Patrick Gallagher
Biographical Sketch

As the University of Pittsburgh's 18th chancellor, Patrick Gallagher directs one of the nation's premier public institutions for higher education and research. In this role, Gallagher oversees a community of more than 34,000 students at five distinct campuses. He also supports the work of more than 13,000 faculty and staff members who are committed to advancing the University's legacy of academic excellence, community service and research innovation.

Under his leadership, Pitt has strengthened its status as one of the nation's premier public institutions for higher education and research, including being named the top public university in the Northeast by *The Wall Street Journal* and *Times Higher Education*.

Prior to his installation at Pitt, Gallagher spent more than two decades in public service. In 2009, President Barack Obama appointed him to direct the National Institute of Standards and Technology. While in this role, Gallagher also served as acting deputy secretary of commerce before leaving for Pitt in the summer of 2014.

Today, Gallagher serves as the chair of Internet2 and is active on a number of boards and forums, including the NCAA Division I Presidential Forum and the Allegheny Conference on Community Development. He has also completed terms on a wide range of community boards and committees, including President Obama's 12-person Commission on Enhancing National Cybersecurity in 2016.

Gallagher holds a PhD in physics from Pitt and a bachelor's degree in physics and philosophy from Benedictine College in Kansas.

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EDUCATION:
Ph.D. in Physics, 1991, University of Pittsburgh, Pittsburgh, PA
M.S. in Physics, 1987, University of Pittsburgh, Pittsburgh, PA
B.A. in Physics and Philosophy, 1985, Benedictine College, Atchison, KS

PROFESSIONAL EXPERIENCE:

- **Chancellor and CEO,** *University of Pittsburgh, August 2014 – present.*

- **Acting Deputy Secretary,** *U.S. Department of Commerce, June 2013-June 2014.* Appointed to the position by President Obama to replace Deputy Secretary Rebecca Blank on June 1, 2013.

- **Director,** *National Institute of Standards and Technology, 2009-2014.* Confirmed as the 14th Director of the U.S. Department of Commerce's National Institute of Standards and Technology (NIST) on Nov. 5, 2009. Also served as **Under Secretary of Commerce for Standards and Technology**, a new position created in the America COMPETES Reauthorization Act of 2010.

- **Deputy Director,** *National Institute of Standards and Technology, 2008-2009*. Carried out the responsibilities of the Director while the NIST Director position was vacant, including overall programmatic, management, and operational responsibility for NIST.

- **Director**, *NIST Center for Neutron Research, National Institute of Standards and Technology,* 2004-2008.

- **Leader, Research Facilities Operations Group**, *NIST Center for Neutron Research, National Institute of Standards and Technology, 1998-2004.*

- **Agency Representative,** *National Science and Technology Council, Office of Science Policy and Technology (detail)***,** *November 1999-June 2001.*

- **Physicist**, *NIST Center for Neutron Research, National Institute of Standards and Technology, 1993 -1998*.

- **Research Associate**, *Boston University, 1991 – 1993*.

- **Research Assistant**, *University of Pittsburgh, 1986 - 1991*.

CURRENT BOARD MEMBERSHIPS:
- Trustee, *University of Pittsburgh*, Pittsburgh, PA (since 2014)
- Member, Board of Directors, *UPMC*, Pittsburgh, PA (since 2014)
- Member, Board of Directors, *Allegheny Conference on Economic Development* (since 2014)
- Member, Board of Directors, *Dietrich Foundation*, Pittsburgh, PA (since 2014)
- Member and Chair, Board of Trustees, *Internet2*, Washington, DC (since 2015)
- Member, Board of Directors, *United Way of Allegheny County*, Pittsburgh, AP (since 1016)

SELECTED PROFESSIONAL ACTIVITIES:

- Member, National Commission on Enhancing Cybersecurity (Presidential appointment, 2015-16)
- Co-Chair, National Commission on Forensic Science, US Departments of Commerce and Justice (2014)
- Co-Chair, Subcommittee on Standards, National Science and Technology Council, Office of Science and Technology Policy (2010-2014)
- Chair, Interagency Working Group on Neutron Science, National Science and Technology Council, Office of Science and Technology Policy (2000-2006)
- Chair, Interagency Working Group on Synchrotron Light Sources, National Science and Technology Council, Office of Science and Technology Policy (2002-2008).
- Member, Math and Physical Sciences Advisory Committee, National Science Foundation (2008)
- Member, SNS Neutron Sciences Advisory Board (2007-2008)
- Member, 2006 DOE/BES Committee on Visitors, Division of Materials Science & Engineering
- Member, 2007 DOE/BES Committee on Visitors, Scientific User Facilities Division
- Member, Solid State Sciences Committee, Board on Physics and Astronomy, National Research Council (2002- 2004).
- Member, Neutrino Facility Advisory Committee, Board on Physics and Astronomy, National Research Council (2002-2003).
- Member, Committee for an Assessment of and Outlook for New Materials Synthesis and Growth, Board on Physics and Astronomy, National Research Council (2007-2009).
- Acting Chair, NIST Ionizing Radiation Safety Committee (2003-2008).
- Member, American Physical Society
- Member, American Association for the Advancement of Science
- Sigma Xi Honor Society, elected 1987.
- Sigma Pi Sigma Honor Society, elected 1994.

