UCLA
University-Led Grand Challenge Materials

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About This Report

This report is designed to provide an overview of the attributes and benefits of university-led Grand Challenges, with a summary of best practices and strategies for universities currently engaged or considering starting their own programs. The report also makes the case for a new Community of Practice on University-Led Grand Challenges and highlights opportunities for other sectors—philanthropy, associations, professional organizations, and Federal, State, and local governments—to support and participate in these efforts.

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Executive Summary: University-Led Grand Challenges

Grand Challenges—also known as "moonshots"—are increasingly being pursued by organizations and individuals. These ambitious goals have the potential to capture the public's imagination, increase support for policies and investments that foster innovation, and serve as compelling "North Stars" for cross-sector and multi-disciplinary collaboration. From President Kennedy's moonshot goal to put a man on the moon and return him safely to Earth, to the Obama White House's cross-sector call to action to make progress towards Grand Challenges, as part of a national strategy for American innovation, Grand Challenges have a history of catalyzing innovation for the benefit of society. Today, nearly 20 North American universities[1] are leading Grand Challenge programs that are rallying research communities to contribute to solving a major societal challenge; attracting new investment and resources; demonstrating value of university research; and engaging students, partners, the broader community, and the public. In October 2017 at UCLA, participants in a Workshop and Strategy Session on University-Led Grand Challenges identified opportunities for universities, philanthropy, associations, and industry to further advance these efforts through a new Community of Practice.

The process to develop Grand Challenge programs at universities—and approaches to administering those programs and engaging students, partners, and the public—are widely varied among universities. That said, universities experience common challenges and have identified effective strategies related to launching and sustaining interdisciplinary Grand Challenge research efforts.

Some of those strategies include:
- Ensuring leadership buy-in is evident to internal and external stakeholders
- Putting in place sufficient staffing and clear roles and responsibilities for administering Grand Challenge programs during development and implementation phases
- Developing faculty and staff buy-in, incentives, and a culture of accountability, collaboration, and risk-taking
- Changing business operations at the university to support interdisciplinary initiatives
- Leveraging (not duplicating) existing university strengths, such as centers and institutes
- Supporting, fostering, and mentoring leaders for Grand Challenge teams
- Collaborating with external partners such as industry, government, and non-profits
- Establishing robust work plans and research plans for each Grand Challenge goal
- Raising sufficient funding, keeping momentum, right-sizing, and ensuring sustainability of these long-duration research efforts

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[1] Including, as of October 5, 2017, Carnegie Mellon University, Colorado State University, Georgia Institute of Technology, Indiana University, Michigan State University, McGill University (Canada), New York University, North Dakota State University, Princeton University, Stanford University, Texas A&M University, The Ohio State University, The University of Texas at Austin, UCLA, University of Colorado Boulder, University of Michigan, University of Minnesota, University of Wisconsin-Madison, and Washington State University

- Including students in Grand Challenges research and problem solving at scale
- Communicating progress frequently, transparently, and effectively internally on campus, with outside partners, and to the public

Universities embarking on Grand Challenge efforts are traversing new terrain—they are making commitments about research deliverables rather than simply committing to invest in efforts related to a particular subject matter. To mitigate risk, those universities that have entered this space are informally consulting with others regarding effective strategies, but the entire community would benefit from a more formal structure for identifying and sharing "what works." To address this need the new Community of Practice for University-Led Grand Challenges—launched at the October 2017 workshop at UCLA—aims to provide peer support to leaders of university Grand Challenge programs, and to accelerate the adoption of Grand Challenge approaches at more universities supported by cross-sector partnerships.

This Community of Practice is envisioned as a stand-alone, informal, peer-organized body, open to all university representatives actively involved in managing the development or implementation of a Grand Challenge program. The initial core functions will comprise: a listserv, a document repository, a calendar of regular events, and shared distribution of news and communications relevant to university-led Grand Challenges.

In addition to sharing effective strategies and lessons learned on an informal basis, members of the Community of Practice are interested in collaborating on joint projects and activities for the benefit of the field, such as:
- Co-designing and co-hosting workshops, webinars, and retreats for professional development and knowledge sharing, including at association and professional organization conferences
- Coordinating reciprocal visits and mentorship by and among peers
- Sharing sample documents, templates, and proven processes
- Engaging in joint communications efforts to raise awareness about university-led Grand Challenges inside academia and across other sectors and the public
- Continuing to document both the unique attributes of Grand Challenge programs as compared to other large, interdisciplinary research efforts and the diverse models and processes being used by universities to support Grand Challenges
- Partnering among universities on common Grand Challenge topics ranging from environmental sustainability, to precision medicine, to addiction
- Setting agendas for future Grand Challenges that could be led by universities, philanthropies, Federal agencies, or other organizations
- Identifying and piloting additional approaches to involving students and youth in research, problem solving, team work, critical thinking, and design thinking related to Grand Challenges

The university community has identified extensive opportunities for collaboration on these Grand Challenge programs with other sectors. Philanthropy can support the development of

new Grand Challenge programs at more universities by establishing planning and administration grant programs, convening experts, and providing funding support for documenting these models through white papers and other publications and for evaluation of these programs over time. Relevant associations and professional development organizations can host learning sessions about Grand Challenges for university leaders and professionals. Companies can collaborate with universities on Grand Challenges research, act as sponsors and hosts for university-led programs and activities, and offer leaders, experts, and other personnel for volunteer advisory roles and tours of duties at universities. Federal, State, and local governments and elected officials can provide support for collaboration among government agencies and offices and the research community on Grand Challenges.

Today's global society faces pressing, complex challenges across many domains—including health, environment, and social justice. Science (including social sciences), technology, the arts, and humanities have critical roles to play in addressing these challenges and building a bright and prosperous future. Universities are hubs for discovery, building new knowledge, and changing understanding of the world. The public values the role universities play in education; yet as a sector, universities are less effective at highlighting their roles as the catalysts of new industries, homes for the fundamental science that leads to new treatments and products, or sources of the evidence on which policy decisions should be made. By coming together as universities, collaborating with partners, and aiming for ambitious goals to address problems that might seem unsolvable, universities can show commitment to their communities and become beacons of hope.

I. Introduction

In recent years, a growing number of individuals and organizations—including universities—have decided to identify and pursue ambitious but achievable goals, often known as "Grand Challenges" or "moonshots." These efforts harness science, technology, and innovation to solve important national or global problems. Today, nearly 20 major research universities—in collaboration with donors, board members, community partners, and local industry—are pursuing Grand Challenges and moonshot goals through multidisciplinary research projects and student-led innovation efforts.

Some of these research universities launched Grand Challenge programs in recent years in response to a call to action by President Obama and the White House Office of Science and Technology. In April 2013, when launching the BRAIN Initiative—a Grand Challenge to revolutionize our understanding of the dynamic human brain—President Obama stated, "we're pursuing other "Grand Challenges" like making solar energy as cheap as coal or making electric vehicles as affordable as the ones that run on gas. They're ambitious goals, but they're achievable. And we're encouraging companies and research universities and other organizations to get involved and help us make progress." [2] Research universities also cited historical examples of Grand Challenges as inspiration for their programs, including the race to win the incentive prize that led to the first transatlantic flight, and President Kennedy's famous moonshot, which catalyzed the space industry, galvanized the creation of new products and jobs, and inspired the nation.

In October 2017, representatives of more than 20 universities and other institutions—including more than 10 universities actively leading or developing Grand Challenge programs—gathered at UCLA for a Workshop and Strategy Session on University-Led Grand Challenges, where they shared effective strategies for the development and administration of Grand Challenge programs, and discussed how to best advance a new Community of Practice for leaders and champions of university-led Grand Challenges.

Informed by the results of that workshop, this report:
- Provides an overview of the attributes and benefits of university-led Grand Challenges;
- Summarizes current university-led programs;
- Describes common challenges in Grand Challenge development and administration;
- Offers strategies for effective programs and illustrative (though not exhaustive) examples from existing university-led Grand Challenges;
- Makes the case for a Community of Practice on University-Led Grand Challenges; and
- Highlights opportunities for action by philanthropies, associations, industry, and government to support the development and administration of effective Grand Challenge programs by research universities.

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[2] https://obamawhitehouse.archives.gov/administration/eop/ostp/grand-challenges and
https://obamawhitehouse.archives.gov/sites/default/files/strategy_for_american_innovation_october_2015.pdf

II. Background on Grand Challenges

Benefits

Grand Challenges have the potential to capture the public's imagination, increase support for policies and investments that foster innovation, and serve as compelling "North Stars" for cross-sector and multi-disciplinary collaboration. Efforts to pursue Grand Challenges, if sufficiently resourced, can expand knowledge across science and technology frontiers, create a foundation for new industries and jobs, and catalyze breakthroughs in fields such as health, education, and energy. These moonshots can inspire youth—tomorrow's change-makers, scientists, engineers, entrepreneurs, artists, and storytellers—and engage them in tackling tough problems.

Grand Challenges represent a paradigm shift for university research—with this model, talented researchers are collaborating with industry experts and government leaders towards ambitious goals, rather than waiting for the market and policymakers to adopt academic discoveries and insights. In pursuing Grand Challenges and moonshots, research universities can:

- Lead and contribute to solving a major societal challenge through application of research
- Rally research communities around a large, multidisciplinary, priority research effort
- Attract new investment and resources
- Raise public profile of existing capabilities and demonstrate value of university research
- More powerfully engage the entire campus community (including students, staff and faculty from all disciplines)
- Connect with partners, broader community, and the public
- Inspire and engage students in problem solving and hands-on research

Attributes

General attributes of effective Grand Challenge goals include:

- A focus on making significant impact in an area of national or global priority through innovation and advances in science and technology
- A thoughtfully defined goal that is not too broad (possible paths toward reaching the goal should be evident) and not too specific (multiple fields and communities should see the relevance of the goal to their work and interests)
- A compelling explanation of why the goal is now within reach
- A plan for pursuing the goal through cross-sector and multidisciplinary collaboration

> ### Motivations for Starting a Grand Challenge Initiative
>
> Universities currently pursuing or considering Grand Challenge initiatives cite a number of motivations, including the following:
> - Change culture of campus
> - Raise public profile of university
> - Build an area of expertise
> - Identify campus priorities
> - Increase impact on society
> - Diversify funding portfolio
> - Foster more collaboration
> - Increase interdisciplinary approaches
> - Position students to be the problem-solvers of the future

In practice, attributes of the development and administration of university-led Grand Challenges are widely varied. In terms of choosing a topic, focus areas and goals may be preselected by university administration, or the process to develop a Grand Challenge may be open to researchers, faculty, students, external partners, donors, or the public. Open processes may be competitive (in which research teams compete for limited resources), collaborative (in which research teams work together to define and evaluate Grand Challenge goals), or a blend.

In terms of program structure, Grand Challenge programs may be led by a specific school or college, campus-wide initiatives, or a small start-up program within the university. Students and youth may participate in developing the Grand Challenge goal and research plan, be provided opportunities to conduct hands-on research or other project-based learning towards the Grand Challenge goal, or be involved in other aspects of the Grand Challenge, such as communications and outreach. Universities are also taking varied approaches to involving their community, partners, and other external institutions, such as by forming advisory boards, conducting open external reviews of proposed Grand Challenge ideas and plans, and establishing formal partnerships or informal collaborations to go farther, faster, together.

HIBAR Research is Another Framework Leveraged for Impact

Pursuing Grand Challenges is one framework being leveraged by universities to increase the societal impact and value to the public of research at universities. Another complementary and synergistic framework is Highly Integrated Basic And Responsive (HIBAR) research. There is a network of researchers developing a Consensus Statement on how universities can improve their research outcomes and benefits to society through HIBAR research, which emphasizes the potential for collaboration across sectors. The Association of Public and Land-grant Universities (APLU) is a strong proponent of and contributor to both of these research approaches.

As with Grand Challenge programs, the reasons for universities to foster HIBAR research are varied, with an emphasis on catalyzing cultural change on campus, increasing impact, improving community relationships, and solving real-world problems while boosting academic research. Certain research projects can be categorized as both HIBAR and Grand Challenge research, while others may fit more squarely in one or the other.

