

**Statement of Pradeep K. Khosla, Chancellor
University of California, San Diego
United States Senate Committee on Appropriations
FY 15 Hearing: “Driving Innovation Through Federal Investments”
April 29, 2014**

Chairwoman Mikulski, Ranking Member Shelby –

Thank you for holding this important and timely hearing, and for this opportunity to participate. On behalf of the University of California, San Diego, it is my pleasure to provide this statement on the critical importance of innovation, underpinned by federal research funding, to my campus, the regional economy of San Diego and the State of California, and indeed to continued competitive leadership of the United States worldwide. Built on the former site of the United States Marine Corps’ Camp Matthews rifle range (your late colleague, Senator John Chafee of Rhode Island, trained here before serving with distinction in the Pacific Theater), UC San Diego is proud to be both a symbol and a primary driver of our region’s innovation economy.

There are myriad examples of San Diego as fertile ground for innovative thinking, scientific curiosity and invention, going back to the 1898 founding in La Jolla of a small marine biology laboratory that subsequently became the Scripps Institution of Oceanography (SIO). To San Diego in the mid-20th century came world-class biomedical researchers, who developed renowned facilities such as the Salk Institute and The Scripps Research Institute (TSRI); these, along with UC San Diego, would help create the biotechnology revolution and related industry cluster that continues to positively disrupt and advance the health care sector. In 1968, a young computer science engineer at UC San Diego started a small company called Linkabit, to develop satellite encryption devices. From this platform, Dr. Irwin Jacobs and several colleagues later spun out Qualcomm, which has transformed wireless communications and reshaped our society.

Similar such examples abound across our nation, and if examined closely, a great many of them, in San Diego and elsewhere, will have some common DNA – they emerged from the confluence of disruptive thinking and support from the federal government of basic research. The importance of this partnership became clear in the years leading up to World War II, and was further refined and underscored by Vannevar Bush’s groundbreaking 1945 report *Science, The Endless Frontier*. This report underscored the point that new discovery generated by basic research becomes the new processes and technologies that advance innovation and competitiveness, and ultimately resulted in the creation of the National Science Foundation. As a result, for the next 50 years, due to this of visionary thinking and related support of the federal government, the United States was the world leader in science and technology development, with the national security superiority and robust economic growth that accompanied it.

As has been well-documented of late, and as the Committee knows well, our S&T capabilities, while still strong, are in uncertain territory. The world, which for so long has benefited from our own investments in and deployments of science and technology, has caught up with us at a time when our willingness to sustain the investments necessary is in question. This is not a situation with which we are familiar, and it is one with which we must not become complacent. You and your colleagues on this Committee understand quite well the difficult budgetary environment, so I respectfully note that we are at a serious crossroads, and as we move forward we should heed the vision and wisdom of Vannevar Bush and his Endless Frontier.

At UC San Diego, we strive to continue to be guided by this thinking, and I would like to provide some examples of this and related suggestions of how we think it will help to transform the next 50 years and beyond. UC San Diego is a \$1 billion research enterprise, one of the top 15 research universities worldwide, and regularly in the top 5 universities in terms of federal research funding. There are more than 650 active companies nationwide which have been derived from UC San Diego-produced innovations, including 200-plus in the San Diego region. This results in roughly 30,000 direct jobs which are attributable to these active companies. We are also very proud of the fact that last year, for the fourth year in a row, we were ranked first in the nation in terms of positive impacts on the country in terms of research productivity, social mobility, and civic engagement. All these speak to the importance and impact of innovation and creativity, and of providing both the resources and environment in which it can thrive.

UC San Diego is a student-centered, research-focused, and service-oriented university, and looking to the future has focused on four multidisciplinary areas in which our campus has broad and deep expertise, and which we believe to be critical to the future of our nation, society, and economy. Each of these represent areas in which past discoveries and economic development has been driven by federal support for basic research innovation, and continued progress in these same areas, whether at UC San Diego or elsewhere, will require the same manner of sustained and resolute commitment. These areas are:

- Understanding and Protecting the Planet: this will entail explaining and effectively communicating environmental change, engineering economically viable solutions that will enhance the resilience of society, and recommending necessary policy changes and assessing their economic impact. To do so, we will work to provide innovations in areas such as technology for renewable-fuel energy strategies and sustainability of dwindling natural resources, and create solutions to predict and respond to natural disasters (e.g., earthquakes, fires, extreme climates, sea-level rise and acidity, drought, and famine).

- Enriching Human Life and Society: this will involve improving health and alleviating ailments, and mitigating social disparities through education, resources, technologies, and communication. We plan to address this by partnering neuroscientists with philosophers, engineers, nanoengineers, visual artists, computer scientists, and musicians to collaborate in understanding the brain to reveal deeper insights into learning, cognition, creativity, and disease.

- Exploring the Basis of Human Knowledge, Learning and Creativity: this will entail probing the structure and workings of the human brain to discover the relationship between the brain and behavior; the impact of genetics, history, and culture on how we think and act; the surging and ebbing movements of nations and populations; and the nature of knowledge itself. To do so, we will invent new health care technologies and “smart” materials (e.g., sensors, cheaper diagnostics, better nutrition, wireless health, use of stem cells or personalized medicines) and advanced manufacturing methods accessible to all the world’s populations.

