UNIVERSITIES RESEARCH ASSOCIATION

URA Roundtable Report on Effective University-National Laboratory Partnerships

A Look to the Future

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Roundtable
Effective University-National Laboratory Partnerships
A Look to the Future

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October 14 and 23, 2020

1 Introduction

The Universities Research Association (URA), a non-profit association of over 90 premier universities with significant responsibilities at Fermi National Accelerator Laboratory and Sandia National Laboratories, hosted roundtable conversations among several member university representatives to gather their perspectives on building more effective partnerships between universities and Department of Energy National Laboratories. The URA *Roundtable on Effective University-National Laboratory Partnerships—A Look to the Future* was held via video teleconference on October 14 and October 23, 2020. The goal was to develop recommendations for impactful, and perhaps novel, concepts for university-National Laboratory partnerships that would inform further thought among URA members and government policymakers.

Universities Research Association, Inc.

The mission of URA is to establish and operate—in the national interest—unique laboratories and facilities for research, development, and education in the physical and biological sciences to expand the frontiers of knowledge, foster innovation, and promote the education of future generations of scientists. With its long-established history of connecting the research missions of national laboratories to the expertise that resides in universities URA is well situated to initiate a national discussion of aspirational links between academia and the National Laboratories.

The Roundtable discussion proceeded in clear awareness that universities and National Laboratories are part of a broader national research and development enterprise. This Roundtable serves as a starting place for exploring and understanding the perspective of universities in this larger complex.

Roundtable participants were drawn from the senior ranks of URA member universities and were asked to explore best practices in university-National Laboratory partnerships from a realistic university perspective. The discussion highlighted positive outcomes of these relationships, identified impediments to the achievement of the full potential of a more successful partnership, and explored concepts for new approaches.

In the first Roundtable session on October 14, 2020 (see Appendix A) participants explored current partnership models and the effects of a changing research and innovation landscape within academe and at National Laboratories. The second Roundtable discussion focused on identifying creative and innovative ideas for future partnership models. Participants offered a

rich array of examples that are representative of the types of relationships that could enhance the university-National Laboratory relationship.

Universities remain a crucial part of the success of the National Laboratories. They are the key contributors and collaborators for cutting edge research, the principal source of the science, technology, engineering, and mathematics (STEM) talent pipeline, and an important source of peer review needed to maintain scientific excellence at the National Laboratories. Drawing on universities' experiences in building partnerships with National Laboratories—both successful and not-so-successful—this Roundtable report makes recommendations for actions that could be taken to improve these critical partnerships and make them more responsive to evolving strategic priorities and an ever-changing research ecosystem.

2 Background

The Department of Energy (DOE) National Laboratories are major stewards of large-scale science capabilities that serve the U.S. scientific community and are a critical part of the research ecosystem. Throughout their evolution, the National Laboratories have been closely linked to, and often dependent on, academia. Research collaborations, facility access, personnel exchanges, and training of students have benefitted both the universities and the National Laboratories. University collaborations help laboratories deliver world-class research while providing critical input to the talent pipeline. Universities benefit from the opportunity to work on cutting-edge problems of national importance, gaining access to specialized research facilities, and potential channels for funding.

As national research capabilities and needs have evolved, so have the missions of the National Laboratories and the nature of the partnerships between National Laboratories and universities. Longstanding differences between interdisciplinary team science as often practiced by the National Laboratories and individual principal investigator (PI)-led science in the university environment have changed as university research teams engage more often in "use-inspired" research. In addition, universities especially are undergoing significant shifts in their business models accelerated by the pressure of responding to the COVID-19 pandemic.

