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Proceedings of a Workshop

IN BRIEF

October 2020

Reopening U.S. Research Universities: Confronting Long-Standing Challenges and Imagining Novel Solutions

Proceedings of a Workshop—in Brief

On **July 21, 2020**, the National Academies of Sciences, Engineering, and Medicine's Committee on Science, Engineering, Medicine and Public Policy (COSEMPUP) hosted a virtual workshop, *Reopening U.S. Research Universities: Confronting Long-Standing Challenges and Imagining Novel Solutions*.¹ Attracting more than 500 participants, the workshop provided an overview of the current situation facing U.S. research universities and explored key questions that the research enterprise must address to build a more effective and resilient 21st century research university.

COSEMPUP Chair **Alan Leshner** (American Association for the Advancement of Science, retired) opened and closed the workshop, and COSEMPUP members **Juanita Merchant** (University of Arizona), **Susan M. Wolf** (University of Minnesota), **John Hildebrand** (University of Arizona), and **Michael S. Witherell** (Lawrence Berkeley National Laboratory), moderated sessions on the following topics: (1) Education/Training/Career Paths/Equity; (2) Trustworthiness of the Research Enterprise—Challenges to Research Integrity and Public Trust; (3) International Collaboration/Coordination/Access; and (4) the Academic Research Environment and Federal Support for Research. A concluding session invited session moderators to identify key issues that could be the focus of future National Academies' activities.

Recurring themes at the workshop included the importance of science to addressing COVID-19; the severity of the financial challenges facing research universities (particularly public universities); the importance of public trust in science and research and trust in institutions of higher education; the need to increase participation of currently underrepresented groups in STEM and address long-standing inequities that have been magnified by COVID-19; and immigration policies that impede foreign students from attending U.S. research universities and becoming part of the U.S. STEM pipeline.

INTRODUCTORY REMARKS

During his opening remarks, Alan Leshner outlined the goals of the workshop. He noted that the workshop would address long-standing challenges for research universities, which have been exacerbated by three disruptors: the COVID-19 pandemic; the current economic crisis; and heightened attention to inequities. Leshner suggested that as institutions reopen, they should both take advantage of lessons learned from COVID-19 and address some of the problems that have long plagued the enterprise so they can restart stronger than before. An important goal of the workshop, he said, is identifying key issues that would benefit from future COSEMPUP activity in the form of workshops or a consensus study.

National Academy of Sciences President **Marcia McNutt** characterized the workshop as a continuation of the discussion from a February 26, 2020 symposium commemorating the 75th anniversary of Vannevar Bush's landmark report *Science: The Endless Frontier* convened by the National Academies with support from the Alfred P. Sloan and Kavli Foundations. That symposium considered how to build a modern research architecture for today's world. She noted the critical role that universities play in conducting research; educating the science, technology, and medical workforce; and promoting economic growth—and in the process laying the foundation for our overall prosperity and security. McNutt noted that the pandemic has become a magnifying lens for many challenges the university enterprise faced before the pandemic. She highlighted five issues central to the future success of research universities, including:

¹ See: <https://www.nationalacademies.org/event/07-21-2020/reopening-us-research-universities-confronting-long-standing-challenges-and-imagining-novel-solutions-an-exploratory-virtual-workshop>.

- (1) articulating the value of a higher education in light of rising costs of a university education and shrinking state support for universities;
- (2) maintaining an open academic environment while addressing the growing concern about intellectual property theft from foreign entities;
- (3) preparing undergraduate, graduate, and post-doctorate students for various career paths;
- (4) maintaining public trust in science; and
- (5) addressing racial inequalities and attracting and retaining members of underrepresented groups in science, technology, engineering and medicine.

McNutt suggested that one of the few silver linings of the pandemic has been an unprecedented amount of international scientific and public health collaboration. This has reaffirmed the importance of attracting the best and brightest foreign talent to the United States. McNutt encouraged universities to strategize on how to foster a welcoming environment for foreign students in the current environment. She ended her remarks by noting that society depends upon science to end the COVID-19 crisis and other global crises, and that research universities play a key role in this endeavor. Actionable, strategic science will enable us to recover from the pandemic and be better prepared for future crises. She encouraged the audience to take this moment as an opportunity to strengthen universities and enhance the ability of both the U.S. and the global community to address significant global challenges.

