Testimony of
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Before the
Subcommittee on Science, Oceans, Fisheries, and Weather
U.S. Senate

October 22, 2019

"Research and Innovation: Ensuring America's Economic and Strategic Leadership"

ASU Charter:

> *ASU is a comprehensive public research university, measured not by whom it excludes, but by whom it includes and how they succeed; advancing research and discovery of public value; and assuming fundamental responsibility for the economic, social, cultural and overall health of the communities it serves.*

Our nation has entered a new, bold frontier in science and technology. At no other time in our history have advancements in science and technology been accelerating at the scale and scope we are seeing today. This will undoubtedly continue into the future. Our country has always been in the vanguard because of the innovative spirt that permeates everything that we do. We are looked upon as a model to be emulated by countries across the globe.

I would like to emphasize that innovation is not only a skill set, but more importantly, a mindset. We therefore need to do everything possible to cultivate, nurture, and advance this innovative spirit to ensure America's competitiveness and strategic leadership. We are not only in a competition to be ahead of other countries, but also in a race to outperform ourselves. This is the ticket to ensuring our economic competitiveness and well-being. How we, as a country, act and advance our science and technology aspirations will have a direct impact on our economic and national security. I am pleased and grateful that we are having this discussion today.

I would like to now outline some of the ways in which we can continue to be in the forefront.

Strong Research and Development Ecosystem

We are a global leader because of the strong federal investments over several decades in science, technology, engineering, higher education, and workforce development. Over the last four decades, total U.S. R&D investment as a proportion of the GDP has remained around 2.5% with federal R&D at 11-13% of discretionary spending[1]. A strong research environment in academia and industry supported by a robust investment strategy will guarantee a vibrant innovation economy for our nation.

While it is imperative to have a robust foundation of basic science and technology research, we should also augment this with focused efforts in thematic areas that position our nation as a global leader in emerging and critical areas. I am enthusiastic about American leadership in the Industries of the Future in the areas such as AI, data science, 5G, advanced manufacturing, synthetic biology, and quantum science[2].

A strong R&D ecosystem with federal labs, academia, and industry focused on advancing new ideas can be a powerful recipe for economic development. For example, the multitude of research laboratories in Colorado have been an impetus for significant economic progress, primarily because of the ideas generated from basic research being translated into solutions[3]. At Arizona State University, we are focused on advancing fundamental science and discovery at scale, and working seamlessly across disciplines to address global grand challenges. Our researchers have pioneered solutions to pandemics such as Ebola and Zika[4], addressed new energy futures with an industry consortium by designing low cost solar photovoltaics[5], and deployed flexible displays for situational awareness critical to ensuring the safety of our warfighters[6].

As a member of the National Science Board, I am proud of the National Science Foundation's efforts such as *Big 10 Ideas*[7] which will contribute significantly to enhancing our global competitiveness. It is imperative that we increasingly focus on stimulating and seeding bold, large-scale foundational research with meaningful societal impact.

Our competitors are increasing their investments at a much greater pace than before[1]. Global R&D investment has increased by 100% since 2000 with U.S. investment increasing by 40%. We are now 10th in research intensity (R&D as a proportion of GDP) behind countries such as Germany, South Korea, Singapore, and China[1] – this comes as a result of economic growth strategies set by those countries. There is an impending need for continuing strong investments in research and development to expand basic science and engineering research as well in focused areas of national importance in order to strengthen our economic competitiveness.

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[1] American Association for the Advancement of Science. *Federal R&D Budget Trends: A Short Summary.* 2019.
[2] White House. *America Will Dominate the Industries of the Future*. 2019.
[3] Colorado Office of Economic Development and International Trade. *Economic Development Commission.*2019.
[4] Arizona State University. *Origins of World's First Cure for Ebola had Roots at ASU*. 2019.
[5] National Science Foundation. *New Research Center to Make High-Efficiency Solar Energy Technologies Sustainable, Ubiquitous, and Cost-Effective.* 2011.
[6] Arizona State University. *ASU Center Produces New Largest Color Flex Display*. 2013.
[7] National Science Foundation. *NSF's 10 Big Ideas.* 2019.

Strong Learner Ecosystem

"Intellectual growth should commence at birth and cease only at death."
- Albert Einstein

Global competitiveness demands a strong focus on science, technology, engineering, and math. It requires a workforce comprised of lifelong learners capable of thinking critically, pivoting when necessary, and successfully adapting to our ever-changing science and technology landscape. A vital element of advancing U.S. competitiveness involves preparing *all* citizens for the fourth industrial revolution and into the future. Automation is changing the ways we learn, live, and work. Some jobs will be augmented, new roles will be born, and some positions may dissipate. Citizens must become master learners with the capability to adjust and adapt throughout their life.

In order to prepare our learners for the future of work, we should not only provide them with skill sets, but also endow them with mindsets for success. Important components of these mindsets include creative thinking, problem solving, working across disciplines, and an entrepreneurial approach. These qualities are best imbibed by students when the institutions of learning exemplify them.

It is imperative that quality education and training opportunities, and upskilling and reskilling of talent are accessible to all, regardless of their socioeconomic background, geographic location, or where they are in their career and educational trajectory. Empowering online learning platforms like MIT edX[8] and ASU EdPlus[9] offer quality higher education accessible to all. These universal learning models help reshape society by democratizing access to learning. While innovation leading to start-ups is a great beginning, we need to be able grow these enterprises domestically. This requires a spectrum of talent that is available at scale. Thanks to the proliferation of technology, we can not only train the skilled technical workforce but also virtually connect this talent to meet the demands of these enterprises. More importantly, this ensures prosperity across the nation.