How the Grand Challenges and HIBAR Frameworks Differ

- **Scale, Scope, and Team Size.** Grand Challenges tend to be large in scale, ambitious in scope, and multi-disciplinary, while these attributes are not necessary for HIBAR research. HIBAR research may include one person or a team's research, with no required emphasis on interdisciplinary work.
- **Engagement of Partners and Timing.** HIBAR research anticipates the inclusion of stakeholders from the very inception of the project. While Grand Challenge programs often benefit from collaboration with external stakeholders, there are no prescriptions requiring their inclusion or the timing of such inclusion.
- **Research and Problem-Solving Approaches.** HIBAR research integrates basic research with a commitment to addressing societal challenges, while also combining different problem-solving approaches. Grand Challenge programs are not prescriptive about inclusion of both basic and applied work, or about the problem-solving approaches. That said, many Grand Challenges programs will rely on both basic and applied research, as well as varied problem-solving approaches.
- **Goal Orientation**. Some Grand Challenge programs are focused on ambitious and measurable goals, while others are not. HIBAR research does not require a goal orientation.

The Advantage of Setting Ambitious SMART Goals

"By defining our goal more clearly, by making it seem more manageable and less remote, we can help all peoples to see it, to draw hope from it, and to move irresistibly toward it." -President John F. Kennedy, 1963

To date, a number of university-led Grand Challenge programs have been focused on broad themes and general areas of opportunity to build a better future, such as precision medicine and environmental sustainability. Other universities—including UCLA and Indiana University—are pursuing specific ambitious yet achievable goals. This goal-driven approach to Grand Challenges offers significant advantages.

Setting out a compelling goal that offers a well-defined vision for success can yield remarkable results. For example, the U.S. Department of Energy has shared that its SunShot Grand Challenge—with the goal of making solar cost competitive with fossil fuels by 2020—has catalyzed $3.4 billion in follow-on private investments in solar startups, dramatically reduced the time it takes to go solar, dropped the cost of solar by 50 percent since 2011, and contributed to the solar industry becoming a thriving source of new jobs.

In another example, in 2013, as the science community rallied behind a 10-year research plan to build the tools that will increase understanding of the human brain in action so diseases of the brain such as Alzheimer's, schizophrenia, and autism can one day be solved, President Obama announced a new BRAIN Initiative Grand Challenge to pursue that goal. Philanthropists, research institutes, Federal agencies, and universities responded to the BRAIN Initiative's ambitious vision, taking on complementary efforts to help achieve the goal. Now, more than 4 years into the project, the initiative is supported by $3 billion in public-private support, engaging thousands of researchers, and yielding transformative research results.

Ambitious yet achievable goals do not work just at the level of national, government-driven movements such as SunShot and the BRAIN Initiative—they also can serve to focus and turbocharge individual teams, organizations, partnerships, and collaborative networks, such as the *100Kin10* network of partners, which is on track to achieve the goal of bringing 100,000 excellent STEM teachers into the classroom by 2021. These moonshot goals—if defined with compelling vision and with a "Goldilocks level of specificity and focus" (in the words of former White House Office of Science and Technology Policy Deputy Director Thomas Kalil)—have the potential to serve as North Stars that can catalyze cross-sector collaboration, provide focus for multidisciplinary research teams, and capture imaginations of partners and the public.

When launching a Grand Challenge program, universities can use a specific, measurable, and ambitious goal to clarify how the university plans to contribute to solving part of a major societal challenge; raise the public profile of the university's existing capabilities; rally the university's broader community around a clear target; and attract new investment and resources.

When working to set bold goals, universities may find it helpful to select a "SMART" goal:

- **S for Specific.** Will researchers have a sense of where to focus and will partners beyond the university be able to identify where they might play a role in the initiative?
- **M for Measurable.** Is success well-defined? Can the university track progress towards the goal?
- **A for Ambitious**. Is the goal a true stretch goal? Is it so big it requires collaboration to solve it?
- **R for Realistic and Relevant**. Why now? Is the goal achievable given recent trends and breakthroughs? Do current events makes the goal especially important now? Can the university clearly articulate what makes it uniquely positioned to pursue the goal?
- **T for Time-bound**. Has a deadline been set for by when the goal will be accomplished? A 2-year goal may be too narrow in its focus, and a 50-year goal may be too big and vague.

Below is a comparison of general themes or focus areas to more specific SMART Grand Challenge goals:

General Theme/Focus Area	Goal
Space exploration	Send humans to mars by 2030
Climate change mitigation	Make solar cost competitive with fossil fuels by 2020
Mental health	End depression as we know it by 2050

III. Current University-Led Grand Challenges

Summaries of Select University-Led Grand Challenge Programs

The following universities provided information about their Grand Challenges program through participation in the October 2017 Workshop and Strategy Session on University-Led Challenges at UCLA. Detailed information about these programs may be found in Appendix C.

- **Carnegie Mellon University.** CMU's college-level, competitive "moonshot" program is designed to provide winning groups of faculty with targeted support to build research capability over a 3-year period in areas that may have long-term opportunity and impact for the University. CMU's first moonshot focuses on bio-engineered organs.

- **Georgia Institute of Technology.** Georgia Tech's Grand Challenges program is a living learning community in which over 100 freshmen (doubling next year) are admitted into the program, live together in a single dormitory community, explore solutions to important problems that impact our society, and implement their proposed solutions in small student-led teams over the course of their undergraduate degree.

- **Indiana University.** IU anticipates investing up to $300 million over the next 5-10 years to tackle 3-5 Grand Challenges faced by the state of Indiana. IU's three active Grand Challenge Initiatives include: (1) the Precision Health initiative that aims to transform health in Indiana through broader application of precision medicine; (2) the Prepared for Environmental Change initiative that aims to position Indiana to combat the growing threats caused by extreme and unpredictable weather patterns and environmental changes that result; and (3) the Responding to the Addictions Crisis initiative that aims to address addictions in Indiana through cross-sector collaboration.

- **McGill University.** The McGill Sustainability Systems Initiative provides support for McGill researchers from the sciences and humanities to co-develop significant, impactful and socially relevant advances that move society towards a sustainable model of existence. The MSSI's first three research areas are: 1) Creating Sustainable Materials for the Future; 2) Adapting Urban Environments for the Future; and 3) Sustaining Landscapes for the Future.

- **The Ohio State University.** OSU's Discovery Themes initiative is helping faculty connect with colleagues across Ohio State and with select partners outside the university to address critical challenges in three broad thematic areas that align with the university's strengths: energy and environment, health and wellness, and food production and security and production. Additionally, translational data analytics and the humanities and arts programs cross each of the three themes. The scale and scope of faculty hiring into these multidisciplinary programs is changing the culture and climate for research at OSU, with more than 120 diverse tenured and tenure-track faculty hired through the Discovery Themes since 2014, and an additional 80 are expected to be hired by 2020.

- **The University of Texas at Austin.** UT Austin's Bridging Barriers is a campus-wide, researcher-driven Grand Challenge initiative overseen by the Office of the Vice President for Research and engaging more than 800 UT Austin faculty, staff and student researchers

representing all disciplines on campus, along with Austin community partners. UT Austin's first challenge is Planet Texas 2050, which will explore how Texas will be able to ensure its resilience in the year 2050, in both the built and natural environments, as it faces weather extremes and rapid urbanization.

- **UCLA.** UCLA Grand Challenges are ambitious research projects that connect hundreds of faculty, students, community members, and leading experts across many fields to solve society's toughest problems. Developed through an intensive faculty working group ideation process started in 2012 and supported by UCLA leadership, UCLA's two Grand Challenges are the biggest, most collaborative, and potentially most transformative efforts UCLA has undertaken to date, and include: (1) launched in 2013, the Sustainable LA Grand Challenge focusing on transitioning Los Angeles County to 100 percent renewable energy, 100 percent locally sourced water, and enhanced ecosystem and human health by 2050, and (2) launched in 2015, the Depression Grand Challenge aiming to cut the burden of depression in half by 2050 and eliminate it by the end of the century.

Spotlight on UCLA Grand Challenges

UCLA's two Grand Challenges provide two robust examples of goal-driven Grand Challenge programs, currently being supported with campus funds, grants from the Federal government and other sources, industry sponsorships, and philanthropic gifts.

Sustainable LA Grand Challenge (SLA GC). The goal of this Grand Challenge is to transition Los Angeles County to 100 percent renewable energy, 100 percent locally sourced water, and enhanced ecosystem and human health by 2050. The estimated cost of this effort is $150 million. Nearly 30 faculty members co-developed a 5-year work plan of over 100 research recommendations, reviewed by external experts. This work plan has served as a guide for the work that is undertaken to meet the goals. A critical success factor for this Grand Challenge is buy-in and support of the city and county. In spring 2017, SLA GC announced the formation of the L.A. Sustainability Leadership Council chaired by UCLA Chancellor Gene Block and L.A. Mayor Eric Garcetti. This council is designed to lead a focused, coordinated effort to make Los Angeles the world's first sustainable megacity and includes many stakeholder representatives. To measure the progress of the city and county efforts, the SLA GC is publishing a series of Environmental Report Cards reporting on various metrics related to the SLA GC goals. The SLA GC created a signature course tied to the Grand Challenge in which students enroll in a yearlong program including coursework, traditional research, and an interdisciplinary student team project.

Depression Grand Challenge (DGC). The goal of this Grand Challenge is to cut the burden of depression in half by 2050 and eliminate it by the end of the century. The approach to this Grand Challenge focuses on four interrelated components: discovery neuroscience to understand how depression arises; a 100K patient study to reveal the genetic and environmental factors at play with depression; an innovative treatment network focused on providing the most appropriate and evidence-based treatment; and research focused on understanding and eliminating the stigma associated with depression. The estimated cost for the first 10 years of this effort is $525 million. Accomplishments include recruitment of high-profile leadership for the challenge, more than $20 million in funding invested to date, and commencement of multiple pilot studies towards the 100K patient study. In fall 2017, UCLA's Chancellor committed to screen and provide required treatment for depression and anxiety for all incoming students who need it. Students engage with the DGC by serving as first-line responders after being trained to serve as faculty-supervised Resilience Peers, as student workers communicating about progress, and as student researchers in clinical and laboratory settings.

- **University of Colorado Boulder.** The "Our Space. Our Future." Grand Challenge initiative fuses CU Boulder's unique strengths in Earth, space and social sciences with new technologies and partners to address the pace and pattern of changes for our environment, our resources and our planet. This initiative aims to develop pathways to connect critical earth and space science knowledge to stakeholders and decision makers, to create an environment for cross-sector collaboration, to build new infrastructure and capabilities, and to train students to meet national needs.

- **University of Minnesota.** Minnesota's Grand Challenges program is in its third year. The focus is on five Grand Challenges: (1) Feeding the world sustainably; (2) Assuring clean water and sustainable ecosystems; (3) Fostering just and equitable communities; (4) Advancing health through tailored solutions; and (5) Enhancing individual and community capacity for a changing world. Minnesota's program has three integrated elements: an undergraduate Grand Challenges curriculum, which offers roughly ten interdisciplinary team-taught courses each semester; competitive grant and logistical support for interdisciplinary research teams, with 35 teams involving several hundred faculty from more than 50 departments supported with slightly more than $7 million in the first 2 years; and competitive faculty release time and logistical support for brainstorming participation in a Grand Challenges Scholar Collaborative to launch new projects.

- **University of Wisconsin-Madison.** The University of Wisconsin-Madison School of Education's Grand Challenges is bringing together the UW School of Education, the broader campus, and community partners to identify and address critical problems in education, health, and the arts, through a competitive grant program to provide support for its faculty, staff, and students to define and explore innovative research and programs in education, health, and creative expression. Grand Challenges is engaging all 10 departments in the School of Education and sparking interdisciplinary teams to engage in projects to make a profound difference in scholarship and in communities within the state and across the world.

- **Washington State University.** WSU's Grand Challenges focus its research, innovation, and creativity in specific areas to achieve broad societal impact. Grand Challenge focus areas include: Sustaining Health; Sustainable Resources; Opportunity and Equity; Smart Systems; and National Security. Six projects were funded last year to stimulate new areas of research. Twenty-six new faculty members will be hired as a result of these funds.

