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The Honorable Mo Brooks, Chairman

Testimony of

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The Role of Research Universities in Securing America's Future Prosperity: Challenges and Expectations

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Chairman Brooks, Ranking Member Lipinski and Members of the Subcommittee, thank you for your efforts to highlight research universities and the important role these institutions undertake in our nation's security and economic prosperity. I am James N. Siedow, Vice Provost for Research at Duke University and am grateful for the invitation to be part of this critical discussion.

Duke University is a relatively young institution, created in 1924, but it has quickly risen through the ranks to become one of the leading research universities in the nation. The campus, located in Durham, North Carolina, is home to 14,746 undergraduate, graduate and professional students and employs over 33,000 people, making it the second largest private employer in the State of North Carolina. Duke is an anchor in the Research Triangle Park (RTP), which was created in 1959 and remains one of the most transformational public-private partnerships in the country. RTP includes about 170 private, governmental research, and non-profit companies that employ more than 49,000 workers, making the region one of the nation's leading centers for research, science, and engineering with one of the highest concentrations of Ph.D.s and M.D.s in the world. More than 15 companies in the region have resulted from technological innovation at Duke or by Duke researchers.

The research enterprise on campus is robust. Nationally, Duke ranked 5th in FY2010 (the most recent year for which such statistics are reported by the National Science Foundation (NSF)) among all U.S. colleges and universities in total research and development expenditures, and second only to Johns Hopkins among private institutions. In FY 2011, the Duke research enterprise totaled just under $1 billion. This research is conducted by hundreds of faculty throughout the university. Over 80 percent of the research expenditures are associated with the School of Medicine, with the remainder being split among the other schools, most significantly Trinity College of Arts and Sciences, the Pratt School of Engineering, and the Nicholas School of the Environment.

The National Institutes of Health (NIH) is the largest federal sponsor of research across campus, accounting for $417 million or roughly seventy-five percent of all federal awards in FY 2011. The NSF and the Department of Defense are the second and third top federal sponsors of research, providing $45 million and $30 million respectively.

Duke also ranks first nationally in the category of industry-sponsored research and development expenditures, a ranking it has maintained for over a decade. Much of the activity in this area is associated with the Duke Clinical Research Institute (DCRI) which works with industry to oversee clinical trials. In keeping with the university's obligations under the Bayh-Dole Act and its mission of knowledge in the service of society, Duke actively seeks to translate its basic scientific discoveries into commercial opportunities. The university received $24.2 million in licensing and royalty income from patents in FY2011.

- **What are the major challenges facing your university's research efforts today? Has your university made any changes to its research enterprise in light of shifting federal and state funding?**

  The two major challenges facing Duke University research efforts today are 1) the lack of growth or even outright decreases in federal funding for basic research, particularly at NIH, and 2) the ever-growing list of federal regulations that have been promulgated on universities in recent years.

  Because Duke has a medical school with a top-tier research program, we are quite sensitive to changes in federal research funding particularly that at NIH. In 2008-09 we had witnessed a slight downturn in federal funding for research in the School of Medicine prior to the appearance of ARRA funding. The latter program stemmed this decreasing trend, at least temporarily, as Duke was one of the top recipients of ARRA funding among universities (ranking in the Top 20 for total ARRA funding and in the Top 10 for ARRA funding from NIH). As the expenditures for ARRA-funded projects have progressively decreased over the past two years we are beginning to see a return to the flattening and downward slope associated with the School of Medicine's federal research funding profile. The remainder of the university outside of the School of Medicine (referred to as the "Campus") is not as dependent upon NIH funding (only 37% of Campus externally supported research comes from NIH) and its research expenditures continue to show limited growth, led primarily by the School of Engineering's success in identifying and attaining new sources of DOD funding.