The last two decades have witnessed a series of thoughtful reviews of the national research enterprise generally, and more specifically, the role and status of the National Laboratories.[1] One of these reviews, the National Academies of Sciences 2005 workshop report, *National Laboratories and Universities: Building New Ways to Work Together*,[2] specifically addressed the relationship of universities and the National Laboratories and examined collaborative practices from individual investigator-level collaborations to joint centers and laboratory-run, university-populated user facilities. The workshop report also catalogued examples of impediments to university-laboratory collaborations, many of which remain today. A more recent report examined the landscape of laboratory-university research partnerships from the DOD perspective

[1]Final Report-Commission to Review the Effectiveness of the National Energy Laboratories (2014), https://www.energy.gov/labcommission/downloads/final-report-commission-review-effectiveness-national-energy-laboratories

[2] National Laboratories and Universities: Building New Ways to Work Together: Report of a Workshop (2005) http://nap.edu/11190

and recommended steps to reduce barriers faced in these undertakings and increase collaboration between the two entities.[3]

In 2005 another seminal National Academies of Sciences report, *Rising Above the Gathering Storm*, chaired by Norman Augustine, called attention to the globalization of advanced knowledge and widespread low-cost labor. This report and others like it have highlighted trends that threaten U.S. advantages in the marketplace and in science and technology. They recommended urgent efforts to bolster U.S. competitiveness and pre-eminence in emerging areas of science and technology so that the Nation would consistently gain from the opportunities offered by rapid globalization.

In the intervening decade and a half, the discussion has centered on how to prioritize research resources to focus more sharply on national priorities. In addition to identifying specific science investment priorities, it is crucial to examine how the research ecosystem--including the National Laboratories, academia, and industry--can function most effectively.

More robust connections, greater clarity around current university-National Laboratory partnerships, and identification of opportunities for improvement, would benefit all parties and contribute to the strength and creativity of the entire research enterprise. The vigorous participation of universities—sources of knowledge, of pathbreaking research, and of rich talent pipelines—in this national dialogue is critical.

Giving universities a clear voice in this dialogue is the motivation for the URA *Roundtable on Effective University-National Laboratory Partnerships—A Look to the Future*. The Roundtable discussed the complex issues at the intersection of the intellectual mandate, the creation of the next generation STEM workforce, and the evolving business model for the university.

3 Current State of University-National Laboratory Partnerships

The Roundtable opened with a focused panel discussion on the current context for university-National Laboratory partnerships. Panelists addressed the current pressures that bear on the creation and sustainment of university-National Laboratory partnerships, real and perceived barriers and constraints, and the key elements of successful partnerships.

Participants discussed three pillars of the contemporary university research model—discovery, innovation, and workforce development—that are especially relevant to successful collaborations between universities and National Laboratories.

> ***I basically look at the research enterprise as being made up of three pillars--I hope not three silos. And the three pillars are basically discovery, innovation, and workforce development.***
>
> ***Emmanuel Giannelis***

Elements of the *discovery* pillar include access to talented researchers as well as access to cutting edge research facilities. Increasing financial pressures are making it more difficult for universities to maintain such research infrastructure on their own resulting in greater reliance on federally supported facilities such as the National Laboratories.

[3] Research Collaborations Between Universities and Department of Defense Laboratories, Institute for Defense Analysis, IDA Document D-5230, 2014. https://www.ida.org/research-and-publications/publications/all/r/re/research-collaborations-between-universities-and-department-of-defense-laboratories

Innovation is broadly related to the ability to translate discoveries into the marketplace. Universities are playing an increasingly important role in innovation and are an integral part of the innovation ecosystem that includes industry and the National Laboratories. Since research grants generally do not support innovation activities *per se*, many universities have taken deliberate steps to support entrepreneurs and start-up companies associated with their research efforts. Satisfactory resolution of intellectual property issues remains a common challenge for effective collaborations between universities and National Laboratories though successful models do exist.

Universities are the primary contributor to the STEM w*orkforce development* that is so critical to the success of the National Laboratories. They not only train the next generation of STEM professionals but are critical to the efforts to retain workers in emerging fields of strategic importance. The development of interdisciplinary teams of scientists to focus on areas where discovery is likely to take place is a critical part of their contribution. Collaboration with National Laboratory researchers, where interdisciplinary research has been a hallmark, can be of great benefit to universities in accomplishing their workforce development mission.

> ***Academia faces a trifecta of different challenges. These relate to the crises that we have in rapidly growing tuition and assuring affordability, the impact of racism on academia and the need to address diversity, equity, and inclusion, and the significant challenges related to COVID-19.***
>
> ***Theresa Mayer***

Universities are currently facing a series of unprecedented challenges that will inform and shape their current and future partnerships with National Laboratories. These challenges include financial pressures, the need to stabilize tuition costs, the impacts of the pandemic on access to education, and the need to address diversity, equity, and inclusion. Together, these pressures will make partnerships more important than ever in enabling universities to carry out their mission.