Additional University-Led Grand Challenge Programs

In addition to the above universities, the following universities also are pursuing (or have previously pursued) Grand Challenges through multidisciplinary research programs:

- Colorado State University School of Global Environmental Responsibility[3]

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[3] http://sustainability.colostate.edu/research/gcrt/rfp

- Michigan State University[4]
- North Dakota State University[5]
- New York University[6]
- Princeton Environmental Institute[7]
- Stanford University Catalyst for Collaborative Solutions[8]
- Texas A&M College of Agriculture and Life Sciences[9]
- University of Michigan[10]

> ## Universities Are Not Alone in Pursuing Grand Challenges
>
> Commitments towards Grand Challenges extend beyond the university setting. Grand Challenges are being pursued by U.S. Federal agencies, philanthropists, companies, and nonprofits, usually through cross-sector partnerships and collaboration. Examples include the following:
> - Developing the tools needed to understand the brain in action (BRAIN Initiative)
> - Making solar energy as affordable as fossil fuels by 2020 (Department of Energy's SunShot)
> - Reducing traffic fatalities by at least 80 percent using self-driving cars (Alphabet's Waymo)
> - Becoming a multi-planetary species ("I want to die on Mars, but not on impact." –Elon Musk)
> - Finding all asteroid threats to human population and knowing what to do about them (NASA)
> - Defeating the best human players at Chess and Jeopardy with artificial intelligence (IBM)
> - Developing a "tricorder"—a handheld mobile device that can diagnosis a dozen diseases as accurately as a board-certified physician (Qualcomm Tricorder XPRIZE)
> - Providing Internet access to everyone on the planet (Facebook)
> - USAID's Grand Challenges for Development, including Saving Lives at Birth and All Children Reading
> - Fostering breakthrough innovations to solve key global health and development problems – Gates Foundation Grand Challenges
> - Improving life on the planet in the areas of sustainability, health, security, and joy of living – National Academy of Engineering's 14 Grand Challenges for Engineering in the 21st Century

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[4] http://research.msu.edu/global-impact/global-priority-areas/
[5] https://www.ndsu.edu/grandchallenge/; https://www.ndsu.edu/fileadmin/provost/Forms/Strategic_Planning/NDSU_Research_and_Discovery_Grand_Challenge_Initiative_RFP_Final_071315.pdf; and https://www.ndsu.edu/research/
[6] https://www.nyu.edu/about/news-publications/news/2013/september/nyu-announces-winners-of-grand-challenge-science-competition.html
[7] https://environment.princeton.edu/grandchallenges
[8] https://catalyst.stanford.edu/10-grand-challenges
[9] https://grandchallenges.tamu.edu/home/
[10] http://thirdcentury.umich.edu/global-challenges/

IV. October 2017 Workshop and Strategy Session on University-Led Grand Challenges at UCLA

Workshop Goals

On October 5-6, 2017, UCLA hosted a workshop and strategy session to kick off a new Community of Practice on University-Led Grand Challenges. A robust group of representatives from universities with active Grand Challenge programs and those interested in starting new efforts gathered to:

- Discuss best practices and lessons learned from existing programs
- Inform the direction of the new Community of Practice
- Identify common obstacles and opportunities
- Brainstorm about the resources and tools that would help to sustain and scale this approach on more campuses across the country

Participants

A detailed list of workshop participants can be found in Appendix B. Representatives from the following universities attended the workshop:

- Arizona State University
- Carnegie Mellon University
- Georgia Institute of Technology
- Indiana University
- McGill University
- Oregon Health & Science University
- The Ohio State University
- The University of Texas at Austin
- University of California, Irvine
- University of Iowa
- University of California, Riverside
- UCLA
- University of Colorado Boulder
- University of Kentucky
- University of Maryland
- University of Minnesota
- University of Oregon
- University of Tennessee, Knoxville
- University of Wisconsin-Madison
- Washington State University

In addition, APLU participated in the workshop. As noted above, APLU is supporting development of a consensus statement on Highly Integrative Basic And Responsive (HIBAR) Research, a complementary and synergistic framework to Grand Challenges, which builds upon excellence in basic research and excellence in application and societal engagement.

UCLA Chancellor Gene Block provided welcoming remarks, which included his continued support for the Grand Challenges approach at UCLA, his acknowledgement of the risk-taking and campus culture change required for success, and the opportunity for continued and expanded cross-sector partnerships to support Grand Challenge efforts.

Topics Discussed at Workshop

As discussed in more detail in section V of this report, workshop participants discussed common challenges and effective strategies related to:

- Demonstrating leadership commitment to internal and external stakeholders
- Putting in place sufficient staffing and clear roles and responsibilities for administering Grand Challenge programs during short-term development and long-term implementation phases
- Developing faculty and staff buy-in, incentives, and a culture of accountability, collaboration, and risk-taking
- Changing business operations at the university to better support interdisciplinary initiatives
- Leveraging but not duplicating existing university strengths, such as centers and institutes
- Supporting, fostering, and mentoring leaders for Grand Challenge teams within the university
- Collaborating with external partners such as industry, government, and non-profits
- Establishing robust work plans and research plans for each Grand Challenge goal
- Raising sufficient funding, keeping momentum, right-sizing, and ensuring sustainability of these long-duration research efforts
- Including students in Grand Challenges research and problem solving at scale
- Communicating progress frequently, transparently, and effectively internally on campus, with outside partners, and to the public

As discussed in more detail in section VI of this report, workshop participants expressed interest in working together on:

- Building, supporting, and participating in an active Community of Practice to foster peer-led mentorship, learning, and collaboration across campuses
- Sharing sample documents, templates, and proven processes
- Engaging in joint communications efforts to raise awareness about university-led Grand Challenges inside academia and with philanthropy, industry, Federal agencies, and the general public
- Continuing to document both the unique attributes of Grand Challenge programs as compared to other large, interdisciplinary research efforts and the diverse models and processes being used by universities to support Grand Challenges
- Partnering among universities on common Grand Challenge topics ranging from environmental sustainability, to precision medicine, to addiction
- Setting agendas for future Grand Challenges that could be led by universities, philanthropies, Federal agencies, or other organizations
- Identifying and piloting additional approaches to involving students and youth in research, problem solving, team work, critical thinking and design thinking related to Grand Challenges

V.   Strategies for Leading Grand Challenge Programs

A. Introduction: Demonstrated Leadership Commitment is Essential

This section of the report shares the experiences, observations, and lessons of universities engaging in Grand Challenges, and details particular phases of Grand Challenge program development and operational hurdles. Woven throughout these examples, the commitment of university leadership is essential for the success of a Grand Challenge program, and that leadership buy-in must be secured by any university interested in creating such a program. Commitment of university leadership alone, however, is not enough: **internal and external audiences must be able to see and know that leadership has committed to the Grand Challenge**. The demonstration of the leaders' commitment should weave through communications, actions, and metrics (such as university goals or its strategic plan). When this support is demonstrated from the very top of the campus and is evident to all stakeholders, solutions to the obstacles discussed in greater detail below are more easily found.

B. Design of New Programs and Ideation

Advantages and Risks of Common Approaches for Ideation and Design of New Programs

Multiple approaches are being used on campuses to identify focus areas for new Grand Challenges, and each of these approaches has advantages and disadvantages. Two approaches are described below with examples and risks.

Offering open competitions for seed funding. A number of universities have used campus-wide competitions for seed funding of promising proposals from multidisciplinary teams toward new research projects focused on ambitious goals. One advantage to this approach is that there is a mechanism to capture all ideas from across a university. For example, in 2013, NYU's Grand Challenges Competition awarded $500,000 to two individual research projects—one pursuing microbial metagenomic mapping and the other pursuing advances in neuroprosthetics.

- *Risks of approach.* Submitted proposals may not match desired attributes or scope for Grand Challenges. Instead, the competition may result in proposals for a new center or institute, or supporting the work of a single researcher or a small team within a single discipline or lab.
- *Risk Mitigation.* Leaders and administrators of the competition can host regular office hours and information sessions to clarify expectations and desired attributes of Grand Challenge proposals, and can offer illustrative examples of projects that meet the criteria and those that do not.

Hosting campus-wide, facilitated sessions. Some universities, including University of Minnesota, UCLA, and UT Austin, have hosted a series of broad ideation sessions to form teams and build out robust concepts for compelling and ambitious multidisciplinary challenges. Sometimes, these facilitated ideation sessions are informed by an initial proposal collection process or competition as described above. By setting clear expectations and establishing an environment conducive to out-of-the-box thinking, these facilitated processes can foster

teamwork and generate promising proposals for interdisciplinary Grand Challenge goals. Universities who participated in the ideation processes report that the faculty who had been engaged were truly inspired by the process, even those whose ideas were not ultimately pursued. As some faculty shared with facilitators, the ideation process put them back in touch with what motivated them to pursue a career in academia in the first place: having a meaningful impact on society.

- *Risks of approach.* These ideation sessions can be time consuming, costly if external facilitators are hired, and inefficient or dominated by a team with a specific agenda, if not properly facilitated.
- *Risk mitigation.* Facilitators and leaders of the ideation process should be thoughtful about the composition of working groups, session participants, and the approach to facilitation. In addition, inputs into the process should be considered (such as how and whether to utilize pre-submitted proposals) and synthesis of the results of the process should be carefully considered, to authentically reflect participant input while taking into account considerations of feasibility, portfolio mix, strengths and complementary efforts at the university, and campus leadership prerogative.

Additional Strategies for Ideation and Design of New Programs

There is no single right approach to an effective ideation process. The important consideration is that risk factors are identified and mitigated for each decision. For example, if there is a curated team gathered with faculty known to work well with others, facilitation can be minimal and an added lay perspective might be a helpful addition. Compare that scenario to an open meeting where there are tens of people from various backgrounds focused on finding common ground across their topics of interest. In this latter scenario, strong facilitation is likely required, and deep content expertise might be needed to control the room and manage navigating through less viable ideas.

While no approach is foolproof, universities have identified a number of additional strategies for effective ideation and design of new programs, included below.

Identifying and broadcasting the primary goals of the initiative. Leaders and participants in an ideation process should be clear about whether the primary goal is to build collaborations, change culture, engage the public, increase campus impact, engage students, or some other motivation. The program needs to be designed to meet the main identified purpose—a Grand Challenge program designed to build a new area of expertise and research experience will look very different from programs designed to engage students in hands-on problem solving or to increase a campus' impact on the community.

Setting expectations about the process and path forward. Clear communications for participants about what is expected and what will happen at each stage is critical to success. If the path is still undefined, be transparent about this lack of definition. Some campuses have disseminated extensive written guidelines.

Acknowledging that the process is new and unfamiliar for many researchers. Thinking big about how interdisciplinary university research and cross-sector collaboration can yield positive impact for society is not necessarily a natural or familiar activity for researchers and faculty, many of whom have spent their careers focused on incremental progress towards curiosity-driven research and pitching ideas that might be fundable. Guided with specific questions and a clear process, however, most faculty and researchers are ultimately capable of collaborative ideation that generates bold ideas.

Ensuring dedicated staff time to support the ideation process. Some campuses offered dedicated open houses and office hours to answer questions about the process, and other campuses had staff attend and lead each ideation session. Campuses might consider identifying an experienced facilitator to guide working groups through ideation.

Cultivating helpful skills in current and potential Grand Challenge leaders. Within universities, faculty and staff Grand Challenge leaders and champions are pushed to think big and strategically, listen to other voices and make adjustments, engage others of varying backgrounds to trust in the Grand Challenge process, make tough decisions, have credibility, and connect with scientists, humanists, administration, funders, media, internal staff, and the public. These skills are not often fostered in the academic environment and thus, universities may consider investing in training for key Grand Challenge faculty members (and potential future leaders) on necessary skills of communications, public speaking, storytelling, relationship management, meeting facilitation, and fundraising. Of note, in today's environment, these skills are valuable beyond Grand Challenges across all types of interdisciplinary research, especially those efforts involving cross-sector collaboration and a focus on social impact.

Prioritizing inclusion of diverse perspectives and viewpoints. Given the collaborative nature of Grand Challenge projects, inclusive processes and diverse, "porous" teams are critical to the health of a Grand Challenge initiative over time. This diversity can yield fresh perspectives on how to define and approach Grand Challenge research goals, and who to bring to the table throughout the project. Leaders of ideation processes should consider including a wide variety of participants in the ideation process, including diverse researchers from multiple disciplines, staff from across an administration, undergraduate and graduate students, community members, board members, and potential and current donors. Facilitators might ask working groups and process participants to consider what other disciplines might contribute to their effort and how the project might be enriched with more perspectives. In an example of bringing arts, humanities, and social sciences to the planning table early, the University of Wisconsin-Madison School of Education's Grand Challenges effort is matching authors of Grand Challenge proposals with artists who helped bring the ideas to life through artistic representations of the Grand Challenge concept.

Completing thorough research about related third-party activities. Before finalizing selection of a Grand Challenge goal or focus area, Grand Challenge champions should be sure to conduct and disseminate a thorough competitive analysis of the market and related third-party activities, to ensure campus-wide awareness of the current landscape and context.