INTERNET & SOCIAL MEDIA:

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Statement by the Honorable Patrick D. Gallagher
Chancellor, University of Pittsburgh

before the

United States House Committee on Science, Space, and Technology's Hearing on "Maintaining US Leadership in Science and Technology"

March 6, 2019

I would like to begin by thanking Chairwoman Johnson, Ranking Member Lucas, and all the members of the House Committee on Science, Space, and Technology for the invitation to speak today. I have many fond memories of testifying before, and working with, the members and staff of this Committee over my 21-year government career. Through that experience I grew to appreciate the unique and vital role that this committee plays in our nation's science and technology enterprise, and it is with that fond appreciation that I tell you what a real pleasure it is to be back before you today to discuss the topic of U.S. leadership in science and technology.

Assessing U.S. S&T leadership

The charge from the Committee to today's witnesses was a broad one: to assess the current state of U.S. science and technology in the context of today's competitive and rapidly changing global environment and to identify potential elements of our national policy that are vital to maintaining U.S. leadership. From my own personal background, including my various roles in the U.S. science and technology enterprise, I can fully appreciate the scope and complexity of what you have asked us to address. To be helpful to your task, I would like to make a few general observations and then focus my remarks on an examination of the nation's science and technology enterprise from the specific perspective of one of its many elements: namely, research-intensive universities in the United States. Specifically, my perspective and examples will be from the University of Pittsburgh, where I currently serve as chancellor.

The nation's science and technology (S&T) enterprise is massive and complex, but in its modern form is a relatively recent construct, achieving much of its current scale and composition over the period beginning after the end of World War II. According to NSF's National Center for Science and Engineering Statistics, the federal government has spent approximately $5 trillion (constant 2009 dollars) on R&D activities since 1953. This sizeable public investment has been complimented by an even larger investment by the private sector in the United Sates, an investment concentrated in R&D intensive industries and firms. Collectively, this is one of the largest investments that any one nation has made in science and the related technologies, and the impact has been transformative for our country and for global society. Without exaggeration, the United States today owes much of its current economic leadership, military superiority, high standard of living, health and safety infrastructure for our citizens, energy security, and our dominant geopolitical leadership position to these S&T investments. By any measure, the "ROI" has been remarkable.

The Committee charged us to evaluate U.S. leadership in science and technology. The use of a competitive measure of performance – leadership – deserves a quick comment, since it infers that there is a policy benefit to "being a leader" beyond trivial benefits, like national bragging rights. If we assume that the government's primary goals are to protect and defend the country and to promote our national well-being, then the inference is that being in a leadership position in S&T relative to other countries must advance these primary objectives. One simple way to break this down is to consider our federal S&T investments as having two outcomes: to create knowledge (i.e. scientific understanding and data) and to create capability (i.e. the trained scientists and engineers – and the tools – that create that knowledge). Leadership then can be defined from either outcome.

Leadership in scientific or technology knowledge can be assessed according to the quantity, quality or usefulness of that knowledge. Is our stock of knowledge greater than that of other countries? Do we have better data and greater knowledge than our competitors or that they don't possess? Is our S&T knowledge having demonstrable impact on advancing our most important national needs, creating new economic activity, or enhancing our competitiveness?

Leadership in scientific capability can be assessed by the relative abilities of our scientific facilities or assets, but the most important measure is the quality and quantity of our scientific and technical workforce. Specifically, leadership is assessed by our ability to compete globally for talent. Are we better in developing the highest quality new talent than is our competition? Is the size and composition of our scientific and engineering workforce responsive to our national needs and to the demand by American industry for a highly skilled workforce? Finally, leadership can be assessed by the productivity of our S&T workforce. Do technical communities in the U.S. lead in the creation of new knowledge? Do we have faculty who are making the most significant discoveries or developing the foundational technologies in their fields?

