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REMARKS BEFORE THE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY OF THE U.S. HOUSE OF REPRESENTATIVES
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Thank you, Chairman Bucshon, Ranking Member Lipinski, and the honorable members of this subcommittee, for this opportunity to discuss the proposed legislation provisionally referred to as "Frontiers in Innovative Research, Science, and Technology Act."

I am Richard Buckius, Vice President for Research and Professor of Mechanical Engineering at Purdue University. I have been involved in various aspects of fundamental scientific research for my entire career. It is a privilege for me to share with the committee some of the "lessons learned" along the way, and I look forward to answering your questions. After receiving my PhD from the University of California, Berkeley, I took a position at the University of Illinois at Urbana-Champaign (UIUC). My 30-plus year tenure at UIUC provided me with many opportunities to advance, naturally beginning as an Assistant Professor then moving to serve as Department Head of Mechanical and Industrial Engineering, and then as Associate Vice Chancellor for Research. During those years, with time on an Intergovernmental Personal Act (IPA) leave granted from UIUC, the National Science Foundation offered me several occasions to serve the Nation's research enterprise. First, in 1988, I served as the Program Director for the Thermal Systems and Engineering Program. Later, in 2004, after returning to UIUC for several years, the National Science Foundation offered me the chance to serve as Division Director for Chemical and Transport Systems, and, between 2006 and 2008, I served as assistant director of the NSF Directorate of Engineering.

In 2008, I joined Purdue University as the Vice President for Research and as a Professor in Mechanical Engineering. Purdue is a public land grant university educating over 75,000 undergraduate and graduate students each year throughout the state. Faculty conduct $240 million in federally funded research projects annually, which is a significant contribution to the University's overall research portfolio totaling more than $640 million annually in sponsored program research expenditures. The Office of the Vice President for Research assists faculty and staff in their research efforts, and leads the University's research administration and oversight efforts. We also assist faculty with research development, such as proposal preparation, identifying funding opportunities, and building private sector partnerships.

Fiscal Reality and Basic Research

As a representative of a public research institution, we join with our colleagues at many institutions of higher learning to appeal to the Congress to help close the Nation's innovation deficit and promote economic growth for the sake of future generations. Economists estimate that technological innovation, much of which is a result of federally-funded scientific research, has been responsible for more than 50 percent of the US economic growth in recent decades. Federal research also allows us to educate and train the next generation of innovators.

It is clear that we are in a period of great financial stress in many areas of the federal budget, and this stress is felt in our states, and within people's homes. The projections of the Nation's future debt paint a picture of an extremely heavy burden on future generations. With this proposed Act, the opportunity exists to meet a great challenge that can both fund future discoveries and innovations and prepare our young people to participate in the innovation future. I suggest that it would be most effective to promote both the well-being of our Nation's human resources along with our ability to compete in a global environment of innovation. Placing discretionary research spending in opposition to mandatory spending could jeopardize future discoveries that yield tomorrow's innovations, and undiscovered talent in our youth today who will make those future research discoveries. With the financial debt and limited resources, it is our hope that financing future innovative research, science, and technology and the need to cultivate future generations to pursue STEM fields, are carefully considered together with the looming fiscal debt.

Science often advances by enhancing previous findings and is the foundation for applied research. In many ways, transformative discoveries cannot happen without building off of those previous outcomes. NSF takes the long view by supporting efforts that expand knowledge and enhance understanding, which in turn provides the engine for new technologies.

As important, federal research enables the education and training of the next generation of innovators.

STEM Priority, an example of diverse, interdisciplinary research

Purdue University strongly urges Congress to provide reliable, sustained funding for STEM research and education in the context of a responsible budget. We applaud the discussion draft's language to consider coordination of federal STEM funding, yet ensuring the agency's dependent approach.

Purdue is among the institutions graduating the most engineers in the nation. In our effort to address the Nation's competitive need for graduates with STEM degrees, Purdue is in the process of increasing the College of Engineering faculty by 30 percent in the next 5 years. Purdue has also committed to grow the Department of Computer Science by 25 percent, and to transform our College of Technology with a more experiential and project-based curriculum. At the same time, Purdue recognizes the central role the liberal arts play in building a well-rounded curriculum at an institution as strong as Purdue in science, technology, engineering, and math.

Purdue has earned the reputation as a national and global leader in discovery and innovation with preeminent scholars in science, engineering, agriculture, business, technology, as well as in the health and human sciences, education, humanities, social sciences, pharmacy, veterinary medicine, and the arts. We believe our STEM students and all students need a broad-based education to make a difference in the world. Purdue's Discovery Park, our interdisciplinary hub, assists in promoting disciplinary strengths and coordinating interdisciplinary activities. The diverse, interdisciplinary approach can only work without barriers. We don't duplicate efforts, but rather collaborate across disciplines to enhance the total impact. This is very similar to the current federal agency and NSF approach. Enhancements to breaking down "silos" between research areas are encouraged and welcomed.

Transparency and Impact

We fully support the public access to the results of federally-funded research which is central to the mission of higher education. For nearly a decade, Purdue University, together with others in the higher education community, have promoted open access policies for federally- and state-funded research output to better manage the intellectual assets of higher education in support of teaching and learning (see Purdue e-Pubs for articles http://docs.lib.purdue.edu/ and Purdue University Research Repository (PURR) for data sets https://purr.purdue.edu/). The publication delay time for public access is a key

point and various sound arguments have been provided, yet it is important to proceed with the implementation and a shorter delay. We applaud the open public access directive and are eager to see it succeed.

As appropriate and depending upon the research, moving discoveries from the bench to the marketplace is a high priority. At Purdue, 47 Purdue University faculty, students, and staff made discoveries that were patented last year. The Purdue Research Foundation reported 356 invention disclosures, 446 patent applications worldwide, 95 patents issued worldwide, and the creation of five startups from Purdue-licensed technologies. In the most recent four-year period, Intellectual Property disclosures at the University have increased by 21.4 percent, and patent filings have increased 14.6 percent compared to the previous four-year period. This year, at the urging of many of Purdue's own engineering and science faculty, the University made changes to its Intellectual Property practices to streamline the process of moving inventions and innovations from the lab to the market.

The National Science Foundation relies on thousands of experts from every field to provide knowledgeable evaluations on proposals. Reviewers deliver this detailed level of evaluation confidentially and without compensation. This is a valuable service provided to the Nation and it needs to be preserved. Consistent with the wording in section 104 (b) (i.e., affirmation that the award is in the national interest, worthy of Federal funding, and achieves one or more of the stated goals – increased economic competiveness, advances the health and welfare of the American public, develops a STEM workforce and increased public scientific literacy , increases academic/industry partnerships, promotes the progress of US science, and supports national defense), an affirmation by the foundation should be possible with a slight increase in administrative load. Yet the prior publication of awards and associated information will severely compromise the process and add tremendous administrative burden.

In closing, I wish to express my sincerest thanks to the Committee for the opportunity to participate today and for your leadership, commitment, and partnership on this important topic of maintaining American innovation and competitiveness through fundamental/basic scientific research.