Clarifying why now is the time to pursue the identified Grand Challenge. An important problem or a grand goal is not enough. When framing a Grand Challenge, be sure that there are answers to the questions of "Why now?"..."Why this problem?"…"Why this campus/team?" For these intractable problems, longstanding challenges, and targets that have long felt out of reach, it is critical to communicate to potential partners and the public why the current conditions and context, and/or why recent scientific and technical progress, have made what was impossible now within collective grasp.

C. Securing Funding

<u>Funding Issues and Obstacles</u>

Universities deciding whether to launch a Grand Challenge initiative must consider how the program might be funded. Universities have used a variety of approaches for funding these programs:

- UCLA began its program as a start-up pilot without designated funding
- Indiana University reserved funds for several years to designate $300 million for its Grand Challenge initiative
- The Ohio State University creatively leveraged an up-front payment of $483 million in 2012 for a long-term lease management of its parking facilities, providing a large portion of those funds for the OSU Discovery Themes initiative and the hiring of up to 200 new faculty to support the Discovery Themes.

The source of the funding may influence the way the money is spent over the course of a Grand Challenge initiative. A number of common issues and obstacles related to funding have been identified by universities and are detailed below.

Offering sufficient support for finding follow-on funding in addition to seed funding. A number of existing Grand Challenge programs are provided some seed funding from the university, generally from a fund intended for strategic initiatives. These seed-funded Grand Challenge teams later must secure follow-on funding, but often their projects do not align with traditional funding mechanisms, posing a challenge for the sustainability of these initiatives.

Engaging key Federal funding agencies at the appropriate point in project development. One dilemma shared by universities is their struggle in deciding about the right time to engage funding agencies and raise awareness at those agencies of plans for a Grand Challenge initiative. Some researchers express concern that pursuing Federal funding for Grand Challenges might limit funding available for other efforts, including fundamental, curiosity-driven research, given the potentially reduced Federal funding available for basic research in the years ahead.

Finding a seat at the table. Another obstacle identified by universities is that State, Federal, and philanthropic organizations generally are not used to the idea of universities leading "applied" projects. When funding is available to allocate to these efforts, these parties often have preconceived views that universities are supposed to do basic research and other

organizations are supposed to apply the work. Thus, these organizations may be hesitant to fund universities to lead such efforts. In addition, universities in this space at times have pointed to a gap in evidence to support certain advocacy positions and the development of policy or regulations. Initial reactions to efforts to sit at the table have been characterized as universities overstepping their traditional roles or pursuing funding that is not designed for universities. This is an area ripe for future discussion and collaboration with APLU and the HIBAR workgroup.

Aligning fundraising and development models with the Grand Challenges approach. For many universities, the standard university model of fundraising and development can be incompatible with the type of funds needed to support multidisciplinary, long-term Grand Challenge research projects. University development, advancement, and fundraising staff members are familiar with effective approaches for raising funds for endowed chairs, capital projects, and scholarships, for example. In addition, at many universities, fundraising activities can be conducted in silos. These silos can be intensified by the way some universities organize financial and alumni information and set and measure fundraising goals—for example, fundraising and development staff may be incentivized to raise money at the college level and dis-incentivized to support interdisciplinary efforts that do not support those college-level goals. The type of funding required to accelerate Grand Challenges is different from the funds commonly raised for university activities. Multidisciplinary Grand Challenge research programs need large, flexible blocks of funds with the freedom to invest where funding is needed most and with the flexibility to change directions or invest differently as plans adapt to new research results and as other more restricted funding comes into the university that address certain aspects of the research plan. Being able to provide advancement personnel with data and stories is important to facilitate fundraising, particularly several years into the implementation of a Grand Challenge project when meaningful progress is anticipated.

Eliminating procedural obstacles that inhibit productive use of available funds. As noted, some universities have large allocations of funding for their Grand Challenges, but even in these instances there can be procedures and restrictions that create obstacles for the Grand Challenges. These obstacles include:
- Available funds are restricted to the hiring new faculty, but the Grand Challenge team needs funding for research activities.
- Funding streams are linked to specific departments, but the multidisciplinary research plan requires effort across multiple departments.
- Financial management and other campus policies and procedures, often originally instituted to preserve the independence of departments, create obstacles for distributing funding to cross-department research teams.
- Funds must be used on campus, thus limiting the ability of the team to collaborate with other universities or partners to meet the goals, which can hinder robust partnering with other organizations. Partnering has many benefits to Grand Challenge efforts and can provide validation and capacity that attracts additional funding over time.

Phasing and staging funding. A university may want to phase and stage its funding allocations for Grand Challenges and make the release of funds contingent on completion of certain deliverables or achievement of certain research milestones. The communication and expectation setting with faculty about phasing and staging needs to be explicit at the start of any Grand Challenge initiative. In addition, university administrators should be mindful that the scale, scope, and complexity of managing ambitious, goal-oriented Grand Challenge projects requires flexible timelines in recognition of obstacles that may need to be navigated due to first-time experiences or adjustments required to research plans over the course of these long-duration projects.

Delivering against funding commitments. As a Grand Challenge project proceeds over time, a potential complication is failure by university leadership to follow through consistently on funding commitments. This failure can create significant disruption for Grand Challenge team leaders who carefully budgeted and approved projects in reliance on their campus' commitments. Hard choices need to be made, progress can be delayed, and trust can be damaged both at the team level, as well as with the administration.

<u>Effective Strategies to Support Fundraising and Funding Allocation and Distribution</u>

Interdisciplinary and partnership-driven Grand Challenge projects are complex. Given that complexity and the restrictions of various funding sources, universities see the benefit of having a portfolio with diverse funding sources and identifying alignment with other campus programs to increase flexibility and better manage risk. Through experiences to date, universities have suggested strategies that can support fundraising and make funding allocation and distribution more effective and efficient:

Using research and work plans to inform funding needs over time. Universities see value in developing research and work plans for Grand Challenges that organize the effort, scope required resources, and form the basis of fundable time-phased roadmaps. Developing these plans can be a time-consuming process, but provides the university an opportunity to ensure that funding ambitious ideas for solving a Grand Challenge is achievable and ensures that near-term milestones are right-sized with available funding.

Matching funding sources with discrete project activities. The research and work plans may illuminate potential funders and different funding sources for distinct project activities, such as undergraduate research or community implementation, for which there may be targets for viable funding sources through philanthropy or Federal agencies.

Setting clear expectations related to funding allocation, phases, and stages. When funding commitments are made by a Grand Challenge leadership team to researchers whose work is being funded to further the Grand Challenge goals, expectations and milestones should be set, and funding might be phased so that if the research is not going as planned, there is an opportunity to change course. In so doing, leadership teams must set explicit expectations through clear and frequent communication with researchers.

Designating funding for key operational functions. Universities benefit from having a separate budget established and set aside for non-research expenses over the life of the Grand Challenges project, such as internal and external communication, community outreach, student engagement, evaluation, data sharing, administration, and development support. These operational activities are critically important for the health of the initiative, but if presented as a choice between funding these activities or a specific research project, these activities might not be prioritized. See Appendix A for information about particular operational roles that universities might want to explore.

Embedding fundraising team in the Grand Challenge effort with aligned incentives. A fundraising team should be embedded in the Grand Challenge initiative to understand the nuances and connection points across the university. In addition, in light of the fact that many advancement professionals are evaluated by whether they have brought in funds to their schools or departments, a new approach to evaluation and credit for fundraising professionals must be established, so that incentives are aligned to reward such staff members when Grand Challenge work is funded, regardless of where in the university the work will occur.

Exploring new models for funding. In recognition that Grand Challenges are different from regular university approaches to research, new and unusual funding models should be explored, including models dependent on collective impact, partnership, cost-sharing, and technology transfer.

D. Facilitating On-Campus Collaboration and Aligning Incentives

Common Issues That Arise When Facilitating On-Campus Collaboration

Many universities report concerns with encouraging collaboration among interdisciplinary faculty and staff teams to support and implement Grand Challenge programs and projects. These concerns connect to campus culture (which is often oriented to support solitary principal investigator models), incentives, distrust of campus administration, and existing processes that may hinder collaborative work and team efforts.

Promoting "We" instead of "Me." Faculty governance and traditional tenure policies that promote individual efforts over team collaboration are cited as particular barriers to fostering Grand Challenges. To foster collaboration, flexibility, adaptability, and accountability, universities must proactively work towards a culture of data sharing, transparency, knowledge management, and bias incentives towards "team credit" over "individual credit" for purposes of compensation, tenure, and promotion. While there was discussion about what has worked at certain universities and what has not, workshop participants shared the belief that the questions of how to align individual incentives to encourage and promote teamwork and cross-campus coordination—and how to develop new tenure and career paths for researchers opting into Grand Challenges and out of traditional models of research—deserve more in-depth discussion and review across the field, especially related to incentives tied to tenure, pay, promotion, and scope of responsibility, across both faculty and staff within a university.

Ensuring faculty buy-in. Some universities also note concerns that some faculty might feel disenfranchised from the design and development process, either because their ideas are not selected or are perceived as rejected, or because more vocal (but potentially less productive) faculty and staff are allowed to dominate the design process. Obtaining faculty buy-in can be very difficult for Grand Challenges selected by university leadership, administration, and donors without intensive faculty participation in early phases.

Bringing cross-functional contributors into the design process early. Several universities with advanced Grand Challenge programs note in hindsight that cross-functional teams including communications, research development, fundraising, administration, student experience and curriculum, researchers, tech transfer offices, and government relations should have been brought into the planning process earlier to facilitate ownership, greater understanding and shared success in each of these key areas. Similar observations are made about the need to bring representatives of the arts, humanities, and social sciences into planning teams earlier in the process.

<u>Additional Strategies Related to On-Campus Collaboration and Aligning Incentives</u>

Universities with active programs have many ideas and lessons learned to share with respect to on-campus collaboration and internal buy-in, including the following strategies.

Securing and maintaining leadership buy-in. Before launching, Grand Challenge champions should ensure leadership buy-in across the university—among the university's presidents, chancellors, provosts, deans, and other leaders. While these leaders ideally have been receiving updates, some leaders may feel that there has been insufficient communication. Buy-in, an understanding of the process, and support from all campus leaders will be important for the success and sustainability of the initiative.

Building in time for a quiet planning phase in advance of public launch. During this quiet period after a Grand Challenge goal and focus area have been identified, a university can take time to foster cross-functional and multidisciplinary university teams, establish a governance structure, set expectations, prepare operational plans, and facilitate a sense of group ownership <u>prior</u> to publicly announcing the challenge or involving community partners. In-person networking opportunities and small facilitated ideation sessions—with thoughtful and intentional diversity of participants—are effective strategies for fostering unlikely collaborations, even within a given discipline and especially across disciplines.

Reviewing and updating campus policies and procedures. The university administration should conduct a review of campus policies and procedures, with input from collaborating faculty members to understand current barriers or obstacles for collaboration that might derail or hinder an interdisciplinary team with funding from a variety of sources. The university administration could consider forming a barrier-busting "navigation team" to convene ad hoc as these issues surface.

Developing a research and work plan for the Grand Challenge. This can occur either before or after the quiet period. This internal planning period allows the cross-functional team to collaborate to work out the details of the scope of the Grand Challenge by defining some clear boundaries and a framework for deciding what is in and out of scope. These plans should consider roles, responsibilities, resource needs, and timeline prior to making third-party or public commitments. Beyond the 5-year work plan available online for UCLA's Sustainable Los Angeles Grand Challenge,[11] few public examples of best-in-class plans are available publicly for other universities to use as reference points, and as noted in Section VI, a Community of Practice can collect more such example documents and templates from across the Grand Challenges community.

Seeking external stakeholder and public input. After the Grand Challenge goal has been selected and development of a work plan is underway, universities should develop a strategy for soliciting feedback, obtaining buy-in, identifying potential partners and engaging the public. At universities and in other sectors, Grand Challenge program managers have sought this input by going on "road shows"; asking for suggestions on where to start from researchers across multiple disciplines, cross-sector experts, and the public; and collaboratively developing open research plans.

E. Identifying and Establishing Partnerships

Forging and Navigating Cross-Sector Partnerships

Cross-sector partnerships are often challenging to establish and execute successfully. Having alignment on vision and goals is a key element of successful partnerships—so in theory, partnerships formed around a Grand Challenge goal of mutual interest will be rooted in an inherently shared vision of the future. That said, many universities still struggle in this area with three primary issues:
- Identifying aligned local and national partners that could play a strategic role in the Grand Challenge effort;
- Assessing and engaging the potential partner in a manner and at the right level that increases the likelihood of shared success in reaching the identified Grand Challenge goal; and
- Determining the right time(s) in a project to engage those partners.