THE CURRENT SITUATION

National Academy of Medicine President **Victor J. Dzau** moderated a session on the current situation facing research universities. The session included perspectives from academia and government. Dzau noted that U.S. research universities, one of our country's greatest assets, are facing increasing challenges, including decreased enrollments, loss of state funding, increasing federal research and reporting requirements, aging infrastructure, and technological change. He observed that challenges are particularly acute for public universities. Dzau posed several questions about how the research laboratory, teaching, education, research and career paths may change in the future. He noted that barriers to data and information sharing fell as the pandemic unfolded and asked if new approaches might be part of a new model to enhance knowledge exchange. The goal is to shape institutions to meet future challenges.

Mary Sue Coleman (Association of American Universities) described how U.S. universities have been devastated by the pandemic, including the economic and social consequences. Universities are seeking to protect the safety and health of their faculty, staff, and students while maintaining high standards of education. AAU estimates that the pandemic will result in aggregate losses of \$20-\$30 billion for one year to its members. Universities are planning how to reopen campuses in the fall while simultaneously dealing with immigration pronouncements impacting student enrollment. She noted that a recent JASON report, *Managing the Risk from COVID-19 During a Return to On-Site University Research*,² laid out a plan for universities to reopen. The financial devastation stemming from the pandemic will have immediate and long-term impacts on research universities, and AAU is urging Congress to provide some additional funding to universities, Coleman said.

M. Peter McPherson (Association of Public and Land-Grant Universities), described how APLU's members are being adversely impacted because of COVID-19. APLU estimates that its members will experience a \$26 billion loss of revenue and additional expenses of \$20 billion in 2020. As a result, some public universities may have reduced research capacity. APLU is seeking additional funding support for universities through this difficult situation. In addition to funding, he also noted the immigration challenges facing universities. McPherson noted that some researchers with small children have encountered challenges working from home that will need to be taken into account by university tenure committees. He also observed that the disproportionate impacts of COVID-19 on minorities and the poor, combined with intense interest in diversity and inclusion, requires the research enterprise to give heightened attention to equity issues.

Michael Lauer (National Institutes of Health) praised the university research community's ability to quickly focus its resources on addressing the COVID-19 pandemic and its important role in expeditiously advancing our understanding, diagnosis, and treatment of the disease and development of a vaccine. He noted the development of strong public-private partnerships to combat the virus as well as NIH's concerns about the impact of the crises on the future science and technology workforce, including adverse impacts on women with young children and researchers

² JASON | MITRE Corporation. 2020. *Report on Managing the Risk from COVID-19 During a Return to On-Site University Research*. <https://www.cogr.edu/sites/default/files/JASON%20covid%20report.pdf>.

who rely on a single grant for their livelihood. According to Lauer, the Office of Management and Budget (OMB) has allowed NIH some flexibility in grant-making, and NIH will continue to enable researchers who had limited access to research laboratories to receive salaries for as long as OMB permits. NIH, he said, has been able to continue to conduct peer review of proposals without interruption, noting that the number of proposal submissions to NIH remains high. He acknowledged an increasing use by the community of publication preprints and expressed optimism that science will solve the COVID-19 problem.

SESSION ONE: EDUCATING/TRAINING/CAREER PATHS/EQUITY

Moderator **Juanita L. Merchant** (University of Arizona College of Medicine) noted that the panel would focus on the impact of the pandemic, how the economic downturn and racial injustice affects STEM students and new career entrants. The session would also seek to identify steps that universities should undertake to further education, research, training, and career paths—while incorporating racial justice—to ensure that we do not lose the upcoming STEM workforce.

Jennifer Zeitzer (Federation of American Societies for Experimental Biology) addressed the topic of careers for young scientists and career trajectories that support excellence in both teaching and research. She encouraged research universities to educate and train students for a variety of STEM career paths, including academic positions, policy positions, and industry jobs, and to provide students with the skills needed for the future workforce. In light of potential hiring freezes, increased grant chasing, immigration restrictions, and funding constraints, she encouraged STEM entrants to consider non-academic careers. According to Zeitzer, COVID-19 has taught us that flexibility is key and that research is not limited to the laboratory. She also encouraged new STEM entrants to take advantage of opportunities such as virtual meetings and webinars.

Frances Ligler (North Carolina State University/University of North Carolina-Chapel Hill and COSEMPUP member) proposed realigning the relationship between research and education. She observed that faculty is often rewarded more for publishing than teaching. Ligler suggested that large public universities could broaden the use of extension service activities. She identified stresses on the current system, including “indentured servitude,” in which some post-doctoral students spend too many years in the laboratory, stove-piped research that limits future professional opportunities, minimal choices for undergraduate, graduate and postdoctoral students, faculty recognition focused on independent contributions, and limited diversity in laboratories. She suggested providing opportunities for corporate internships, paid summer research opportunities for students who are economically challenged, and providing students with cross-disciplinary training. Ligler also proposed major changes to the ecosystem, including creating opportunities for faculty to move between academia and other sectors, such as government, non-profits, and for-profit corporations. This would foster professional development and career diversity, as well as provide new mechanisms to break down the boundaries between professors of practice, teaching faculty, and tenured faculty, so that students could be exposed to a greater range of career options.