Universities are increasingly called upon to streamline their operations and make business-based decisions. The growth period during the 1990s resulted in many universities expanding the number of new programs and initiatives. Now, due to financial pressures, universities are faced with difficult decisions arising from the need to shed programs that are viewed as less relevant. In addition to the costs of retiring less productive facilities, there is a need to keep up with technology inflation by constantly improving performance to address cutting edge science and meet growing expectations.

Societal expectations of academia have grown far beyond simply providing students with a broad-based education and performing research. Universities are now expected to be a driver for economic development, a major source of technology transfer, and far more engaged in public-private partnerships. Despite decreasing revenues and state funding, there is a growing demand by public and private entities for universities to contribute their own resources and "put skin in the game." Notwithstanding the substantial resources many universities appear to have, the "atomization of funding" that can occur when many legacy projects demand small increments of funding can result in insufficient resources at the program level, an issue shared by many National Laboratories.

> ***Industry, in particular the tech industry, has been very aggressive in identifying and outbidding the academic enterprise for top talent. This is potentially dangerous for us and therefore a threat to the labs. The challenge is finding a way to identify and encourage students to take a basic research pathway early in their college career so that they become acculturated to this kind of environment.***
>
> ***Dan Jaffee***

The panel characterized the current relationship between universities and the National Laboratories, as essentially an "extractive" one. That is, a relationship in which both parties seek to extract for themselves maximum benefits from the partnership instead of seeing the partnership itself, with its value added, as the beneficiary. In parallel with this, programmatic decisions are driven by top-down pressure to address big problems with a potentially high payoff. An alternative approach that fosters deliberate connections of researchers at the individual level would better promote the co-sponsorship of students and promote long-term research relationships that are a strong basis for larger scale collaborations.

4 Current Models for University-National Laboratory Partnerships

A second panel discussed current models and practices for research relationships between universities and National Laboratories and how they impact the STEM workforce pipeline and technology development activities. The participants heard from panelists with a variety of experiences and relationships with the National Laboratories.

In one model, the University of California (U.C.) system carries out management and oversight for Lawrence Berkeley National Laboratory (LBL), Los Alamos National Laboratory (LANL), and Lawrence Livermore National Laboratory (LLNL). LBL, as a DOE Office of Science laboratory, has a strong partnership with the U.C. campuses, particularly UC Berkeley, where about 250 Lab scientists have joint faculty appointments with the campus. The two U.C. national security labs, LLNL and LANL, have strong mission-oriented cultures that are evolving at an accelerating pace and are going through major workforce growth and turnover.

> ***The mission challenges are evolving at an accelerating pace if you just look at the geo-political landscape around the world. As a result, the Laboratories are required to have technical agility and a sustained long-term science and technology investment. The partnership and collaboration with academia and industry are very important to the depth and breadth to their core competencies. They enable them to anticipate, innovate and ultimately deliver on their mission.***
>
> ***June Yu***

U.C. views itself as operating these Labs as a public service for the Nation and reinvests its fee revenue in initiatives with long-term benefit of the laboratory enterprise, including research partnerships and other initiatives.

The U.C. National Laboratories Fee Research Program (LFRP) enhances the missions of the laboratories and U.C. in ways that cannot or are unlikely to be funded by the campuses or the laboratories on their own. The LFRP provides students with unique training opportunities and provides a holistic preparation to launch successful careers. The competitive research awards enable U.C. faculty and laboratory scientists to advance their science in strategic, topical areas and position them to compete for extramural funding. Since 2017 fifteen graduate students have received the UC-National Laboratory in-residence fellowships that provide each student with two or three years of direct support to pursue dissertation research at LANL or LLNL with mentorship and training opportunities at premier laboratory facilities.

U.C. has also established programs outside of research and student programs that assist its laboratories to experiment with new business models and technology transfer mechanisms. One goal has been to connect philanthropic donors with researchers. As the laboratories and the university evolve, U.C. continues to look for ways to improve and strengthen the Labs-campuses partnerships and incentivize new models of doing business.