Best Practices for Establishing Effective Partnerships

Universities report that there is natural pressure to identify partners early in the ideation phase. While *potential* partners should be identified at this phase, Universities with mature Grand Challenges have found it beneficial to wait until the work plan phase or thereafter to solidify partnerships, to ensure those partners have a strategic and effective role in advancing towards the Grand Challenge goal. Even at that later stage, most universities have reported

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[11] https://ucla.app.box.com/v/sla-gc-work-plan-full

that identifying the right partners and establishing the right balance continues to be a challenge. Tips shared for establishing effective, lasting partnerships include the following.

Defining clear roles and specific needs for partners proactively. Upon launch, universities are inundated with potential offers to partner. It is important to be proactive in defining the ideal roles for partners within a given Grand Challenge project, instead of only responding reactively to incoming inquiries following the launch of a Grand Challenge. Universities should identify specific needs that a partner could help to address, such as technology, data, facilities, hosting, testbeds, target audiences, and other in-kind resources.

Doing research and utilizing networking to identify potential partners. Engage in environmental assessments, competitive intelligence and analysis of networks to identify potential partners. Consider asking board members, advisors, university leaders, and development leads to amplify the call for partnership to their networks and to make connections on behalf of the Grand Challenges team.

Considering factors beyond shared vision. In addition to agreement on the goal, there needs to be alignment on topics that might later derail the partnership, such as approaches to managing intellectual property, tech transfer, transparency, open-innovation approaches, relationship management, messaging, and exit strategies should the interests of the partners later diverge.

Establishing supporting structures and joint responsibilities with the partner. Joint efforts could include, for example, a newsletter that must be jointly written, a grant project in furtherance of the goals, or a joint governance committee. The more connection points, the more likely it is that the partnership is effective and mutually beneficial.

F. Keeping Momentum

<u>Issues with Running a Marathon that Feels Like a Sprint</u>

Given the long-term nature of Grand Challenge research efforts, and since most universities have relatively new programs launched in the last 1-2 years, universities are rightly concerned with how best to keep momentum over multiple years and prevent these unique multidisciplinary and cross-functional programs from falling back into a more standard center or institute model. UCLA's program is one of the longest running university-led Grand Challenge programs, having been launched 4 years ago in November 2013. Maintaining momentum is a daily focus for the UCLA Grand Challenges team, who devote significant effort to cross-campus communication, celebrating successes and tracking progress across UCLA's two active Grand Challenges.

<u>Practices that Help Maintain Momentum</u>

Maintaining momentum over a multi-year research project is a concern shared by universities. Below are some of the strategies that are currently being used by these teams:

Prioritizing of the Grand Challenges by university leadership. Including the Grand Challenge as part of a university strategic plan or regular Chancellor/President talking points ensures that the Grand Challenge stays top of mind for the campus and shows the participants that there is accountability. University of Minnesota used its Grand Challenge framework as the central organizing principal for the university's strategic plan.

Touching base regularly among the research team. Regular meetings among researchers funded by the Grand Challenge funds allow those researchers to share their progress and adjust plans as needed. On one team, these occur biweekly as 1-hour sessions. For another, they are occurring once or twice per year in more of a symposium-style session.

Host regular Grand Challenges gatherings with faculty, staff, students and community members. Bringing the University and broader community together to share food and drink, meet one another, get updates, and discuss Grand Challenges-related topics is an effective way to emphasize the community-building side of these initiatives. Displaying posters on which artists depict proposals on posters or showing videos of teams in action are two ways to enrich these events with both art and technology.

Publicly reporting on progress. For example, UCLA's Depression Grand Challenge recently began publishing a quarterly external-facing newsletter. UCLA's Sustainable LA Grand Challenge publishes a dense and data-rich report card on various metrics related to the Grand Challenge goals.

Running campaigns. One university shared that its central team focuses its efforts on campaigns or a single project per quarter. In this way, there is planning, execution, and an end to the short-duration project, which brings attention to the focus area and identifies early results. After the conclusion of the campaign, a new one is developed. These campaigns tend to be external facing with a particular goal in mind, such as raising awareness or getting students involved with a particular issue. They are refreshing not only for the internal stakeholders, but they also provide opportunities to reengage the public.

Committing to regular internal communications and celebrating successes. Throughout the planning process and implementation of the Grand Challenge research effort, staff should maintain proactive communication with stakeholders across campus about the status of the initiative and planning process. Consistent communication with internal constituents cannot be emphasized enough. Parties rarely assume that a lack of communication is due to being stretched too thin, and instead presume that there is no news to report. In response to this observation, UCLA commenced a biweekly internal newsletter for campus leaders. A person in the office of the Vice Chancellor for Research publishes this email service with snappy updates about developments with each of the Grand Challenges with links to longer stories. A periodical internal newsletter-style communication can be regularly distributed to campus leaders who may not necessarily be involved day-to-day in the ideation and planning process. Regular updates should be provided at leadership meetings, even if just to say that the process continues. One university shared its philosophy of celebrating successes big and small with

personal communications and including such successes in newsletters. Acknowledgement and recognition generally leads to greater engagement.

Maintaining flexible plans and porous boundaries. Even once research and work plans are established, flexibility and adaptability are key to long-term success—these plans must be treated as living documents and revisited often as research progresses and new developments occur. This continual commitment to adjusting plans to current context requires time and resources, and may require very frequent interactions among the university, its partners, and the public. Identifying off ramps is also essential, when developed technologies can be handed off from the university to the private sector or other stakeholders for further development and implementation. The research team itself also must be "porous." Looking ahead, given the long-term nature of these research efforts, teams must be able to survive the loss of some members and embrace the addition of new members over time.

Preparing for university transitions. An underestimated but critical factor for some universities has been anticipation and a plan for university leadership transitions. New leaders to universities need to learn about the Grand Challenge from the Chancellor or President, be informed that the Grand Challenge is a campus-wide priority, and understand the expectation that new leaders will help it be successful. For these programs to be successful, there needs to be some space for the incoming leader to provide feedback or course adjustments. There have been several transitions at universities where this prioritization message has not been clearly communicated, hindering progress as new leaders need to be convinced that the path that is currently in place is one of value.

G. Communicating and Keeping the Public Engaged

How to Keep Talking about Something that is So Far in the Future

Since Grand Challenges are marathons, not sprints, it is insufficient to announce the goal and hope that researchers, entrepreneurs, and the public keep running towards it. Unlike other initiatives, for Grand Challenges, universities need to invest in and plan for a multi-year engagement plan that includes communications, marketing, events, reports, media outreach and ways for the public to be involved.

Universities, especially in the early years of a Grand Challenge program, may struggle to achieve buy-in towards the indicators and metrics that will help the university, its partners, and the public know if progress is being made towards the goal. While universities who are engaged in Grand Challenges note that the public is inspired by their efforts and eager to be involved, their universities have yet to catch the attention of the media in a meaningful manner. There is sometimes tension internally when discussing approaching the media as media relations teams can be unwilling to discuss the full long-term vision for the Grand Challenge, instead feeling more comfortable focusing on discreet aspects of the initiative.

This struggle with communicating about the complexity/multiple dimensions of a Grand Challenge surfaces again when a program tries to report on progress in a clean and coherent

manner. Progress is not linear but rather occurs in fits and starts across the Grand Challenge and along metrics beyond research output.

<u>Best Practices for Engaging the Public</u>

As alluded to above, most of the participating universities shared that they are still struggling with this aspect of their Grand Challenge initiatives. Even with programs where there is dedicated staff, there is the sense that internal and external opportunities are not being fully leveraged and communication about progress is difficult. Communications and public engagement strategies include the following.

Communications Strategies

Emphasizing consistent messaging. Several of the universities have an aspirational goal of consistency in their messaging, seeking to provide sample presentations and talking points for faculty and campus leaders who might be talking about the Grand Challenge externally. The success with these coordination efforts is mixed, but there can be a communications drumbeat that includes internal and external newsletter content, websites, social media, stakeholder talking points, videos, events such as symposia, public forums, an annual celebration, and participation in relevant conferences.

Developing a content calendar and populating online content such as blogs and research portals. Internal communication is discussed above in the "Keeping Momentum" section. Universities have shared that they have found it helpful for both internal and external communications to establish a content calendar and host regular features so there is always a plan for what information might be featured in newsletters, social media and other channels. Including anticipated future "news" items (reports, meetings, publications) also helps the team be more proactive about sharing. In recognition that progress occurs in a non-linear fashion, blog posts can provide an invaluable historical picture and serve as a log of activities and developments with links to additional information. Online research portals and databases can provide additional public insight and data about specific research efforts underway over time.

Seeking pitch coaching and storytelling expertise. A few universities have at times secured the assistance of a pitch or storytelling coach to help tell the Grand Challenge story and the researchers' connection to it in a relatable and compelling manner. While some faculty have been hesitant to engage in this service or at least hesitant to share with others that they have done so, it has changed their perspectives and approaches to talking about the Grand Challenge.

Engaging the Public

The above examples all represent the university providing information to target audiences. Beyond this one-way communication, Grand Challenges offer the opportunity to authentically engage stakeholders and the public and share a sense of ownership over the challenge with the community. Examples that universities might consider for this authentic engagement include the following:

- Offering a public comment period on the Grand Challenge goal, milestones, and research and work plans
- Hosting webinars and social-media discussions—such as via Facebook Live, YouTube Live, Twitter, or Reddit—with researchers where audience members can submit questions
- Opening up discrete research and development challenges to innovators and citizen solvers outside of the university through incentive prizes, crowdsourcing, a hackathon and citizen science
- Clarifying calls to action and volunteer opportunities over time
- Collaborating with partners to host public dialogue about the societal implications of solving the Grand Challenge
- Conducting social media and crowdfunding campaigns that allow the public to take small steps to support the Grand Challenge
- Engaging people who are being affected by the problem as storytellers, advocates, and team members

H. Meaningfully Involving Students in Grand Challenges

<u>Struggles in Meaningfully Engaging Students</u>

Grand Challenges have the potential to engage students in problem solving, critical thinking, and design thinking skills, helping to develop the changemakers of the future. Yet not all university-led Grand Challenge programs are including meaningful opportunities for student participation. Universities should decide if they intend to prioritize student engagement, and if so, they must ensure that there is funding dedicated for this effort along with at least one person assigned responsibility to make it happen. Roadblocks cited by universities include concerns about continuity and the feasibility of maintaining student-led projects over the long-term; competing priorities for students; funding and insufficient incentives for meaningful faculty and researcher interactions with students on Grand Challenge research projects.

<u>Ideas for Engaging Students</u>

To involve students in hands-on research, problem solving, and design thinking related to Grand Challenge programs, universities can:
- Launch experiential undergraduate courses, supported with central university funds for space and resources required, and provide opportunities for students to, as Thomas Kalil has proposed, "major in a discipline, minor in a problem"
- Embed immersive Grand Challenges opportunities in multiple courses across campus, the University of Minnesota has done by offering a Grand Challenges curriculum, which offers nearly 10 cross-disciplinary courses for undergraduates per semester, with each course taught by two or three faculty from distinct disciplines and focused expressly on preparation for and involvement in Grand Challenges problem-solving
- Create living-learning communities, as Georgia Tech has done, that give undergraduate students early experiences in team projects to address Grand Challenges

- Create an interdisciplinary (e.g. engineering + business) graduate course, where the goal might be, for example, to identify and make the case for a corporate moonshot, in collaboration with local industry and alumni networks
- Expand student competitions such as the Global Social Venture Competition or Big Ideas@Berkeley to make the case for a corporate moonshot as opposed to a new social venture
- Join existing programs such as the National Academy of Engineering's Grand Challenge Scholars Research Program, which has been implemented at more than 40 engineering schools around the world and is expanding to more than 120 additional engineering schools
- Identify opportunities to expand the Grand Challenge Scholars Program model beyond engineering to multiple disciplines and to include a team-focused approach
- Host externship programs that allow students to tackle issues alongside industry professionals, such as The Ohio State University's INNOVATE-O-thon programs that lead to problem solving and recruitment for the company, and real-word experience and industry contacts for the student over intensive weekend design sessions
- Develop, share, and curate Open Educational Resources organized around Grand Challenges (as opposed to disciplines)
- Help students connect to external organizations and funding sources
- Open student research positions with scholarship or fellowship funding with researchers working on one of the university's Grand Challenges
- Require design thinking and innovation training, as the University of Maryland has done
- Offer student clinics for Grand Challenges teamwork and skill development for credit
- Design regional conferences, competitions, and showcases for students to engage with Grand Challenge problem solving, similar to regional entrepreneurship competitions
- Embed students in a component of the Grand Challenge as has been done by UCLA, which trained students to be first line responders to peers who are at risk or experiencing low levels of depression, referred to as the Peer Resilience Network, and by Minnesota, which through a special funded program, the Grand Challenges Undergraduate Research Opportunity Program, encourages each funded Grand Challenges research project to involve two or three undergraduate students per year
- Employ students as student workers on non-science functions related to the Grand Challenge such as helping create content (social media, newsletter, video) for various communications channels.