- Understanding Cultures and Improving Society: Addressing Disparity, Social Justice, Access, Equity and Inclusion: the goal here is to reveal the full richness and breadth of human experience by building an appreciation of diverse cultures, perspectives, value systems, historical contexts, governance, and organizational structures; and fostering the creation of new means of expression, analyses, and social organizations that will be important intellectual tools for the next generation. Our intent is to improve literacy and empowerment; develop new modes of global communication; generate foundational knowledge about human cultures and behavior through

in-depth local studies and broad comparative analyses; formulate new public policy and ethical guidelines; and understand and imagine possible new worlds.

These are admittedly ambitious goals, which are reflective of the challenges and demands facing our society today. However, the scope and magnitude of recent discoveries and innovations demonstrates meaningful and encouraging progress. For example, UC San Diego researchers are making significant advances in the following areas:

Exploring and understanding the secrets of the brain: in response to the President's "grand challenge" to chart the function of the human brain in unprecedented detail, UC San Diego established the Center for Brain Activity Mapping (CBAM). This new center is tackling the technological and biological challenges of developing a new generation of tools to enable recording of neuronal activity throughout the brain. It will also conduct brain-mapping experiments, analyze the collected data, and develop the necessary support mechanisms for managing the enormous datasets these efforts will generate. CBAM brings together researchers from neuroscience, engineering, nanoscience, radiology, chemistry, physics, computer science and mathematics; new discoveries from these collaborations may improve understanding of disorders such as autism, traumatic brain injury, and Alzheimer's, and potentially result in new treatments. Additionally, the technologies and methodologies developed in the course of this research will almost certainly have industrial and economic applications outside of medicine.

Improving treatments and services for our returning veterans: Researchers at UC San Diego's School of Medicine are at the forefront of efforts to prevent and treat posttraumatic stress disorder (PTSD) and traumatic brain injury (TBI), two prevalent but poorly understood battlefield-related disorders that affect millions of people, both military and civilian. UC San Diego researchers, supported by the Department of Defense, are working on new therapies to prevent illness and enhance recovery in individuals at risk for adverse psychological and cognitive outcomes resulting from a traumatic injury, and for individuals who have already developed psychiatric problems because of an injury. Other research focuses on the short- and long-term symptoms caused by mild head injuries, which are not well understood in the treatment of military or civilian populations. These efforts will help design viable treatments to address the needs of people who develop PTSD and TBI, and hopefully, even find ways to prevent them.

Unlocking the value of marine natural products: our oceans are a rich source of microbial diversity for the discovery of new natural products, such as drugs for treating infection, cancer, and other medical conditions. Scientists at UC San Diego's Scripps Institution of Oceanography (SIO) collect and characterize unique marine products from bacteria, sponges and algae. Many valuable drugs have been derived from natural sources, such as penicillin, aspirin and digitalis.

Protecting public safety and reducing risk via forecasting innovations: extreme weather events increasingly threaten public safety and economic stability. Scientists at UC San Diego, SIO and NASA's Jet Propulsion Lab have made enhancements to existing GPS technologies, resulting in new systems to warn of natural hazard threats such as earthquakes, tsunamis, and other such events. This technology assesses damage to hospitals, bridges and other critical infrastructure to be used in real time by emergency personnel and first responders to help mitigate related threats to public safety. Researchers are also developing ways to better monitor, forecast, and act on atmospheric river events which are responsible for nearly half the annual rainfall in the U.S., and most major flood episodes. This capability could have significant impacts on water supply and management for the communities and businesses that are impacted.

Developing new sources of and systems for alternative and sustainable energy sources:

researchers at UC San Diego and SIO, along with a cohort of active industry partners, are at the forefront of developing sustainable alternative transportation fuels derived from algae. These drop-in hydrocarbon fuels have been proven in automobiles, commercial trucks and airliners, and Navy ships and planes. Our researchers are continuing to improve the processes for growth and cultivation of these algae strains, and collaborating with the industry partners who are working to produce these fuels at commercial scale. Additionally, UC San Diego faculty and staff have developed a state-of-the-art, self-sustaining microgrid. This 42-MW microgrid self-generates 92% of its own annual electricity load and 95% of its heating and cooling load, resulting in savings of \$800,000 per month. UC San Diego is actively partnering with public utilities, the commercial energy sector, and the Navy in efforts to advance and expand related technologies in areas such as energy storage, advanced photovoltaics, efficient buildings and micro-forecasting.

Investing in our national security: thanks to continuing DoD and Navy investments in basic and applied research, UC San Diego and SIO researchers are leading scientific inquiry and developing new technologies that strengthens our national security and provides the U.S. with critical operational advantages. Our researchers work to recognize quickly and understand the needs of our warfighters and strategic planners, and identify new capabilities and information for speedy implementation and use.

These projects and discoveries have been significantly propelled by federal government investment in research. Future solutions to many of these challenges will continue to emerge from American universities, research institutions, and industry labs, and I am confident that UC San Diego will continue to be a leader in these areas. However, the larger point moving forward is that we have to continue to sustain and grow the national environment in which these and other kinds of knowledge discovery – and the economic, public health, environmental and national security benefits that accompany them – can be enabled and encouraged.

I said earlier in my statement that we are at a serious crossroads; difficult and challenging decisions lie ahead. But even as we acknowledge this, we should nonetheless look forward with optimism and confidence, because we as a nation still know better than any other how to innovate, build, compete, and succeed. Together, we need to continue to invest in research that will transform our nation and world, and move past this “innovation deficit” to reestablish ourselves as the global leader in innovation and competitiveness. Thank you again for this unique opportunity to participate in today’s hearing.

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