Another model is exemplified by the relationship between the University of Tennessee (U.T.), Oak Ridge National Laboratory (ORNL), and the Y-12 complex. U.T. and Battelle Memorial Institute formed a 50/50 partnership in 2000 to manage and operate ORNL. Seven core universities are represented on the board. Like U.C., the U.T. management fee is reinvested in the laboratory and U.T. invests additional funds, beyond the fee amount, in the Laboratory. There are over 200 joint faculty with ORNL and 25 joint faculty with Y-12 along with associated joint PhD programs. The panel noted that the relationships necessary to make these programs successful require constant attention on an ongoing basis to accommodate shifting priorities.

> ***Both the National Laboratories and universities have to be invested in the relationship and the value of that relationship. They must put themselves in the shoes of the other and together develop win-win strategies. This requires constant communication and strong, honest relationships.***
>
> ***Stacey Patterson***

Understanding the mission of the Laboratory has been key to structuring the university partnership. University faculty and administration may mistakenly view the National Lab as funded in the same way as a university. Unlike academic departments with assumed long-term funding, the National Laboratories must deal with substantially more uncertainty and shifts in funding priorities. This affects the way joint faculty programs operate and universities must anticipate such shifts when hiring new joint faculty.

U.T. has recently set up the Oak Ridge Institute at U.T. to streamline and grow these partnerships. One new initiative includes offering modular course work for graduate curricula, which allows laboratory personnel to better engage in teaching by focusing on a three-to-five week module rather than a full semester. U.T.'s goal is to capitalize on such new models and bring in additional universities to focus on workforce training in a National Learning Collaborative.

Yet another unique variation is illustrated by the founding of URA and Fermilab. At the time, several laboratories had been criticized for favoring "users" from their own geographical regions or even "in-house" users. Fermilab's first Director, Robert Wilson, and his successor, Leon Lederman, were determined that the newly established Laboratory would welcome proposals from all regions of the United States-- offering complete on-site facilities for outside users bearing a competitively acceptable proposal. In that spirit, it was specified that 75% of the research program would be performed by users and 25% by resident staff. Most of the outside users were from U.S. universities, and they soon assumed major leadership roles in the Laboratory's research programs. In addition, Laboratory governance and oversight was in the hands of a Board predominantly populated by senior leaders from URA member universities.

The motivations for a university to undertake a management role are primarily based on the pursuit of knowledge and the benefit of society, and to a lesser extent, national security. The fee for managing these laboratories is relatively small and not sufficient to have a major impact on the success of the laboratories, nor any substantive financial benefit to the university. The risks associated with managing a National Laboratory, however, are significant and the fee falls far short of mitigating them. The missions of the National Laboratories are complicated, with DOE serving as the "owner," the management and operating

> ***We think that we can really be effective managers if we can make the labs more like a university. And if we can make the university a little bit more like a lab.***
>
> ***Juan de Pablo***

(M&O) contractor acting as the operator, and the laboratory in between. The DOE is under a complex set of constraints whereas a university has relatively more flexibility.

All panelists noted the impact the COVID 19 pandemic has had on virtually all their programs and the associated challenges to build capabilities to maintain access without requiring the physical presence of student and faculty on-site.

5 Reinventing the University-National Laboratory Partnership

A third panel discussion addressed "Blue Sky" aspirations and ideal partnerships and explored ways in which the changing research and innovation landscape enables new partnership opportunities. The panel discussed a variety of illustrative approaches to capitalize on the strengths of the National Laboratories in carrying out science at scale with universities as intellectual partners. Immediately achievable new initiatives include expanding partnerships to universities that do not already interact with the National Laboratories. This is directly related to the reality that National Laboratories must develop a new means for remote access to conduct business. New opportunities for broader university participation would encourage the formation of remote collaborative groups and communities of interest. This is especially important to redefining the concept of regional and local innovation ecosystems that have proven so successful in the past. A new model is needed to extend the laboratory presence into new geographic areas aligned with remote university locations.