VI. Role for a Community of Practice for University-Led Grand Challenges

Scope and Structure of the New Community of Practice

Universities embarking on Grand Challenge efforts are traversing new terrain—they are making commitments about research deliverables rather than simply committing to invest in efforts related to a particular subject matter. University-wide buy-in and investment is required in terms of resources and prioritization against other efforts. To mitigate risk, those universities that have entered this space are informally consulting with others regarding effective strategies, and those campuses that have a base of experience have been freely sharing information with others. While this informal information sharing is working to some extent for those who reach out, the entire community would benefit from a more formal structure for identifying and sharing "what works."

To address this need, the new Community of Practice for University-Led Grand Challenges (COP-UGC)—launched at the October 2017 workshop at UCLA—aims to provide peer support to leaders of university Grand Challenge programs, and to accelerate the adoption of Grand Challenge approaches at more universities supported by cross-sector partnerships. Communities of practice have effectively been used in other open innovation fields, such as incentive prizes, to increase the number of people with skills and experience in designing and implementing effective innovation programs. COP-UGC is envisioned as a stand-alone, informal, peer-organized body, open to all university representatives actively involved in managing the development or implementation of a Grand Challenge program (including both campus-wide programs and specific Grand Challenges).

While the intent of COP-UGC is to serve as a community of *practice* focused on supporting active and developing programs, rather than a community of *interest,* university representatives exploring and evaluating whether the Grand Challenges approach is right for their campus would be welcome to avail themselves of COP-UGC resources, mentors, and activities. COP-UGC will act collaboratively with associations and professional organizations such as AAU, APLU, AAAS, and NORDP to raise awareness and interest in university-led Grand Challenges, but will not be affiliated formally with any one association or professional organization, given that Grand Challenges are led and supported by multiple functions across a university (so it would be limiting, for example, to restrict participation to research development professionals).

The core functions of COP-UGC will comprise:
- A listserv intended for regular and as-needed communication among members
- A document repository for sharing
- A calendar of events (webinars, training opportunities, conference calls, meetings, etc.), with a commitment to arrange at least quarterly opportunities for the COP-UGC members to connect with each other
- Shared distribution of news and communications relevant to Grand Challenges

UCLA is reviewing possible tools and platforms to enable the above functions, ranging from Google Groups to AAAS's Trellis toolkit. UCLA intends to pursue modest funding to support secretariat activities for the COP-UGC, including listserv, calendar, and document repository maintenance, event coordination, communications and newsletter coordination, and project management, as well as support for one annual in-person workshop or conference for the community. That said, the intent of the COP-UGC is to be co-created and co-developed body, so all members and participants are encouraged to play an active role in defining, organizing, and hosting COP-UGC activities. A model that might be explored in the future is whether a designated Grand Challenge expert—housed at one university or in a virtual institute—should dedicate a percentage of effort to providing more hands-on guidance for universities seeking to start new programs.

Input from a Survey of Research Development Professionals

Of 45 responses to a May 2017 survey distributed through the National Organization of Research Development Professionals (NORDP) listserv, strong interest was expressed in:
- Capturing lessons learned (39)
- External partnerships and collaborations (37)
- Funding (34)
- Maintaining momentum (33)
- Role of program managers (32)

Some interest also expressed in learning about:
- Processes of ideation and planning (26, more interest from those exploring new programs than from those with already launched programs)
- Raising awareness (20)
- Effectively involving students (15)

Survey participants suggested the following additional topics for a COP to explore:
- Using Grand Challenges as strategic tool for innovation within the institution
- Evaluating start-up and operational costs for a Grand Challenge
- Collaboration among universities on specific Grand Challenge goals
- How to engage faculty

Many of these topics were addressed at the October 2017 Workshop and Strategy Session on University-Led Grand Challenges at UCLA, and should be further explored in future COP-UGC discussions and peer training activities.

Recommended Initial Activities for the Community of Practice

In addition to sharing effective strategies and lessons learned on an informal basis, members of COP-UGC could collaborate on joint projects and activities for the benefit of the field. For example, COP-UGC members could collaboratively:

- Draft white papers on this topic that: (1) document the unique attributes of Grand Challenge programs as compared to other large, interdisciplinary research efforts; (2) offer case studies of existing university-led Grand Challenges; and (3) set out a roadmap for scaling this approach to more universities, with attention to changes needed to academic and research cultures and processes
- Engage in joint process-mapping exercises to document models and approaches to developing and implementing Grand Challenges
- Co-design and co-host workshops, webinars, and retreats for professional development and knowledge sharing among current and potential leaders and support staff on Grand Challenge design, implementation, and administration
- Develop a library of "how-to" guides, resources, document examples, templates, and other material that would speed the development of new programs at additional universities
- Host a conference and networking sessions for program managers and leaders from industry, philanthropy, and governments to raise awareness of this approach and the opportunities available for partnership across multiple universities
- Coordinate reciprocal visits and mentorship by and among peers
- Organize sessions or working groups at conferences hosted by associations, professional organizations, or other institutions, such as at NAE's Global Grand Challenges Summit
- Submit joint proposals for funding, such as for the establishment of a matching grant program to support university "backbone organizations" that develop and administer cross-campus Grand Challenge activities
- Facilitate partnering among universities on common Grand Challenge topics ranging from environmental sustainability, to precision medicine, to addiction
- Take part in joint communications efforts to raise awareness about university-led Grand Challenges inside academia and with media, philanthropy, industry, Federal agencies, and the public
- With researchers, work to define and publish proposed agendas for potential future Grand Challenges that could be led by universities, philanthropies, Federal agencies, or other organizations (including ambitious goals and explanations of "Why Now?" and "Where Could We Start?")
- Identify and pilot additional approaches to involving students and youth in research, problem solving, team work, critical thinking and design thinking related to Grand Challenges
- Share approaches for measuring and evaluating the effectiveness of Grand Challenges

VII. Opportunities for Cross-Sector Participation

Role for Philanthropy

Philanthropists and foundations could support the success of existing Grand Challenges at universities and the scaling of this approach to additional universities by:

- Providing modest funding for the secretariat function of the new COP-UGC, to support maintenance of collaboration tools, event coordination, communications and newsletter coordination, and project management, as well as support for one annual in-person workshop or conference for the community
- Creating a planning grant program to support the creation of new programs and a matching fund to support coordination and administrative activities by university Grand Challenge "backbone organizations"
- Funding relief time for faculty members who are being cultivated to lead a specific Grand Challenge or ideation effort
- Inviting university grant winners from above funding programs to participate in a "moonshot bootcamp" to learn about approaches to identifying and defining ambitious yet achievable goals (training the trainers)
- Convene community- or field-specific stakeholders to identify a compelling Grand Challenge goal, make the case for solving that goal, and define a multi-disciplinary project to pursue that goal (as the nanotechnology community has done by defining a Grand Challenge for future computing, and as the Kavli Foundation did for the research ideas that informed the development of the BRAIN Initiative)
- Collaboratively support development of a "Grand Challenges Institute" that could aid organizations in identifying ambitious goals, assessing the state of science and technology related to those goals, engaging experts to refine the goals and path forward, and defining funding and collaboration opportunities that would advance progress towards the goals
- Fund the development of a series of white papers and other publications that capture and communicate the varied models being used to support
- Support evaluation and studies that assess the impact of long-term Grand Challenge research programs, as compared to other large interdisciplinary research efforts

Role for Associations and Professional Organizations

Associations and professional organizations can support the growing number of universities and academic faculty and staff engaged in Grand Challenges research programs in various ways. What will be critical, however, is having the leaders of campuses currently engaged in this effort, step forward and talk with their peers about their experiences and why these programs are of benefit to universities. Specific potential actions for associations include:

- The Association of American Universities (AAU), APLU, and other relevant associations could host sessions for university Presidents, Provosts and other leaders to raise interest in Grand Challenges and answer common questions about the nature of these programs

- NORDP and other professional organizations could host dedicated learning sessions led by COP-UGC, include information about COP-UGC in its newsletters and communications as appropriate, and refer interested professionals to join COP-UGC
- APLU could continue to work with COP-UGC to identify synergies between university-led Grand Challenges and its HIBAR initiative
- An emphasis should be placed on engagement of associations such as SACNAS (the Society for Advancement of Chicanos/Hispanics and Native Americans in Science) that focus on diversity, equity, and inclusion in the research community, as well as outreach to HBCUs, to ensure that Grand Challenge goals and research programs engage diverse researchers and reflect the communities they are attempting to benefit.

Role for Industry

To support a collaborative innovation ecosystem and interdisciplinary research activities towards solving Grand Challenges, companies could:
- Publicly announce pursuit of a Grand Challenge goal (as IBM, Facebook, Google, SpaceX, and Qualcomm have done, among others) and partner with universities, graduate students, and philanthropy to pursue that goal
- Explore different assets they could use to achieve this goal, such as internal R&D, the skills of their employees, corporate venture investments in startups, advocacy for policy changes needed to achieve the Grand Challenge, their capacity to serve as an early customer of the innovations, their supply chains, and corporate philanthropy or corporate citizenship activities
- Sponsor university efforts to pursue Grand Challenges
- Host cross-sector dialogues among the university research community and industry researchers to brainstorm about Grand Challenge goals and the industries and technologies of the future
- Support universities in producing multi-media communications that tell the compelling stories of Grand Challenges and the innovators pursuing them
- Partner with universities to launch open innovation programs (prizes, co-creation, crowdsourcing, citizen science, etc.) to engage entrepreneurs, researchers, and startups in solving aspects of a Grand Challenge
- Engage in technology transfer activities with universities to further develop early stage technologies that could help address a Grand Challenge
- Support executives and corporate leaders joining advisory boards, councils, and other volunteer bodies to provide input on the design of Grand Challenges at universities
- Support corporate researchers and scientists in doing "tours of duty" at universities, much as Ohio State University has paired universities with private-sector business experts in the leadership of its Discovery Themes

Role for Government

Much as President Obama's administration supported participation in Grand Challenges by organizations and individuals across the country through the Strategy for American Innovation,

the Federal government has a role to play in supporting university efforts to address Grand Challenges.

For example, Congress could host a broad, bipartisan Moonshot "Summit" with a call to action, collaboration with external organizations for commitment development, and announcement of commitments at summit. Universities could play a part in this summit alongside representatives from other sectors. Authorizers and appropriators in Congress could support Federal research agencies continuing to fund and partner with universities and other sectors in the pursuit of Grand Challenges. Federal agencies leading Grand Challenges—including the Department of Energy, Department of Defense, National Institutes of Health, USAID, NASA, and USDA—should raise awareness of opportunities for universities to contribute to those Grand Challenge efforts and engage in dialogue with the research community about research plans for identified Grand Challenges. The Administration or Congressional committees could convene workshops of multidisciplinary experts to discuss and define specific moonshot goals, and issue open, public findings.

Local and State governments can also support the pursuit of Grand Challenges in their region. Elected officials become champions for particular Grand Challenges based on their interests, regional challenges and capabilities, and committee assignments. For example, Los Angeles Mayor Eric Garcetti is collaborating with UCLA's Chancellor Block on the L.A. Sustainability Leadership Council as part of the Sustainable LA Grand Challenge. IU Governor Eric J. Holcomb and Indiana state officials are collaborating with Indiana University on its new Responding to the Addictions Crisis Grand Challenge. Several agencies of the Minnesota state government, Hennepin County government, and the Minneapolis city government are collaborating as partners on projects addressing the Grand Challenges, of Fostering Just and Equitable Community, Assuring Clean Water and Sustainable Ecosystems, and Enhancing Individual and Community Capacity for a Changing World.

VII. Conclusion

The growing number of research universities committed to addressing ambitious Grand Challenges through interdisciplinary and cross-sector collaboration offers promise for solving some of the toughest problems facing society today. These efforts will further establish the vital role that research and universities play in the innovation ecosystem that can improve the human condition and create the jobs and industries of the future.

For universities, Grand Challenges can foster many winners across the university community—the public who can be active participants in research focused on benefiting their community, partners who can forge new collaborations with researchers, individual faculty who can connect with what brought them into research in the first place, staff who help support efforts having greater impact than ever imagined, and a campus that is able to demonstrate its values and its value to society through its action.