  Given the general mood regarding the future of federal funding for basic research, Duke has taken a number of steps to begin to address dealing with this funding picture. All the research-active schools at the university have instituted processes for providing bridge funding to laboratories that have lost a competing renewal but show a good likelihood of being funded in a subsequent resubmission based on the reviews of the proposal. The most sophisticated of these programs resides in the School of Medicine where there is a formal system for applying for such funds and a standing faculty committee that makes the decision to bridge fund or not. This program has been, by all accounts quite helpful in keeping research laboratories operational through temporary unfunded periods. Similar programs exist in other schools but the final decision about providing the bridge funds generally lies in the hands of the school's dean.

  There is a second area of relatively new activity within a number of Duke schools at present that is designed to enhance the effectiveness of attracting research funding. This the establishment of so-called Research/Grant Development offices that are designed to provide help to Duke faculty who are interested in applying for grants of $1M-plus (annual budgets) usually involving multiple investigators and having an interdisciplinary focus. These offices begin by looking for potential funding opportunities of this nature and then line up one or two faculty who might be interested in leading the development such a proposal. The Research Development group provides administrative, organizational and editorial help

throughout the proposal process, relieving the faculty of what are otherwise seen as major burdens in developing proposals of this nature and scope. While still at an early stage, Research Development groups have now been established in the Pratt School of Engineering, the School of Medicine, the Division of Natural Sciences in Arts & Sciences, and the Social Sciences Research Institute in Arts & Sciences. The initial results from the early adopters (Engineering and Medicine) have been quite positive with relatively high rates of proposal success, as has been seen elsewhere around the country when such groups have been established.

This emphasis on promoting larger multi-investigator, interdisciplinary projects is in keeping with Duke's own strategic commitment to fostering interdisciplinarity as a cornerstone of its research enterprise across the university. It also coincides with funding trends at numerous federal agencies, including NIH and NSF.

The second challenge cited above relates to the costs associated with the growing number of research-related compliance regulations that have flowed down from federal agencies over the past 10 to15 years. Because there has been no increase in the administrative component of the indirect cost recovery (F&A), which is currently capped at 26%, much of the cost of administering these new and/or enhanced federal regulations have had to be borne directly by the university. In that regard, the research-related and quality assurance costs to Duke between 2000 and 2010 rose over 300% at the same time that our direct and indirect costs each increased only 130%. These additional costs arose in a number of areas, including the Research Compliance Office, the Office for Research Integrity, Pre-award and Post-award Management, Information Technology, the Human Subjects Protection Program and IRB, Animal Welfare and IACUC, the Institutional Biosafety Office, and Clinical Trial Billing & Management.

This growth in compliance-related costs over the past ten years has been the result of several different compliance and/or regulation-related issues. Included among these are new areas of compliance that have been appropriately identified over this time frame (e.g., export controls, information technology security). While always an issue, oversight of clinical research has taken on larger dimensions in recent years, including enhanced protection of human research subjects and the increased complexity associated with site-based clinical research which is intertwined with unique clinical practices that can involve specialty- and even faculty-specific nuances. The need to develop robust IT systems for conducting research administration and compliance is imbedded in most all these changes. Additional costs have arisen from the need to modify our compliance operations to respond to OIG interpretations of existing regulations that change with some frequency and with audit experiences at other schools (e.g., effort reporting, monitoring of subcontracts, conflict of interest, appropriate charging of clerical and administrative expenses). Similarly, Congressional oversight can lead to a resulting focus by OIGs on specific, and often new, compliance areas.

In addition to presenting the university with the challenge of continually keeping up with new and/or modified research-related regulations, operationalizing our compliance responses

in many cases means flowing down new responsibilities not only to departmental grant managers but also to research-active faculty. This perceived piling on of new reporting requirements has led to negative responses on the part of faculty, who see more and more of their time being committed not to actually carrying out the funded research but to a myriad of mundane administrative duties. This has at times led to near mutinous conditions and a lot of upper administrative time is itself spent educating faculty as to the necessity of carrying out these duties. This is not to suggest that these regulations are unwarranted, far from it. Only that the extreme to which some of these regulations have gone of late seems well beyond that needed to accomplish the original regulatory ends.