Suzanne Ortega (Council of Graduate Schools) spoke about the agility that universities have demonstrated in responding to the current moment. Universities are concerned about availability of visas for international students, she said. CGS is monitoring the adverse impacts on disadvantaged and first generation college students who benefit from the sense of community and peer network provided by an on-campus experience. CGS, she said, is looking at methods to expand student participation in professional development activities, internships, and field experience; to fund graduate students through degree completion; and to maintain a diverse graduate pipeline. Additionally, CGS is concerned about how changes to corporate business models, such as downsizing, acceleration of shifts to project and short-term employment, and increased use of artificial intelligence and robotics may impact the next generation of scientists. Additional funding will be needed, according to Ortega, to support graduate students through the end of their degrees. She stated that the education aspirations of students of color has been profoundly disrupted by the pandemic, and that strategies are needed to maintain graduate school goals for students whose family circumstances are impacting their ability to relocate to or attend graduate school. She emphasized the need to prioritize the mental health of graduate students during these stressful times. Ortega noted that steps must be taken so that we do not lose the next generation of scientists and scholars.

Claude M. Steele (Stanford University) proposed an overarching approach to achieve a climate that promotes diversity at research institutions and in STEM disciplines. Steele emphasized the importance of building trust to achieve a diverse community in classrooms, universities, scientific disciplines and society. He cited research on stereotypes and the pressure that stereotyping places on students. He said that the importance of this issue has been underestimated. In Steele’s view, the challenge is to build trust among groups despite existing tensions. Developing trust, he said, should be part of our ethos and is a fundamental part of education. He stressed the importance of instructor feedback and en-

sure that the feedback is based on the quality of the student's work and not on stereotypes. A fundamental challenge is to build an environment that everyone can trust and feel valued.

SESSION TWO: TRUSTWORTHINESS OF THE RESEARCH ENTERPRISE—CHALLENGES TO RESEARCH INTEGRITY AND PUBLIC TRUST

Moderator **Susan M. Wolf** (University of Minnesota) reiterated Dr. McNutt's message that science needs to deliver the answer to COVID-19. The challenge, she said, is to ensure that science is conducted with ethics and integrity and to maintain public safety while under extreme pressure to deliver results rapidly.

Christine Grady (National Institutes of Health) noted that there is an ethical imperative to conduct research on COVID-19. As of July 20, 2020, she reported, there are 482 therapeutic agents and 156 vaccine candidates in the pharmaceutical pipeline. She suggested that both speed and vigor are important. To comply with ethical or scientific standards, Grady recommended: (1) embedding ethical standards and principles throughout the research process; (2) priority setting at the institutional level and flexibility to change course; (3) coordination and collaboration, such as pooling resources and sharing data; and (4) public engagement and trust, which impacts the willingness of the public to undertake public health measures.

Holden Thorp (American Association for the Advancement of Science; *Science* magazine) spoke about trust and transformation in the scientific publications industry. He noted that science has made a tremendous amount of progress in 5 months toward diagnosing and treating COVID-19 and developing a vaccine, but that it has not received public recognition commensurate with its accomplishments. Thorp said that the number of articles submitted to *Science* has risen during the pandemic. *Science*, he said, plans to conduct an analysis next year to evaluate if the pandemic resulted in inequities to certain authors or reviewers, such as those working at home with young children. While *Science* has not had a problem with authors submitting COVID-19 publications based on fraudulent data, he noted the importance for publishers to require that authors make their underlying data and code available if for no other reason than to enable replication and verification.

SESSION THREE: INTERNATIONAL COLLABORATION, COORDINATION, AND ACCESS

Moderator **John Hildebrand** (University of Arizona) set the stage for a session on international cooperation by discussing how the U.S. has been an aspirational global leader for science and technology since Vannevar Bush. However, he noted that in recent years, the U.S. government has withdrawn from international engagements amid growing concerns about theft of intellectual property and national security issues, thereby straining international science and technology cooperation. Hildebrand said that U.S. mismanagement of the pandemic response has undercut U.S. global public health leadership.