While university-led Grand Challenge programs are widely varied in structure, funding, focus, and approach, there are numerous shared challenges and effective strategies to be exchanged among leaders of these programs. This approach represents a departure from "business as usual" for universities, with significant implications for approaches to staff and faculty collaboration and incentives, for administration of standard procedures and business processes, for fundraising models, and for internal and external communications. Therefore, a critical success factor for Grand Challenges research is buy-in and support from university leadership, because with that, most internal obstacles can be navigated.

As additional universities build Grand Challenge programs and currently active campuses expand their work in this area, leaders need to continue to share their experiences and lessons learned with other campuses. A new Community of Practice on University-Led Grand Challenges will help fill that need by providing a forum for informal information sharing, co-created peer learning opportunities, and collaborative joint projects and communications. Members of the Community of Practice have expressed interest in continuing to exchange ideas about persistent challenges and open questions, including how to evolve university culture and incentive structures to support these innovative models; how to encourage researchers and university leadership to embrace well-defined and time-bound ambitious yet achievable goals; and how best to provide more students with hands-on experiences and opportunities for teamwork towards solving a Grand Challenge. In the near term, core collaboration tools will be set up to support the initial activities of the Community of Practice on University-Led Grand Challenges, and Community of Practice members will collaborate to develop shared professional development opportunities and document models and practices from existing programs.

Grand Challenges represent exciting opportunities for meaningful collaboration across sectors to address the toughest challenges of our time. The university community has identified multiple opportunities for participation, collaboration and support towards these Grand Challenge programs for philanthropy, associations, professional organizations, industry, and Federal, State, and local governments. Many of these partnerships can thrive with local and regional focus.

Campuses that have launched Grand Challenge programs are excited and eager to share with their peers the benefits of these collaborative efforts and the value in overcoming associated barriers and mitigating risks. Universities possess incredible intellectual capital, with creative and resourceful faculty and staff who can achieve remarkable results by working with their peers across their campuses and with their communities, government, and industry to tackle today's Grand Challenges.

Appendix A: Staffing and Operational Needs for Effective Grand Challenge Initiatives

Approaches to effectively staffing a Grand Challenge team at a university surfaced several times during group discussions at the workshop. Building a team to support Grand Challenges requires different skills from standard functional teams within a university's administration or as found in research centers or institutes. This topic of staffing and skills is one that requires further attention and comparison across universities—a potential topic for review by the new Community of Practice—but below are listed some of the positions or functions that have been established in various settings and skills that a Grand Challenges program leader might need.

Central administration point person who is the campus Grand Challenge "guru" (often, an Executive Director). This tends to be a person who has been involved since the beginning, who understands the underlying goals of the program, who is fluent in the campus priorities, who is a skilled navigator, and who brings an unyielding sense of optimism and deep commitment to transformative change. The person needs to be trusted by both the Grand Challenge teams and campus administration. There is a delicate balance for this person in terms of letting the Grand Challenges be free to develop and grow versus when the campus perspective may need to be re-emphasized. These issues tend to arise most with communications (internal and external) and navigating campus operational issues.

Faculty lead of a specific Grand Challenge project. Ideally this person has a dedicated executive team of faculty with distributed responsibilities covering the facets of the Grand Challenge. Of note, defining this role must balance the extent to which giving talented faculty leadership roles in Grand Challenges will involve them in team coordination activities that will pull them away from individual research, which will be perceived as a sacrifice by many faculty.

Lead project manager for each Grand Challenge project. This person needs to be a skilled project manager with significant interpersonal skills to cultivate relationships across the Grand Challenge. Serving as the subject matter expert for project implementation, management, and operations, this role allows the faculty lead for the program to focus on the research science.

Internal communications and outcomes lead. If the Grand Challenge is large like those at UCLA, with over 100 faculty each and tens of departments represented, it is important to have a person whose primary role is communicating internally. There are relevant research activities and meetings occurring every day. This role is charged with meeting with researchers, gathering progress and outcomes, and flowing that information to others who might benefit from hearing it. Of note, collecting data across the many facets of the Grand Challenges is a time-consuming process and unless there is dedicated funding and personnel time committed to this purpose, it will be difficult to evaluate progress and outcomes against agreed-to measures and indicators and to collect anecdotal stories of progress. While fulfilling these activities may seem like an expensive undertaking, UCLA has found a way to engage students for some of these functions. In particular, for UCLA's Depression Grand Challenge, there is one neuroscience undergraduate

student worker who has managed most of the writings that have been shared for both internal and external audiences over the past 2 years.

External communications and public relations staff. Some universities expressed concern that there is not enough public attention about the commitments that have been made and the novelty and promise of this approach. Optimizing and coordinating external communications is an area that universities thought they might strategize together through the new Community of Practice.

Best practices staff support. At The Ohio State University, there is a person dedicated to identifying and sharing best practices across their eight Discovery Themes. Having a person in this capacity ensures that the university is capturing its own best practices and enabling other internal teams to take advantage of lessons learned. This is largely done through in-person meetings of communities of practice involving each of the eight Discovery Theme programs.

Partnership liaison. In most universities, this function of creating partnerships seems to be falling on existing members of the Grand Challenge teams or other offices on campus. In these situations, however, the amount of time that can be dedicated to researching potential partners and maintaining relationships with existing partners is limited. UCLA recently hired a former consultant to serve in this capacity for a short-term basis.

Student and education liaison. If it is not a focus of a particular person, the engagement of students and the development of meaningful curriculum, hands-on research experiences, and other student engagement activities become afterthoughts within a Grand Challenge program rather than integral to its success.

Volunteer management. Yet another area where staff assistance might be needed is managing volunteers. There are numerous people who express interest in being involved with the Grand Challenge after it is public. Unless there is a person responsible for cataloging gaps and matching volunteers with such gaps, the response to the generous offers of these volunteers is less than optimal.

Research development staff. At UCLA, the academic lead of the Sustainable LA Grand Challenge recognized that it would be beneficial for UCLA's environment and sustainability community to have a dedicated staff member providing research development services. Other universities have a central office providing this service for Grand Challenge programs across the campus.

Appendix B: List of Attendees at October 2017 Workshop and Strategy Session

The following individuals participated on behalf of their institutions and organizations in the October 2017 Workshop and Strategy Session on University-Led Challenges at UCLA.

1. Eva Allen, Assistant Director, Environmental Resilience Institute, Indiana University
2. Sarah Archibald, Co-Director, Grand Challenges, UW-Madison School of Education
3. Mitch Boretz, Technical Communication Specialist, UC Riverside
4. Elizabeth Cantwell, Vice President, Arizona State University
5. Emily CoBabe-Ammann, Director, Strategic Projects, University of Colorado, Boulder
6. Gil Conchas, Director, UCI Engage and Professor, Office of the Provost & Executive Vice Chancellor, UC Irvine
7. David Conover, Vice President for Research and Innovation, University of Oregon
8. Erik Davidshofer, Proposal Development Officer, University of Kentucky
9. Jeff Davis, Faculty Co-Director, Grand Challenges Living Learning Community, Georgia Institute of Technology
10. Cristin Dorgelo, Independent Consultant and Facilitator, and former Chief of Staff to President Obama's Science Advisor
11. Rachel Dresbeck, Director, Research Development, Oregon Health & Science University
12. Geeta Dutta, Director, Research Advancement and Partnerships, Washington State University
13. Raymond Duvall, Professor and Special Assistant to the Provost, University of Minnesota
14. Kimberly Eck, Director, Research Development, University of Tennessee, Knoxville
15. Faye Farmer, Director, Research Development, Arizona State University
16. Erin Fitzgerald, Director of National Research Initiatives, University of Maryland
17. Tessa Green, Program Director, Bridging Barriers, The University of Texas at Austin
18. Rich Halverson, Professor, University of Wisconsin-Madison
19. Shana Herron, Proposal Development Officer, University of Kentucky
20. Christy Hershey, Project Coordinator, Office of the Vice Chancellor for Research, UCLA
21. Lisa Higgons-Hord, Assistant Vice President for Community Engagement, University of Kentucky
22. Seth Kahan, Founder, Visionary Leadership
23. Thomas Kalil, Advisor, Eric and Wendy Schmidt Group, and Entrepreneur-in-Residence, UC Berkeley
24. Faith Kirkham Hawkins, Associate Vice President for Research, Indiana University
25. Aaron Kline, Research Development Coordinate, University of Iowa
26. Leslie Leve, Associate Vice President for Research, University of Oregon
27. Jennifer Lyon Gardner, Assistant Vice President for Research, The University of Texas at Austin
28. Heather McShane, Program Director, McGill Sustainability Systems Initiative, McGill University
29. Randy Moses, Senior AVP for Research, The Ohio State University

30. Michelle Popowitz, Assistant Vice Chancellor for Research and Executive Director, UCLA Grand Challenges, UCLA
31. Esther Pratt, Assistant Director, Foundation Relations, Washington State University
32. Maureen Purcell, Special Projects Coordinator, UCLA Grand Challenges, UCLA
33. Cassie Rauser, Director, Sustainable LA Grand Challenge, UCLA
34. Jill Reddell, Co-Director, UCLA Grand Challenges, UCLA
35. Sarah Rovito, Assistant Director, Research Policy, Association of Public Land-grant Universities
36. Matthew Sanfilippo, Chief Partnership Officer, Carnegie Mellon University
37. Amy Spellacy, Administrator, Discovery Themes, The Ohio State University
38. Taylor Stang, Marketing & Partnerships Manager, Elsevier
39. Judy Stepan-Norris, Vice Provost for Academic Planning, UC Irvine
40. Gillian Wilson, Professor of Physics and Astronomy, Interim Deputy Director, UC Observatories, UC Riverside

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Anya Li
Tracy Nguyen
Kira Petersen
Grace Phillips

Appendix C: Examples of University-Led Grand Challenges

The following universities provided information about their Grand Challenges program through participation in the October 2017 Workshop and Strategy Session on University-Led Challenges at UCLA.

Carnegie Mellon University

CMU is in the second year of administering a college-level, competitive "moonshot" program that is designed to provide winning groups of faculty with targeted support to build research capability over a 3-year period in areas that may have long-term opportunity and impact for the University. CMU solicited proposals for moonshots from faculty through a competition. CMU awards one new moonshot each year for a total of three moonshots running at any one time. CMU's first moonshot focuses on bio-engineered organs.

Georgia Institute of Technology

Georgia Tech's Grand Challenges program[12] is a living learning community. Every year 110 freshmen are admitted into the program and live together in a single dormitory community. As freshmen, this group explores solutions to important problems that impact our society, and they implement their proposed solutions in small student-led teams over the course of their undergraduate degree. The program aims to train students to pursue solutions to Grand Challenges that face our society, to be effective teammates and team leaders, and to develop critical thinking skills and design-thinking methodology. Program faculty typically identify general focus areas (such as energy, education, health, agriculture, water and sanitation, infrastructure, and security), and then the students determine the specific problems they will tackle. The program has had positive impacts on participating students, with student teams working to start for profit and non-profit businesses, presenting their work at conferences, and winning hack-a-thon competitions and other awards. The program will double in size next year.

Indiana University

Indiana University is leveraging expertise across disciplines and campuses to develop sustainable solutions to the great challenges faced by the state of Indiana. IU anticipates investing up to $300 million over the next 5-10 years to tackle 3-5 such Grand Challenges.[13]

IU's three active Grand Challenge Initiatives include:
- The Precision Health initiative that aims to transform health in Indiana through broader application of precision medicine and through dramatic progress in treatment of a particular cancer, which is among the most common cancers in Indiana.

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[12] http://www.grandchallenges.gatech.edu
[13] https://grandchallenges.iu.edu/

- The Prepared for Environmental Change initiative that aims to position Indiana to combat the growing threats caused by extreme and unpredictable weather patterns and environmental changes that result.
- The Responding to the Addictions Crisis initiative aims to address addictions in Indiana through collaborative action across IU's seven campuses and with industry, nonprofit, and government partners.

IU's first two Grand Challenge Initiatives resulted from a formal Request for Proposal issued in 2015, and the topic for IU's third Grand Challenge Initiative was identified by university leaders informed by faculty and external stakeholder input.

IU's Grand Challenge Initiatives are initially funded through university funds, with the expectation that work will be continued through external funds after the initial GC grant period. Through these initiatives, IU has enhanced its profile, made significant faculty hires and investments in research facilities, increased collaboration across disciplines and across campuses, and begun to see the results of basic and translational research work.