Because Duke University is a private institution, we are not particularly dependent upon funding from the State of North Carolina. However, as a private institution we tend to be much more dependent than are most public institutions upon funding provided through our endowment and annual giving. In 2011 the value of our endowment was over $5.7B but that number represented a substantial recovery from its value in 2009 when the economic downturn of 2008 decreased the endowment value to under $4.5B, almost 30% less than its value the year before. In response to the decrease in this major source of funding, the university instituted cost-saving measures that ultimately equaled $125M annually. Because some of the personnel affected by these measures were associated with research administration, these measures did affect the research enterprise to some extent.

- **How does your university work with industry in terms of research conduct and application? What challenges does your university face in building and maintaining partnerships with industry?**

  As noted previously, Duke University has consistently ranked #1 in industry funding in the annual NSF listing of Academic Research and Development Expenditures. In FY2009 industry-funded research at Duke was over $180M. It is important to reiterate that a large percentage of those monies (well over $120M in 2009) are associated with the very successful Duke Clinical Research Institute (DCRI) which was among the first and remains among the most successful academic contract research organizations (CRO) in the country for conducting clinical trials. Given the focused and structured nature of running a clinical trial, DCRI long ago developed a standard contract that works well for most of the organizations, particularly for-profit companies, that request its services. For that reason, there usually are minimal difficulties encountered in putting together a contract that can be agreed upon by both parties and that helps make DCRI the very successful organization it has become.

  Duke University has also devoted considerable effort in recent years to enhance its interactions with private industry outside of DCRI. The university currently views private industry as a potential source of new funding for research if the expected losses of federal research support come to pass. Independent of DCRI, the Duke School of Medicine, much like other schools of medicine around the country have frequent interactions with industry, many of which include funding research studies either solely at Duke or in collaboration with

the industrial partner. This area of funding has increased for Duke, as it has for other universities, in recent years since the movement over the past decade or so of many pharmaceutical firms out of the large-scale basic research business.

Outside of the biomedical research arena, efforts to connect with industry within Duke's Pratt School of Engineering have also met with some degree of success; the volume of industry-funded research at the school has grown consistently in recent years. Here however is where we have run into the most difficulty trying to develop research agreements that are acceptable to both parties. It is important to note that the majority of contracts that Duke negotiates with industry are developed with relatively little difficulty or contention. However, in osme cases, negotiating a successful research contract can take many months, something that faculty in particular can find very frustrating. Most frequently the difficulties arise with some companies that raise issues, often associated with intellectual property (IP) rights, which we cannot accept. Negotiating around these can take months or even become deal-stoppers altogether.

The notion of a standardized contract or form that we can make available to a potential industrial collaborator up front on a kind of "take it or leave it" basis has been raised frequently as a way of avoiding back and forth negotiations for months on end. While this idea sounds good on the surface of it, our finding is that many of the non-medical contracts we negotiate with industries are unique to the particular company at issue and even if Step #1 were for Duke to given the company a standard form to take or leave, Step #2 would almost certainly involve negotiating changes in the standard contract that would be acceptable to the company (i.e., more or less what is done now).

Another issue related to industry funding of Duke research is that many companies balk at paying Duke's federally negotiated indirect cost rate of 57%. Because even that rate represents a value less than the actual indirect costs we incur, were Duke's research portfolio to become too heavily populated with industrial support, we would be subsidizing our research efforts to an even greater extent than we do already. So while we will continue to work to develop industrial funding of Duke research, we have to remain cognizant of getting that research funded in full, to the extent possible.

Finally when comparing research funding by federal agencies with that of industry, most companies turn to universities to get research carried out that they want to know the answer to but they cannot undertake themselves. Conversely, the ability to fund a research project over an extended period of time - i.e., so long as new results continue to appear – is one of the constructive hallmarks of NIH- or NSF-funded projects. Projects at these two agencies lasting 8 to 10 years are not uncommon. With industry-funded research, they are more generally looking to get a specific question answered, basic in nature though it may be and are not necessarily interested in funding a project long-term with the goal of seeing where it goes or hoping that something good will come out of it. This makes industry-supported research more short-term in nature and, as a result, less amenable to long-term planning from

the standpoint of the individual investigator who has to think about the support of students, postdocs and/or technicians going forward.