Geraldine Richmond (University of Oregon) noted that, at a time when global engagement is of increasing importance, U.S. students need the opportunity to work with students from other countries. Current financial challenges at research universities, she said, could result in cuts in critical international programs. Research universities and employers, Richmond said, depend upon foreign graduate students in STEM fields; current immigration policies are likely to reduce the number of foreign students attending U.S. universities. Richmond proposed that universities attract more domestic students to STEM fields by focusing on the practice of discovery rather than just a body of knowledge. She suggested rethinking metrics for faculty promotion and encouraged tenure bodies to value faculty contributions to important global issues, such as climate change and biodiversity. Richmond noted that while accomplishments in such areas may be more difficult to quantify than metrics—such as the number of publications—they are of great societal value.

Maria Zuber (Massachusetts Institute of Technology) discussed international science and technology cooperation in an era of increasing tensions with China in particular, noting "concerns with China are not just a passing phase [...] nor are they the province of just one political party." International cooperation will always be essential, she said, because the U.S. does not have a monopoly on science and technology leadership. According to Zuber, U.S. universities need to craft a balanced, nuanced, and targeted approach to international cooperation. For example, MIT has established a review process for all new research engagements with Russia, China, and Saudi Arabia to assess the benefits from the collaboration. The *JASON Report on Fundamental Research Security*,³ prepared for NSF, found that disclosing funding from foreign sources needs to be part of being a responsible researcher. Zuber cautioned about changing the

³ JASON | MITRE Corporation. 2019. *JASON Report on Fundamental Research Security*. https://www.nsf.gov/news/special_reports/jasonsecurity/JSR-19-2IFundamentalResearchSecurity_12062019FINAL.pdf.

open environment for fundamental research, noting that the JASON report reaffirmed the NSDD-189 principles of openness, by default, for the conduct of fundamental research. Zuber also emphasized the importance of foreign students to U.S. universities and the science and engineering workforce pipeline, noting that the latest statistics show that 85 percent of Chinese students who obtain science and engineering Ph.Ds at U.S. universities remain in the country 5 years after graduating. Zuber agreed that it is important to increase STEM literacy in the United States but suggested that this does not eliminate the need for the U.S. to attract and retain foreign talent to maintain global science leadership.

Arthur Bienenstock (Stanford University) discussed a forthcoming American Academy of Arts and Sciences report that examines the importance of international science and technology cooperation with a focus on large-scale research facilities. He noted the importance of geographically dispersed observatories in fields such as ecological research and astronomy. The stability of U.S. partnerships and commitments to international research facilities is undercut by the annual appropriation process, increasing nationalism, and restraints on foreign travel, he said. According to Bienenstock, absence of an international organization to establish geographically diverse observatories impedes a coordinated international approach. He suggested that UNESCO might serve in this role, but also noted that the U.S. is not currently a member. The most likely foreign pipeline for STEM in 20-30 years will be students and researchers from Africa, Bienenstock said.

SESSION FOUR: THE ACADEMIC RESEARCH ENVIRONMENT AND FEDERAL SUPPORT FOR RESEARCH

Moderator **Michael Witherell** (Lawrence Berkeley National Laboratory) introduced the workshop's final panel by acknowledging the important role that the roadmap in Vannevar Bush's *Science: The Endless Frontier* played in positioning the U.S. as a leader in science and technology during the past 75 years. He said that an updated, visionary roadmap is needed to position the U.S. for the next 75 years.

Keith R. Yamamoto (University of California, San Francisco) addressed the immediate needs and future implications for the academic research enterprise. Yamamoto expressed support for additional fiscal year 2020 funds for existing NIH grants to help cover the costs of reopening of suspended biomedical research activities and the challenges it poses for laboratory space, lab culture, and coherence. He recommended that various federal agencies collaborate to provide funding for team-based multidisciplinary research, suggesting, for example, that NIH work with the Department of Energy and its laboratories to fund and build large platform technologies for the biomedical research community. He called for a renewed recognition of the value and importance of science, evidence, and research. To address societal issues such as security, health, food, energy and the environment, Yamamoto called for a reset of the federal support base for science and technology research and education.

France Córdoba (National Science Foundation, retired) highlighted the impact of the COVID-19 pandemic on the physical sciences. She cited a 2020 American Institute of Physics report entitled "Peril and Promise: Impacts of the COVID-19 Pandemic on the Physical Sciences."⁴ The report provides examples of how COVID-19 is impacting the scientific workforce in the physical sciences and exacerbating disadvantages for underrepresented minorities. Córdoba discussed the increase in philanthropic investments in basic science and the creation of the Science Philanthropy Alliance.⁵ She expressed support for the Endless Frontier Act, wherein Congress proposes to change the name of the National Science Foundation to the National Science and Technology Foundation and add a technology directorate to emphasize technology and translational research. She observed that NSF has a history of funding technology programs, citing NSF's Engineering Research Centers, Innovation Corps, Convergence Accelerators, as well as the Division for Industrial Innovation and Partnerships.