Assessing S&T leadership at U.S. research-intensive universities

Universities, especially research-intensive universities, play a unique role in this S&T "ecosystem." They are both producers of new scientific and technological knowledge, and they are the primary drivers for building our S&T capacity. Today by nearly every measure, and despite growing international competition, the best research-intensive U.S. universities remain global S&T leaders. Sixty percent of the top 50 universities in the world named in the five most respected international rankings of global universities were American. Among the top 20 universities world-wide, the US is even more dominant: 75 percent were American.

We can assess the U.S. leadership position by the behavior of countries competing with us. Many competing industrialized countries have explicit targets to grow their domestic S&T capability to rival or challenge U.S. leadership. Examples of research universities in other countries openly modelled after the top U.S. universities are easily found. The King Abdullah University of Science & Technology in Saudi Arabia was consciously modeled after CalTech. Others were created through direct partnerships with U.S. universities; New York University Abu Dhabi is one example. Others are established directly by U.S. universities; SUNY Korea is an example. Further evidence of our leadership is that U.S. graduates, particularly our foreign-born scholars, are targets of talent attraction programs, especially those of technology-intensive middle-income countries.

At Pitt, our own accomplishments mirror this national picture. Following the growth of research funding, especially in the health sciences since the mid 1990's, Pitt has grown to be a top 20 research-intensive university as measured by the share of federal R&D dollars. (This position rises to top 5, when considering only NIH funded research.) Our success has allowed the university to assemble a world-class faculty, who compete successfully for federal funds enabling them to make the discoveries that drive their disciplines.

Just one example of the importance of recruiting world-class faculty is the important partnership between Pitt and three world-renowned French research institutions; the University Pierre et Marie Curie of the Sorbonne Universités in Paris, the Institut National de la Santé et de la Recherche Médicale (Inserm); and the Centre National de la Recherche Scientifique (CNRS), to focus on collaborative research and education in the fields of medicine and biomedical sciences.

This partnership was formed after the recent recruitment of José-Alain Sahel, M.D., one of the world's top experts in retinal diseases, as the chair of the Department of Ophthalmology at Pitt's School of Medicine. The agreement will enable researchers of all four institutions to cooperate on fundamental research, development of novel therapeutics, and clinical trials, with an initial focus on ophthalmology, vision and neuroscience. We will exchange academic personnel, host joint academic conferences, and exchange of scientific, educational and scholarly materials.

As a measure of our impact, the University set new records last year for invention disclosures submitted, licenses and options, and startups formed. By nearly every measure, the culture of innovation and entrepreneurship at Pitt is blossoming. This year the University set new records with 363 invention disclosures submitted (nearly one for every day of the year), 162 licenses and options, and 23 startups formed. Pitt also rose in the rankings of worldwide university patent issuances to 21st, up from 35 in 2015 and 27 in 2016, according to the National Academy of Inventors and Intellectual Property Owners Association annual report. Our startup number increased by more than 50 percent over last year, placing Pitt in the top five individual universities nationally based on the most recent reported results.

Pitt's footprint on the region is immense, with nearly $4 billion of yearly economic impact, we generate over $190 million in local and state tax revenue, support just under 30,000 jobs throughout Pennsylvania, and produce over $74 million in charitable and volunteer service donations. The university role in shaping the region's economy is probably most dramatically shown with the Pittsburgh "renaissance" where, based on the deep expertise at Pitt and our neighbor Carnegie Mellon University, Pittsburgh was reshaped from a heavy-manufacturing based economy, to one based on "eds and meds." In fact, in terms of current employment, today more people are employed in Pittsburgh healthcare and health sciences sector than were employed at the peak of the steel economy.

Challenging the assumptions necessary to maintaining leadership

If the current position of the U.S. S&T enterprise is one of leadership, at least from the perspective of U.S. research universities, then it may be a surprise that there is growing worry and pessimism about the ability of the U.S. to maintain this position. The reason is that the U.S. faces a dramatically different global S&T enterprise as other nations recognize the importance of R&D to their industrial competitiveness.

Although the United States remains atop the list of the world's R&D-performing nations, our share of total global R&D has declined from 40% in 2000 to 28% in 2016.[1] We are now in an era where the U.S. finds itself a parity player rather than the dominant global R&D figure, but only for a short while longer. Although total U.S. R&D spending has been growing steadily for decades with only minor exceptions and now exceeds $500 billion per year, it is only a matter of time before the U.S. is neither the leading source of R&D funds nor the world's leading performer of R&D. Steady investment by the European Union and astounding growth in R&D by China means the Federal government and American industry cannot spend our way back to an historically dominant position.