- **What is the responsibility of the Nation's research universities in encouraging participation in scientific research and preparing a STEM literate workforce?**

  Research universities are uniquely positioned to play a leadership role in preparing a workforce in the STEM (Science, Technology, Engineering and Mathematics) fields, particularly given their inherent integration of research and teaching. This is a priority area for Duke University and several national, state and local programs have been enacted to that end, often with federal support, to both encourage and improve STEM participation in the K-12 level and retain students who have chosen STEM majors once on campus.

  Many of the STEM initiatives on campus are organized through Duke's Pratt School of Engineering's Engineering K-PhD Program. The primary goal of the K-PhD program is to increase significantly the number of children, particularly females and underrepresented groups, who choose to pursue science-related careers. Some of the initiatives focus on after-school programs in the K-12 arena. One example is TechXcite, a national engineering after-school program sponsored by NSF will feature a Duke-developed curriculum to be utilized by the national 4-H program. TechXcite offers hands-on, vibrant exploration of STEM through seven theme areas.

  Duke has also partnered with the nationally-based Project Lead the Way (PLTW) and the North Carolina Department of Public Instruction to develop the North Carolina Project Lead the Way program. Project Lead the Way is a rigorous STEM curriculum geared for elementary, middle and high school students. The North Carolina PLTW reaches approximately 100 schools in the state, impacting more than 14,500 students and 193 teachers. In addition, Duke hosts summer programs and camps for students and training programs for teachers.

  In 2004, the Duke University Medical Center partnered with the Durham Public Schools through the Duke-Durham Neighborhood Partnership to create the BOOST (Building Opportunities and Overtures in Science and Technology) Program. BOOST aims to encourage Durham students in grades 5 to12, particularly underrepresented minorities, girls and students from economically disadvantaged backgrounds, to get involved in science, medicine and related fields. The multidimensional program features summer camps, year-long projects, research summits and mentoring opportunities to attract and excite students about science.

  Of course, the job doesn't end once students interested in a STEM major enroll in college, and Duke has worked to improve its own curriculum and provide other programs designed to keep these students interested in and excited about STEM. The Duke Smart Home Program began in 2003 as a student-run project and has developed into a "living laboratory" for students interested in energy efficient technologies or "smart" living. Projects allow students

to move ideas into proof of concept, development of prototypes and, finally, install-ready technologies. This program also provides an opportunity for students to interact with industry, through collaborative research, product testing and internship opportunities, to name a few.

In addition, Duke's Pratt School of Engineering has engaged in a restructuring of its curriculum in order to provide more opportunities for first and second-year students to participate in hands-on, project-based activities, something that was previously reserved for third and four-year students.

- **What novel programs, practices, and organizational processes is your university employing to encourage innovation and American competitiveness?**

Oversight and coordination of innovation and entrepreneurship at Duke is housed administratively within an organization, Duke Innovation and Entrepreneurship (Duke I&E) Duke I&E is committed to: 1) building a community and fostering a culture at Duke that supports innovation and entrepreneurship; 2) creating resources and infrastructure to support faculty, students and alumni in ideation, planning and launching of new enterprises; and 3) celebrating Duke entrepreneurs who are addressing the world's problems through the creation of new ventures. Through Duke I&E efforts to promote innovation and entrepreneurship permeate all levels of campus activity from formal academic programs for undergraduates, graduates, and professional students to informal working groups to competitions open to entrepreneurs of all types. A brief overview of some of the programs available is presented below.

Duke has a wide array of academic programs, at both the graduate and undergraduate level that focus on entrepreneurship. Many of these programs are located, not surprisingly, in Duke's Fuqua School of Business. Among these Fuqua programs are: 1) the Program for Entrepreneurs (P4E) which assists entrepreneurs in launching new business and social ventures. It leverages Fuqua's academic research, courses and broad community of practitioners to work with entrepreneurs to define, plan, establish, and finance new ventures; 2) the Center for the Advancement of Social Entrepreneurship which is a research and education center that promotes the entrepreneurial pursuit of social impact through the thoughtful adaptation of business expertise; and 3) Invention-to-Application which is a year-long, experiential class for MBA, graduate biomedical engineering, engineering management, medical, and medical basic science students designed to integrate and expand their prior learning and draw on the experiences of teammates in order to understand and screen a group of real-world research projects based on their commercial potential.