CONCLUDING ROUNDTABLE WITH SESSION MODERATORS

National Academy of Engineering President **John Anderson** moderated a concluding roundtable with the moderators of the four panel sessions. He asked the panelists to summarize the key challenges facing research universities as they reopen and identify innovations developed in response to COVID-19 that may provide new approaches to address both perennial and new problems.

Juanita Merchant said that the three disruptors identified by Dr. Leshner (COVID-19 pandemic; economic crisis; and heightened attention to inequities) are dismantling current notions of research and training, and providing an opportunity to rebuild with diversity of thought, execution and the workforce. She said that there is an urgent need to

⁴ See <https://www.aip.org/covid-impacts-on-physical-science>.

⁵ See <https://sciencephilanthropyalliance.org>.

create capacity for non-academic careers and provide students with education and training that provides them with the range of skills needed for the future workforce, including strong communication skills. Merchant asked how to restructure research laboratories to provide greater interaction between faculty and students and suggested that university faculty take sabbaticals at underserved institutions to exchange information and improve cultural understanding. Science literacy for political leaders and journalists is also important, Merchant said. She urged universities to use the present situation as an opportunity to promote a diverse workforce and build a trusting environment.

Susan Wolf said that the urgency to find solutions to COVID-19 must not undercut the integrity of research. Crises pose challenges to integrity and trustworthiness, which include exacerbation of previously existing challenges as well as new challenges. She recommended expanding the scope of ethics discussions to include the need for both expediency and rigor in research, and to streamline research processes while ensuring appropriate journal and peer review of research.

John Hildebrand emphasized the benefits that the United States derives from international cooperation and the need for international trainees. Regions of the world with younger demographics, such as Africa and Latin America, he said, may be a good source for future STEM trainees. Although the U.S. needs to address bad international actors that are not following important scientific principles, in Hildebrand's view, this should not dissuade the United States from engaging in international cooperation. He suggested that COSEMPUP should conduct a deep dive into the value and benefits of international cooperation.

Michael S. Witherell emphasized the need to ensure that basic research is aligned with national needs. He noted the importance of research in addressing national health, security, sustainable energy, and environmental challenges. Multidisciplinary approaches to solve problems and multiple agency funding for projects that span disciplines are needed, Witherell said. He suggested that COSEMPUP might help find ways to overcome these barriers.

In response to the request for comments from speakers, **Mary Sue Coleman** suggested that COSEMPUP, together with architects, undertake a project that considers what research laboratories should look like in the future. Keith Yamamoto suggested a consideration of the importance of open access to publications to address disparities and cited the National Academies' Project on Open Science Practices.

COSEMPUP Chair **Alan Leshner** concluded the workshop by thanking the workshop moderators, speakers, and attendees for a vibrant and robust discussion about the key issues facing U.S. universities as they cope with current disruptors and long-standing challenges. COSEMPUP, he said, will consider the proposals posed at the workshop and develop activities to assist U.S. research institutions in shaping a research ecosystem that meets future research challenges and provides the education, research and training necessary to create an inclusive STEM workforce for the 21st century.

DISCLAIMER: This Proceedings of a Workshop—in Brief has been prepared by Anita Eisenstadt, Steven Kendall, and Anne-Marie Mazza, as a factual summary of what occurred at the meeting. The committee's role was limited to planning the event. The statements made are those of the individual workshop participants and do not necessarily represent the views of all participants, the planning committee, the Committee on Science, Engineering, Medicine and Public Policy, or the National Academies.

REVIEWERS: To ensure that it meets institutional standards for quality and objectivity, this Proceedings of a Workshop—in Brief was reviewed by **Angela Diaz**, University of California, San Diego, and Richard Seligman, California Institute of Technology. **Marilyn Baker**, National Academies of Sciences, Engineering, and Medicine, served as the review coordinator.

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JOHN L. ANDERSON, President National Academy of Engineering (NAE) serve as ex-officio members to the Committee. **National Academies of Sciences, Engineering, and Medicine Staff:** **Anne-Marie Mazza**, Senior Director; **Steven Kendall**, Program Officer; **Anita Eisenstadt**, Program Officer; **Dominic LoBuglio**, Program Coordinator.

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