In the face of the considerable complexity of this internationally competitive landscape, we should examine whether some of the long-standing assumptions in U.S. science policy may be invalid or that function as barriers in this new environment:

Building capacity: how much and in what areas? Federal funding decisions have a strong effect on the size and composition of the U.S. S&T enterprise. Most of the major changes in the size or shape of the U.S. S&T workforce arose from significant shifts in federal R&D support to meet national needs. Major examples include the Manhattan Project, the manned space program, armed services labs during the cold

[1] John F. Sargent Jr., Global Research and Development Expenditures: Fact Sheet, Congressional Research Service (R44283, version 9), updated June 27, 2018.

war, the Strategic Defense Initiative, energy security and the development of the energy labs, the war on cancer, the doubling of NIH, etc. These "moonshot" efforts coupled clear national policy objectives to major shifts in the amount or composition of federal S&T funding.

Pitt is a good example. Leveraging strong programs in clinical medicine, the University began a concerted effort to strengthen its biology and health science programs during a period that coincided with the rapid growth of NIH funding. No major U.S. university rose faster or farther in scale and reputation in these specific areas of research, and the resulting impact on Pitt and the entire western Pennsylvania area has been transformative.

However, these types of targeted growth create problems as the S&T enterprise matures. Federal grant dollars to universities don't just fund the creation of new S&T knowledge, they also produce new scientists and engineers and create more demand. This is often negatively characterized as simply a form of entitlement behavior, but it has a very specific origin. When new and growing research dollars are targeted to grow a certain area, then new scientists and engineers are produced through the expanded graduate programs. A portion of these newly trained scientists then start their own laboratories and seek federal grant dollars. If future funding does not keep up with this form of growth then the entire S&T enterprise suffers from over competition (low success rates, risk adverse awards, depressed salaries, low employment). The long time and high cost of producing new scientists and engineers means that the university-funded enterprise is unstable against funding that doesn't match the growth. This is the origin of the perpetual call for more funding (over inflation) in all established areas of research.

This tension between stimulating growth and managing it are well known, but current federal S&T policy is not good at defining or signaling the amount of growth desired. Past attempts to link federal R&D expenditures to addressing expected capacity needs (or shortfalls) in the private sector have been unsuccessful, sometimes wildly so, as in the case of the incorrect predictions in the 1980s of looming shortages of Ph.D. scientists and engineers.[2] Lack of a stable, long range budget planning process means that this is a balancing act addressed in the annual budget process in decisions on how much money is made available in a particular area. However, there are recent efforts to explore reshaping federal grants to change the number of new scientists and engineers that are produced under federal grants.[3]

Private sector vs. public sector: a growing divide. Early U.S. science policy assumed a large role by large, research intensive industries. In fact, much of the early mobilization of the U.S. S&T enterprise during and after WW2 was achieved by leveraging the capabilities of these companies to address national needs. Early federal dollars made up a large part of the overall R&D expenditures for the country, but there was a significant level of participation in this research by industry and national laboratories operated by industry. As a result, this early S&T enterprise provided a close and collaborative relationship between industry performed or managed research with university-based researchers, particularly in the areas of fundamental scientific research funded by the government.

However, beginning in the 1980's with growing competition from other countries (particularly Japan), concerns began to grow that the United States was not fully realizing the economic benefits of its public investments in R&D. Key policy responses during this period included the Bayh-Dole Act to increase technology transfer from university-based research, the Stevenson-Wydler Technology Innovation Act to accelerate transfer from government laboratories, the R&E tax credit, and the creation of several technology programs to stimulate the amount of private sector R&D and the translation of federally-funded R&D knowledge to the commercial sector.

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[2] Greenberg, Daniel S. Science, money, and politics: Political triumph and ethical erosion. University of Chicago Press, 2001.

[3] Alberts, B., Kirschner, M. W., Tilghman, S., & Varmus, H. (2014). Rescuing US biomedical research from its systemic flaws. Proceedings of the National Academy of Sciences, 111(16), 5773-5777.

Over the past 30 years these investments have had a remarkable impact. Private sector R&D expenditures began to expand more rapidly than public sector spending. Today, private sector spending is nearly 3 times larger than the federal R&D budgets (the public sector R&D spending surpassed federal R&D spending in 1980). Similarly, U.S. universities began to expand their entrepreneurial activities by pursing commercialization of potential technology and licensing of university IP.

During this period of industrial R&D growth, the composition of industrial R&D also changed dramatically. Companies began to refocus their corporate R&D activities away from the areas of basic research that they had in common with university-based researchers, preferring instead to invest in late stage research and product development efforts. R&E tax credits succeeded in stimulating new investments by the private sector, but funding in areas that federal government funding actually shrunk. The landscape of industrial science labs common up until the late 1980's gave way to two separate, and distinct R&D worlds: one of university and national laboratory-based researchers working on federally funded R&D, and a separate infrastructure of industrial or contract research and development activities that had little or no connection with the universities. The "valley of death" actually got wider.