Another academic program is housed within the Duke Law School. The Law and Entrepreneurship LLM Program operates at the intersection of the legal and business ends of new ventures and provides a valuable foundation for lawyers who plan to be involved with innovative ventures after graduation, either as advisers, executives, or CEOs.

There are many ways for students to get involved with entrepreneurship at Duke outside of the classroom setting. Graduate and undergraduate students can choose from a variety of student clubs and living groups. There are several networking opportunities for students, faculty and alumni – including interest groups for social entrepreneurship, mobile applications, biotechnology and many more. The annual Duke Start-Up Challenge (founded in 1999) is open to all Duke students to compete for seed funding for their enterprise. The competition has seven independent "tracks", including undergraduate team, social venture, life sciences, and women-led teams.

Research commercialization is the process of bringing research discoveries to market, so that they have a practical impact on people's lives. The Duke Office of Licensing & Ventures (OLV) is responsible for patents and technology licenses for Duke University and is the first stop for a faculty member or new venture team looking to commercialize technologies initially developed on campus. OLV is composed of a team of invention managers who have expertise in licensing, business development, marketing, and legal matters. The office reviews incoming invention disclosures and works within its investor network to identify startup opportunities and to create new companies.

There is also a number of specific funding and development support programs at Duke focused on particular areas of technology that are designed to assist new venture teams in navigating their technology through the commercialization process. These include: 1) the Duke-Coulter Translational Partnership Grant Program which is designed to accelerate the development of promising biomedical research programs that address important unmet clinical needs; 2) the Duke Translational Research Institute whose mission is to rapidly and effectively invent, develop, and test new drugs, diagnostics, and devices for human use; 3) the Biomarker Factory which is a company co-owned by Duke University and LabCorp that funds and manages the development and commercial launch of clinical diagnostics; 4) the Blackstone Entrepreneurs Network which presents a unique approach to accelerating the growth trajectory of promising start-ups in the Research Triangle Park. The Network reflects an unprecedented collaboration between the region's major universities, including Duke, UNC-Chapel Hill, NC State University, and NC Central University, the region's entrepreneurial community, and the private sector.

For Duke students considering starting a new venture or joining an early venture that does not necessarily involve Duke intellectual property? There are a variety of programs to help them get started and assist them as the venture develops. These include: 1) the previously mentioned Duke Start-Up Challenge which encourages students to plan and launch their own businesses, receiving feedback from experienced professionals and a chance to win seed capital; 2) the Program for Entrepreneurs (P4E) which lets Duke students receive course credit for work towards starting a company. Students with projects can attempt to join the program by pitching their ideas at an Idea Pitch Event; and 3) DUHatch, which has a primary focus of assisting student entrepreneurs in creating viable business ventures.

- **In light of the release of the National Academies report, *Research Universities and the Future of America*, please comment on the strengths and weaknesses of the recommendations.**

  Before addressing the specific recommendations, we should note that Duke University strongly endorses the three broad goals underlying the ten recommended actions. Those goals include the need to: 1) revitalize the partnership among universities, federal and state governments, philanthropy and the business community; 2) undertake actions that will streamline and improve research productivity at research universities; and 3) implement measures to ensure the pipeline of future talent in the STEM fields. It is essential to the future economic health and vitality of the nation that ways be found to successfully address these issues as the nation finds itself operating in an increasingly competitive world in which many of the comparative scientific and technological advantages the United States maintained in the past are no longer as significant or, in some cases, even present.

