successful in significantly raising the test scores of students who previously failed state math assessment tests. Most pilot participants were African-American or Hispanic and most were from economically disadvantaged circumstances. First launched at a junior high in the Richardson Independent School District, today more than 40 schools from eight states participate.

Community Colleges
Community colleges are an important element of the economic development, workforce, and educational ecosystem of our community and should be contemplated when developing national strategies for creating climates conducive to economic growth.

One of the essential roles community colleges have historically played in North Texas regional workforce development is providing manufacturing technician training. TI's manufacturing facilities, or "fabs" require technicians to have an associate's degree. Fab technicians perform technical tests and engineering experiments, and need to be able to apply advanced math skills and pass a test on basic electronics, applied physics, and basic chemistry.

The community colleges serving Dallas and Collin counties (Texas) – Dallas County Community College District (DCCCD) and Collin Community College District (Collin) – have combined to receive over $27 million in workforce training grants from local, state and federal sources in 2008-09. Those investments have been deployed to establish and implement a variety of training programs that range from English as a Second Language to Lean Manufacturing and Six Sigma.

Increasingly community colleges also serve as a critical pathway to a bachelor's degree. Community colleges serve close to half of the undergraduate students in the United

States.[2] Currently, more than 600,000 students are now enrolled in community colleges in Texas; that enrollment represents 75 percent of all freshmen and sophomores in Texas and 78 percent of all minority freshmen and sophomores as well.[3]

To increase college going rates, the TI Foundation, since 1999, has supported *Rising Star* scholarships to enable Dallas County students in the top 40 percent of his or her high school class to attend any Dallas County community college. *Rising Star* scholarships go to students who might not otherwise be able to afford college, and include tuition, fees and books for the two-year degree. More than 9,000 *Rising Star* students have enrolled in the Dallas County Community College District since the program's inception. Additionally, TI created a $1 million endowment for Collin College in 2004 for the Science, Math, Advanced Research and Technology (SMART) Educational Initiative. SMART provides scholarships for academically qualified community college and high school students who intend to continue pursuit of four-year degrees in engineering or related fields or to take college-level coursework. The goal is to fuel a pipeline of highly skilled professionals in careers in science, math and engineering disciplines. By the end of 2008, approximately 32 scholarships had been awarded.

Recommendations

As illustrated by TI's experience, model research collaborations involve not only industry and universities, but are greatly enhanced by the engagement of federal agencies and state/local government. One of the most important steps Congress can take is to provide regular, predictable sustained investments in basic research. NSF, NIST, DOE Office of Science, and DARPA are the key agencies that fund physical sciences and engineering research-critical disciplines for the semiconductor industry that unfortunately have been relatively underfunded for decades.

Industry can play an important role in establishing the translation of basic research into commercialization by providing insights on appropriate goals and needs for both "directed" basic research and its potential commercialization. This input is provided through advisory panels, consortia, and various industry advisory liaisons' input into federal agency merit review processes. For example, I serve as an industry advisor on NIST's Technology Innovation Program, which supports translational projects in areas of national need such as energy, security, infrastructure, and medical. Direct agency partnership with pre-competitive industry consortia is also a very effective mechanism to achieve close industry-government collaboration and facilitate commercialization of promising research.

State governments also play an important role in leveraging federal funds and facilitating commercialization from universities to industry. Several states like Texas have mechanisms to support these efforts. In addition, state governments are also critical in supporting public research universities from an overall budget perspective.

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[2] American Association of Community Colleges (2005)
[3] Texas Higher Education Coordinating Board

While both Congress and many states have focused on the importance of STEM education, there must be an effort to scale programs that are demonstrating results tied to student achievement. In particular, there should be an emphasis on the fundamental math skills needed to succeed in STEM fields.

Finally, we must address immigration reform for highly-educated professionals. Nearly half of the master's degrees and over 70% of PhDs in electrical engineering from U.S. universities are granted to foreign nationals. While we continue to grow the U.S. STEM pipeline longer term, we must retain this talent. I came to the U.S. on an H-1B and received my green card. Today, hundreds of innovators at TI are stuck in multi-year waits for green cards, limiting their promotion potential and making international travel difficult. This process must be reformed if we are to attract and retain the world's best minds, especially those graduating from U.S. universities.

Thank you for the opportunity to testify today. TI looks forward to continuing our close working relationship with this committee.