Strong Partnership Ecosystem

Partnerships and collaborations within and among regions are key to furthering our competitiveness, leadership position, and prosperity. This necessitates developing synergistic alliances between academia, corporates, government, and non-profit organizations. The recent inter-agency efforts around AI is an excellent example of how agencies can work together to mutually leverage investments to position us into the future[10].

Of the $542B of the U.S. R&D expenditures in 2017, 73% was by the business sector, and 13% by universities and colleges[11]. Programs that promote strong partnerships between academia and industry can take full advantage of the collective investments by federal agencies, states, and

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[8] *Massachusetts Institute of Technology edX*. 2019.
[9] Arizona State University. *EdPlus at ASU Partners to Provide Universal Learning Techniques to Youth.* 2019.
[10] White House. *Artificial Intelligence for the American People.* 2019.
[11] National Science Foundation. *U.S. R&D Increased by $22 Billion in 2016, to $515 Billion; Estimates for 2017 Indicate a Rise to $542 Billion.* 2019.

corporates. Companies need this rich, symbiotic relationship with universities to generate new ideas and train the highly talented workforce that is necessary for them to be successful. The recent White House Industries of the Future initiative calls for leveraging the strength of our unique R&D ecosystem consisting of the federal government, private industry, colleges and universities, research institutions, and science philanthropies[2].

For example, Clemson University's International Center for Automotive Research (CU-ICAR)[12] involves several partners for advancing research, development, and translation that has led to high-value job creation in the sustainable automotive industry. The variety of partnership models enables industry and community partners to customize their relationships to derive the maximal value. ASU has cultivated strong partnerships with corporates locally, nationally, and globally. For example, ASU and Starbucks partner on the College Achievement Plan[13], which provides educational opportunities for Starbucks employees, a model program of an academic-corporate partnership towards building a strong workforce. We have more than 13,000 students enrolled in this program with 3,000 graduates already over the past 5 years. These are exemplars of how such partnerships create real impact at the individual, community, and macroeconomic level. Similarly, as the Advisor for Science & Technology to the Governor of Arizona, my role is to work diligently to connect industry and academia around thematic areas, with the goal of creating a statewide innovation ecosystem that propels us into the future.

We should incentivize building corporate research laboratories that seamlessly span academia and industry to get the best trained workforce, as well as the fastest technology transfer outcomes. It is important to catalyze partnerships at scale to ensure prosperity across both urban and rural areas of our nation.

Strong Economic Development Ecosystem

To create a robust economic development ecosystem, it is critical that we rapidly translate the basic scientific research to the marketplace. This is achieved through bold translational research, corporate partnerships with seamless technology transfer processes, and incubating business ventures, all enabled through interagency and regional cooperation.

Partnership frameworks that accelerate the continuum from basic research to translational research to licensing/startups to impact, will increasingly become a driving force. We need to ensure ease and speed of translation through streamlined IP policies and new models for agreements for commercializing technology. As a recent participant on the advisory council for the green paper focused on "*Unleashing American Innovation*" by the National Institute for Standards and Technology (NIST), I was gratified to see the options put forth for enhancing technology transfer including streamlining federal regulations, enabling greater flexibility for public-private partnerships, increasing engagement with private-sector investors, building a more entrepreneurial workforce, and improving support for innovation[14].

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[12] *Clemson University International Center for Automotive Research.* 2019.
[13] Arizona State University. *More than Tuition: Trailblazing Starbucks College Achievement Plan Continues to Offer Partners Support, Flexibility with ASU Online.* 2019.
[14] NIST. *NIST Releases Findings on Increasing the Innovation Impacts of Federally Funded R&D.* 2019.

At ASU, we have evolved a three-pronged strategy: working with the state and cities to help expand the footprint of existing companies, attracting new companies from outside Arizona (and the U.S.), and incubating new ventures to rapidly vitalize the Arizona economic development ecosystem and the state's competitiveness. We find decision-makers have often cited the strong partnership between ASU and the regional entities as the critical factor in their decision to expand or relocate to Arizona[15].

We also work in partnership with the cities in Arizona using the platform of innovation campuses. For example, ASU's Skysong Innovation campus, in partnership with the City of Scottsdale, houses small and medium enterprises from across the globe, as well as entrepreneurial ventures led by our students, faculty, and the community. This co-working environment fully leverages all assets and creates a synergy that benefits all. It is anticipated to have over $30B of economic impact over 30 years[16]. We also have many programs that serve as portals for unleashing the entrepreneurial spirit in our community. For example, our Venture Vets program taps into the immense entrepreneurial potential that is resident in our active, reserve, and veteran personnel, as well as in active duty military spouses, to launch their innovative ideas into successful ventures[17].

It is imperative that we leverage the broad demographic of talent that exists across the nation. While we have such models primarily concentrated in highly populated areas, we need to ensure that these are replicated in all regions across the country. A vibrant economic development ecosystem ensues when there is a strong partnership between the federal, state, and local entities co-investing in innovation, industries of the future, education and workforce development, and start-up ventures.

I am confident that if we can address and continue to deploy these priorities, we will continue to be in the vanguard of global competitiveness and economic prosperity.

Thank you for the opportunity to contribute to this timely and important discussion. I will be pleased to answer any questions you may have.

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[15] Arizona State University. *ASU, Infosys Partnership will Accelerate Workforce Development in Arizona.* 2019.
[16] Skysong. *SkySong Projected to Make Major Economic Impact on Scottsdale and Valley of the Sun Over the Next 30 Years.* 2016.
[17] Arizona State University. *Operation Start-up: ASU Launches Veteran Accelerator for Aspiring Entrepreneurs.* 2015.