  Recommendation #1
  We stand fully behind the need for the federal government to adopt stable policies and practices for university performed research and development (R&D). This same notion underpinned the philosophy behind the Morrill Act of 1862 which initiated the partnership between the federal government and the nation's nascent university system. A primary driver of the Morrill Act was to foster research that would provide the United States a continual source of new technologies which would, in turn, allow the country to maintain a comparative advantage in an increasingly technologically competitive world. The need for the United States to maintain this scientific and technological advantage is even more critical today and the call encompassed in this NRC report to reexamine and renew that partnership could not be timelier.

  The call to raise national R&D funding to 3% of the gross domestic product and to provide full funding for the America COMPETES act, while not inherently unreasonable is probably a little unrealistic in the near-term in light of current fiscal realities facing the country. We firmly believe the principle of achieving an agreed upon level of national support for R&D is a conversation that should be undertaken but more realistically any implementation should be deferred until we get federal budgeting on more fiscally solid ground and the economy has gotten out of its current doldrums.

  Recommendation #2
  This recommendation is aimed at state-supported universities, of which Duke University is not one. However, we are supportive of the principles that underlay this recommendation. As one of the primary university players in the Research Triangle we have myriad interactions and collaborations with our near-by, state-supported, research universities and when they suffer we do feel that pain. We will leave elucidating the details of this recommendation to the three state institutions participating in this hearing.

Recommendation #3

Strengthening the relationship between universities and private industry needs to be a cornerstone of any national policy designed to strengthen America's research universities. As one of the three major research universities located in the Research Triangle we have seen the advantages to be gained from a 50-year partnership that includes research universities, state and federal governments, and private industry. The result is arguably one of the top research environments in the country, if not the world, particularly in the area of biotechnology. The nurturing environment provided in North Carolina has led directly to the appearance in the area of the R&D arms of many established companies and innumerable start-ups. Many of these start-up firms are derived from technologies that were originally generated as basic discoveries at the area's universities and were supported by federal and state funding.

Looking more specifically at the suggestions for implementation, we are supportive of measures that will strengthen the linkage between research universities and private industry and/or other research institutions (e.g., DOE national laboratories). However in this case, several of the suggestions in the report for implementation of Recommendation #3 are generally lacking in detail for accomplishing things that in several cases have been discussed by the vested parties (i.e., universities, industry, national laboratories, etc.) for years on end without clear resolution. Additionally, while we welcome any resources that support federal research, direct resources to support research via grants and specific programs are more preferable to our mind than most incentives provided through the tax code. In addition, it has been our observation that when most companies express an interest in funding research at Duke, they are not motivated to collaborate with us primarily because of the tax benefits (although one presumes they do not mind them). They generally want to collaborate with Duke because there is something they want done that they feel a Duke faculty member can provide for them.

Recommendation #4

At Duke University, we are very supportive of finding ways to increase research cost-effectiveness and productivity and see this as a constant driving force in our operations. As noted earlier in this testimony, in response to the 2008 economic downturn, the university was able to cut $125M per year from its annual budget. With respect to research we have an ongoing program to enhance research administration across the entire university, primarily through the increased application of advanced information technology within the grants administration structure.

We very much support the call for greater interaction among research institutions and would reiterate that a considerable amount of cooperation currently goes on among institutions within the Research Triangle. There are many examples. The libraries of the three major research universities have long been linked through the Triangle Library Network (TLN) which does a lot to bring down costs that would otherwise be associated with maintaining scientific journals and many books at more than one site. Nuclear physics in the area has long been linked through the presence of the Triangle Universities Nuclear Laboratory

(TUNL). This DOE-sponsored accelerator provides a very cost effective approach to maintaining nuclear physics programs at the three area universities. Talks are now underway among the three research universities regarding sharing a single major data storage facility among the three universities to save on the costs associated with this ever-burgeoning component of all of our research enterprises.

So while this recommendation is very much on target, it also represents a principle of operation that is already familiar to Duke, and most other research universities that we interact with, and recommends a goal we are continually striving to achieve. We also strongly support the implementation suggestion that research universities do a more effective job of better educating key audiences about the character of research universities and their importance to achieving state and national goals.