Today, by many measures the private sector, predominantly through research-intensive manufacturing companies, are a sizeable portion of the U.S. S&T enterprise. However, there is now much less interaction between the two domains. Interactions today occur when universities try to move into areas of industrially relevant work but are limited by constraints of managing industry sensitive information and conflicts of interest. There have also been efforts to pull industry towards the more open type of research favored at universities. This includes incentives towards industry consortia that work on areas of industrially important, but pre-competitive R&D. The recent manufacturing institutes were an example of this type of program.

Current federal policy is unclear in this environment. As a general rule, S&T knowledge is viewed as a "public good" (shared, openly disseminated, etc.) when it is fundamental scientific knowledge. However, it becomes a "private good" when S&T understanding is distilled into a useable commercial process or technology. The middle ground is poorly defined: what benefits a company by collaborating in the open scientific process, and what interests or financial considerations can a publicly funded scientist or engineer have if they collaborate in a potential commercial effort. The current segmented R&D environment means that public-private S&T partnerships must try to navigate this translation often in the face of these competing dynamics.

For universities these trends create a real problem. The largest industrial R&D performers tend to be large, multinational corporations with a global footprint. They are free to move their R&D activities to take advantage of the most favorable government-funded R&D capability anywhere in the world. Universities have tried to move towards commercially-important areas of research but get bogged down in questions of whether or not this is part of their mission and on how to manage the resulting conflicts. At a time when federal R&D prioritize focus on stimulating economic activity, there is a wide and growing gap between the public and private R&D worlds.

In Pittsburgh, a recent report by The Brookings Institution on the effect of the intersection of industry and university on the economic potential of western Pennsylvania noted an interesting problem. The two largest research universities in the region, Pitt and CMU, were effectively creating a "new economy" based on their respective strengths in areas of federal R&D support (mostly in health sciences and computer sciences and robotics, respectively). However, a similar measure of the patent portfolio of the region's R&D intensive companies (heavily weighted towards advanced materials) showed that was nearly no overlap with any research capacity within the universities. The result was two separate economies with little intersection, and a regional economy, that despite a very strong research capacity, that is underperforming in GDP and job growth. I don't imagine that we are alone in this situation, but all of us need to understand that factors contributing such a situation.

Facing the S&T future: growing global competition

As noted above, the U.S. faces a dramatically different global S&T enterprise as other nations recognize the importance of R&D to their industrial competitiveness. We must face these international competitive pressures by doubling down on remaining an attractive location for scientific and technical talent worldwide and by putting a premium on flexibility and speed in science policy innovation in the future

For decades, the United States has been the destination of choice for internationally mobile students. America's university system is immensely capable, but our international competitors are making a concerted effort to attract these students. UNESCO data shows the share of the world's internationally mobile students enrolled in the United States fell from 25% in 2000 to 19% in 2014. Our universities must remain welcoming, engaging, and respectful of international students, employees, and visitors regardless of their country of origin.

In this increasingly global R&D environment, U.S. universities need to prepare domestic STEM students with a broad set of skills necessary to lead in a high-tech, entrepreneurial international world. As an example, Pitt has established an International Research Internship Program, which includes study abroad opportunities for STEM students and brings students from leading global universities, such as Cambridge and the Kings College London, to Pitt for summer research internship experiences in our basic science and biomedical research labs. Pitt's PIRE:HYBRID research and education partnership with a number of top French universities in hybrid materials for quantum science and engineering is an example that formed from research collaborations.

More importantly, we need have a better collective understanding and situational awareness of the global R&D sector. Other countries have systematically collected, translated, and analyzed our science policy documents for decades. Korea, through their Korea Institute of S&T Evaluation and Planning, may be the among the best at doing this. We have done that solely through a national security lens, when we've done it, or not done it at all. The federal government needs to build the capacity to collect and analyze other countries strategic documents from a science policy perspective and feed that analysis into the research agencies and oversight bodies. In the future, we will need to be more sophisticated in identifying research areas where the U.S. must have a leadership position and those where a position of parity with the research capacity of our competitors or even a posture of careful watching developments elsewhere while maintaining a capacity to respond when necessary is acceptable.

Madam Chairwoman and members of the Committee, I would once again like to thank you for the opportunity to appear before you this afternoon. I look forward to working with you in the months ahead as you continue to craft policies that are vital to the health of the U.S. science and technology enterprise. I am happy to respond to any questions you may have.