McGill University

The McGill Sustainability Systems Initiative[14] brings together experts from across McGill's faculties to build a robust and vibrant community of committed sustainability researchers. Taking a multi-disciplinary, multi-sector approach, the MSSI provides support for McGill researchers from the sciences and humanities to co-develop significant, impactful and socially relevant advances that move society towards a sustainable model of existence. As well as engaging researchers from across McGill's ten faculties and twelve professional schools, the MSSI will engage with external stakeholders including industry, government, non-government organizations and civil society at an early stage. Central to the MSSI are the research themes. To determine the first set of themes, the MSSI solicited calls for proposals from faculty then held workshops to find shared areas of interest. The Advisory and Executive Committees selected MSSI's first three research areas, which are: Creating Sustainable Materials for the Future; Adapting Urban Environments for the Future; and Sustaining Landscapes for the Future. These three programs have started with three years of internal funding, with an expectation that they will become self-funding through external grants by the end of this period.

The Ohio State University

OSU's Discovery Themes initiative[15] is helping faculty to connect with colleagues across Ohio State and with select partners outside the university to address critical challenges in three broad thematic areas that align with the university's strengths: energy and environment, health and wellness, and food production and security. Additionally, translational data analytics and the humanities and arts programs cross each of the three themes. Through the initiative, OSU is accelerating and expanding interdisciplinary collaboration and by building on its strengths

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[14] https://mcgill.ca/mssi/
[15] https://discovery.osu.edu/

through an aggressive, strategic hiring plan. Initially, three broad topics were chosen by university leadership and OSU's Board of Trustees. Faculty advisory groups developed prioritized focus areas with help of outside consultants, and two rounds of competitive proposals from faculty teams were used to select topics.

In 2012, Ohio State received an up-front payment of $483 million from an external vendor when it agreed to long-term lease management of its parking facilities, providing a large fraction of the funds for the Discovery Themes initiative. The scale and scope of diverse faculty hiring into these multidisciplinary programs is changing the culture and climate for research at OSU. More than 120 tenured and tenure-track faculty have been hired through the Discovery Themes since 2014, and an additional 80 faculty are expected to be hired by 2020. Each focus area is headed by a faculty lead and an executive director brought in from the private sector.

OSU's Discovery Themes include:
- Energy and the Environment: specifically, (1) Materials and Manufacturing for Sustainability and (2) Sustainable and Resilient Economy
- Health and Wellness: specifically, (1) Chronic Brain Injury and (2) Infectious Diseases
- Food Production and Security: specifically, (1) Foods for Health (nutritional metabolomics) and (2) Food and Agricultural Transformation
- Translational Data Analytics
- The Humanities and the Arts

The University of Texas at Austin

UT Austin's Bridging Barriers[16] is a campus-wide, researcher-driven Grand Challenge initiative overseen by the Office of the Vice President for Research. More than 800 UT Austin faculty, staff and student researchers representing all disciplines on campus, along with Austin community partners, are engaged in finding intersecting research goals to solve the world's most pressing problems. Central to UT Austin's strategy in selecting themes for Bridging Barriers was to solicit concept papers, charge all concept paper submitters to find commonalities between themselves and the other submitters, and synthesize from related concept paper topics a new, unified research plan. Some university funding is provided to the themes, as is grant-seeking and donor-fundraising support and centralized administrative staffing.

The first Bridging Barriers challenge is Planet Texas 2050, which brings together more than 100 faculty members and researchers spanning 14 colleges and schools across the university, and which will explore how Texas will be able to ensure its resilience in the year 2050, in both the built and natural environments, as it faces weather extremes and rapid urbanization. The team will examine these threats through a comprehensive integration of environmental, architectural, archaeological, social and cultural data that will enable them to discover critical interactions between environmental and human systems. Subsequent Bridging Barriers themes

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[16] https://research.utexas.edu/bb/

are under development from the initial process and UT Austin expects to announce additional challenges over the next few years.

UCLA

UCLA Grand Challenges[17] are ambitious research projects that connect hundreds of faculty, students, community members and leading experts across every field to solve society's toughest problems. Developed through an intensive faculty working group ideation process started in 2012 and supported by UCLA leadership, the Sustainable LA Grand Challenge (launched in 2013) and the Depression Grand Challenge (launched in 2015) are the biggest, most collaborative, and potentially most transformative efforts UCLA has undertaken to date, and the discoveries and scholarship produced are delivering real benefit to California, the Nation, and the world.
UCLA Grand Challenge goals include:
- Sustainable LA Grand Challenge (SLA GC) - Transition Los Angeles County to 100 percent renewable energy, 100 percent locally sourced water, and enhanced ecosystem and human health by 2050.
- Depression Grand Challenge (DGC) - Cut the burden of depression in half by 2050 and eliminate it by the end of the century.

UCLA Grand Challenges are currently being supported with campus funds, grants from federal and other sources, industry sponsorships, and philanthropy. The campus has invested both in kind and with direct funding. The SLA GC is estimated to cost $150 million, and the DGC is estimated to cost $525 million for the first 10 years.

At UCLA, students are involved with the Grand Challenges in a number of ways including obtaining hands-on experience working alongside faculty members and as researchers and fellows; working as paid members of the administrative support team; taking courses related to the GCs, and serving as volunteers. UCLA has two notable student engagement activities:
- The Grand Challenges Undergraduate Research Scholars Program (GCURSP) for SLA GC is a year-long experience where students have coursework designed for professional development and concurrently engage in two kinds of research experiences: a traditional research experience in a SLA GC faculty research setting, and an interdisciplinary student team project in the class. This program is currently in its fourth year.
- The signature program of the Depression Grand Challenge involves training students to be resilience peers through a several quarter process and then having them serve as first line responders to peers (under the supervision of faculty) who might be at risk for or experiencing a low level of depression and anxiety. The program began in FY17. To date more than 200 students have been trained to be Resilience Peers, and hundreds more have received care and support through this program.

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[17] https://grandchallenges.ucla.edu/

Partnerships are also a key aspect of UCLA's Grand Challenges strategy. In spring 2017, the SLA GC announced the formation of the L.A. Sustainability Leadership Council chaired by UCLA Chancellor Gene Block and L.A. Mayor Eric Garcetti. This high-powered council—comprising prominent business, academic, government, and community leaders—is leading a focused, coordinated effort to make Los Angeles the world's first sustainable megacity. The SLA GC also partners with county and local city groups, community organizations, other universities, utilities, and foundations on various projects in furtherance of the goals. The SLA GC also has placed paid interns in key external offices, who serve as liaisons between campus and the external body, while receiving a unique and valuable real-world experience.

Select results of the Sustainable Los Angeles Grand Challenge to date include: (1) the development of a 5-year work plan of over 100 research recommendations put together by 28 faculty and reviewed by a team of 10 external urban sustainability academic and professional experts; (2) the allocation of more than $3 million for more than 20 research projects; (3) support for graduate student policy fellows, student fellows working in the LA Mayor's Sustainability Office, a 5-member applied management research team, and 8 paid internships; (4) hosting stakeholder roundtables; (5) support for over 15 grant applications resulting in more than $5 million in awards; and (6) release of the first of a series of Environmental Report Cards for LA County that measures progress in the region with respect to reaching the Sustainable LA Grand Challenge goals.

Select results of the Depression Grand Challenge include: (1) commenced demonstration projects in preparation for a 100,000 person study; (2) screening for depression and anxiety and providing treatment for students who need it in Fall 2017 (tens of students were identified as at risk and are now receiving services); (3) launched Discovery Neuroscience demonstration projects; (4) recruited 10 fellows, all of whom are contributing to DGC research or clinical objectives; (5) developed the Resilience Peer Network, a new treatment model that involves training student peers to be first-line responders; (6) integrated a smart phone remote monitoring system for subjects in the study that can record an individual's behavior patterns that are associated with depression; (7) attracted funding totaling $33 million; and (8) recruited high-profile leadership for the challenge.

University of Colorado Boulder

The "Our Space. Our Future." Grand Challenges Initiative[18] fuses CU Boulder's unique strengths in Earth, space and social sciences with new technologies and partners to address the pace and pattern of changes for our environment, our resources and our planet. This initiative aims to develop pathways to connect critical earth and space science knowledge to stakeholders and decision makers, to create an environment within which academia, industry and government work collaboratively to solve problems of national and international importance, to build new infrastructure and capabilities that support CU Boulder's Earth and space science efforts, and to educate and train students to meet national needs in the emerging Earth and space exploration sectors.

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[18] http://www.colorado.edu/grandchallenges/

To identify focused areas for these projects that are funded by the Chancellor, CU Boulder led an ideation process, solicited proposals from faculty, ran a competition for ideas from faculty, set up faculty working groups, and involved students. Industry partners are involved with all of its major initiatives, serve as reviewers for the competitions, and are consulted as part of its strategic development.

University of Minnesota

Minnesota's Grand Challenges program[19] is in its third year of operation. It has three integrated components: a Grand Challenges curriculum for undergraduate students; competitive grant and logistical support for interdisciplinary research teams; and competitive faculty release time and logistical support for individuals to participate in a Grand Challenges Scholar Collaborative. The program works closely with deans of all 16 colleges across the university to identify high-priority multi-college strategic initiatives around each of five Grand Challenges:

- Feeding the world sustainably
- Assuring clean water and sustainable ecosystems
- Fostering just and equitable communities
- Advancing health through tailored solutions
- Enhancing individual and community capacity for a changing world

The five Grand Challenges were identified through a series of campus-wide forums in 2015, at which approximately 450 faculty members participated in open discussion of ideas about possible Grand Challenges and research agendas to address them.

To date, 35 interdisciplinary projects involving several hundred members of the faculty from more than 50 departments across 16 colleges are being supported with initial investment grants totaling more than $7 million. These funds are provided through central strategic reallocation. All funded projects, as well as many that have not been selected for Grand Challenges funding, are also aided in securing additional external funding. Because external engagement is a criterion for selection, Grand Challenges research projects are in collaboration with external partners, including agencies of Minnesota state government, city and county government agencies, private-sector corporations, non-governmental organizations, community representatives, researchers at other universities, and international partners.

Minnesota offers robust Grand Challenges curriculum, through roughly 10 courses each semester. Each Grand Challenges course is expressly interdisciplinary and is taught by two or three faculty members representing distinct departments; the courses are directed toward undergraduate student preparation for and involvement in Grand Challenges problem solving.

Grand Challenges research projects are also encouraged to involve undergraduate and graduate students. Minnesota created a special fund—Grand Challenges Undergraduate Research

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[19] Research: https://strategic-planning.umn.edu/; and Curriculum: http://gcc.umn.edu/

Opportunity Program—to support participation of undergraduate students, so that their involvement does not take resources from the budget of the funded project.

Minnesota has found that its Grand Challenge initiative has greatly enhanced participation in cross-college and interdisciplinary research collaborations, student engagement, enhanced community and global engagement, and increased capacity for external funding.

University of Wisconsin-Madison

The University of Wisconsin School of Education's Grand Challenges[20] is bringing together the UW School of Education and community partners to identify and address critical problems in education, health, and the arts, through a competitive grant program to provide support for its faculty and staff to define and explore innovative research and programs in education, health, and creative expression. Grand Challenges is engaging all 10 departments in the School of Education and sparking interdisciplinary teams to engage in projects to make a profound difference in scholarship and in communities within the state and across the world.

To identify potential Grand Challenge focus areas, program administrators interviewed 150 faculty and staff from the School of Education to learn what they are excited about and what is on the horizon for them, and then hosted gatherings to facilitate collaboration based on common themes. Over 300 faculty and staff engaged in the Grand Challenge design and grant preparation process; sparking a new interdisciplinary culture and spirit of innovation across our School of Education. Artists were actively included in the process to develop ideas and tell the story of identified Grand Challenges.

Washington State University

WSU's Grand Challenges[21] focus its research, innovation, and creativity in specific areas to achieve broad societal impact. Grand Challenge focus areas (identified by faculty working groups and involving student participation) include: Sustaining Health; Sustainable Resources; Opportunity and Equity; Smart Systems; and National Security. Six projects were funded last year to stimulate new areas of research. Twenty-six new faculty members will be hired as a result of these funds. This has stimulated cross-college collaborations, and proposals for large interdisciplinary funding opportunities are expected.

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[20] https://grandchallenges.education.wisc.edu/
[21] https://research.wsu.edu/research-initiatives/grand-challenges/

If you have feedback or questions about this report, please send to grandchallenges@ucla.edu.

University-Led Grand Challenges