Recommendation #5

We are of the opinion that given the many fiscal issues currently facing the federal budget, coupled with the tenuous state of the nation's economic recovery, now is probably not the time to be discussing the possibility of establishing a new program of this magnitude (however laudable the goals that stand behind it). Serious discussion of this recommendation should probably be put on hold until the federal budget has achieved a more sound footing and the economy is back on a more positive track.

Recommendation #6

This recommendation addresses a relatively contentious issue, covering the full indirect costs (F&A) of research on federal grants and contracts. The many issues involved here are frankly too complex to be address with the simple recommendation that all indirect costs be covered, especially on a basis that no new costs be incurred by the federal government. This issue itself is also currently being considered by the OMB Task Force that is looking into streamlining a number of issues associated with federally-funded research. At this point, it is probably best to let that process run its course.

Recommendation #7

It is difficult not to be in favor of a recommendation to reduce regulations that increase administrative costs and are seen as impeding research productivity without improving the research environment. That is like apple pie on its surface. It is also the case that Duke University, like all research universities, wants to be seen as a good steward of taxpayers' dollars. However, as noted previously in this testimony, we have seen something of a tsunami in new regulations over the past decade or so at a considerable net cost to universities. Some of these new regulations seem to have only marginal, or even negative, effects on research oversight.

For example, as per federal statute (i.e., Bayh-Dole Act) we are cognizant of the need to transfer our basic science discoveries into commercial practice as efficiently and rapidly as possible. However, technology transfer is a complex process that is fraught with tripwires and there are many places where current regulations can hinder those efforts. One notable

example is Conflict of Interest regulations that are making it increasingly difficult for university inventors to remain fully engaged in moving their basic discoveries into the development stage on their way to commercialization because they judged to be too conflicted by current conflict of interest regulations. This is problematic because the inventors are the very people (from a technical standpoint) who should be most intimately involved at this stage of IP development and current conflict of interest guidelines can often serve to marginalize that involvement.

That having been said, the suggestions for implementation of this recommendation, to review current regulations to try and eliminate redundant and ineffective regulations and to make regulations more consistent across federal agencies, both are very reasonable things to do at a limited cost. Such an effort could lead to marked savings in terms of both dollars to the government and enhancements in research productivity.

Recommendation #8

We strongly support this general recommendation to improve graduate education programs in the U.S. with the goal of attracting larger numbers of brighter students into STEM graduate studies. Particularly pertinent among the implementation recommendations is the goal of making graduate students more aware of an expanded range of opportunities for the use of a graduate degree beyond the academy. Many such educational activities are currently taking place within graduate schools across the country and by scientific professional societies, but more needs to be done in the future to make STEM graduate education a more appealing option for K-16 students.

Recommendations #9 and #10

We strongly endorse the general tenor of both these recommendations, the first of which (#9) calls for improving the number and diversity of students in the STEM pipeline by reaching out to all levels of the education system and taking specific steps to improve access to women and underrepresented minorities .

Given the worldwide competition for students educated in STEM areas, the ability of the United States to attract foreign students trained in STEM subjects will be critical for allowing this country to maintain a competitive edge in science and technology in the future. To that end, the recommendation (#10) to streamline the process by which international students who want to study in the United States can obtain visas and doctoral students who obtain their degrees in this country can be allowed to remain here seems well justified and, within the constraints of national security considerations, worthy of relatively expeditious implementation.

Recommendation #11

While clearly not a committee recommendation per se, the overarching tenor of this NRC report and the development of our own testimony for this hearing led us to wonder whether another potential outcome of this reassessment of the partnership between research universities and the federal government might not be a call for a formal look at the country's

research portfolio in light of the strategic research needs of the country going forward. In essence, does the current distribution of federal support for basic research align, or not, with where technology will most need to be advanced in the future if the country is to maintain its competitive science and technological edge.

This suggestion could be seen as running afoul of those who feel this leads to the federal government placing bets on the future, something it should not be doing. The fact is we are already doing that with our current distribution of support for research and all this suggestion says is that it might behoove us to take a more strategic look at whether the research we currently support and the technology we will need going forward align to any extent or not.

Thank you for your time and for your attention to this important issue.