> ***The University of Maryland and several other universities represented on the Roundtable are strong in quantum science and quantum computing. So, a research node could really focus on a joint investment in infrastructure and a joint commitment of hiring faculty and National Lab personnel who might work in College Park, Maryland.***
>
> ***Laurie Locascio***

Joint research nodes aligned with the laboratory mission areas could be located in areas close to universities or industry where particular desired research is strong, rather than in proximity to the laboratories. The establishment of a co-investment in distributed core user facilities or test beds would benefit collaborations between the universities and the laboratories located where the research itself is strong.

The establishment of geographically dispersed university-laboratory partnerships (GULP) that enable the sharing of cutting-edge research equipment, instruments and facilities and provide nimble, remote, and affordable access would jump start emerging research efforts like the one needed to address the COVID-19 pandemic.

> ***There's no time better than now to build regional innovation communities with labs and universities coming together as intellectual partners tied to a grand challenge that inspires blue sky thinking. It's about building a community of trust where you can fail fast and fail often only to come up with scientific breakthroughs that would not be possible otherwise.***
>
> ***Padma Raghavan***

Proximity and a sense of community have played a major role in local and regional innovation ecosystems. Mutual trust within these innovation communities promotes sustained efforts that allow for failure, eliminates boundaries, and values path breaking unconventional research. In this context, universities should be considered trusted, intellectual partners, not contractors. Although remote work will clearly be a feature of any future scenario, laboratories will benefit from having a durable and visible presence on campus.

Other "blue sky" models discussed by the panel capitalized on this intellectual partnership concept to include government, academia, and industry focusing on a grand challenge, "moon shot," initiative to address a defined national priority. A recent example is the successful effort to mobilize national resources around the Operation Warp Speed

initiative to address the COVID-19 pandemic. The response to COVID-19 has resulted in strong collaborations by former competitors.

> ***The COVID-19 vaccine teams have scientists working on vaccines, while distributors are ramping up manufacturing facilities and FedEx and UPS are determining how to transport the vaccines. So, it's the entire chain, that is needed to field the solutions at scale with many solutions moving in parallel. These are the teams we need to build and they have to be interconnected from the start. A single Laboratory or university cannot do it alone.***
>
> ***Lora Weiss***

The result of the mobilization for the COVID-19 response has been that therapeutics and treatments are moving faster than ever before due to the sharp focus of scientists from National Laboratories, academia, and industry, and the entire chain including transportation and distribution. These efforts will result in solutions at scale and foster a multiplicity of parallel approaches from interconnected laboratories, academic labs, and industrial participants. Core threads for these difficult challenges would be linked by fundamental research to translation and implementation.

The panel discussed the value of the human capital within the National Laboratories and ways in which it might be better mobilized. Researchers at National Laboratories are often tied to a particular project or funding stream making it difficult to mobilize expertise in new areas when needed. A model in which laboratory researchers have the flexibility that is inherent in a science-driven university research environment would allow them to form teams and collaborate more effectively. Such teams would be dynamic and form and re-form as problems evolve and arise and make it easier to match expertise to problems.

> ***I think an ideal model for lab research staff would be something is much more like the university environment that many of us are familiar with. And I think the key to this is having these individuals able to form teams. We know that team research is very effective in solving problems. And this typically involves researchers from diverse fields.***
>
> ***Richard Reeder***

Such a model for dynamic team building would involve a physical environment that is less restrictive than most laboratories currently have. There are examples, such as Brookhaven National Laboratory's Discovery Park, in which some laboratories are creating open spaces "outside the fence" to promote such flexible collaborations among laboratory employees, academic researchers, and industrial scientists. Conversely, universities can also create collaborative centers where laboratory and industrial research partners can effectively work together with their colleagues in academia. Because these are part of the university, they can be more open settings than would be the case for a laboratory-sponsored facility.

The panel noted that all of these "Blue Sky" concepts would require streamlining the contracting process to allow National Laboratories to manage their contracts in a simpler and more flexible manner, a critical element of partnering with industry and academia.

6 Federal Government Views

Dr. Kelvin Droegemeier, Director of the White House Office of Science and Technology Policy, and Dr. Chris Fall, Director of the DOE Office of Science contributed their perspectives to the Roundtable discussion. Both have figured prominently in recent discussions of the evolution of the National Laboratories and how industries of the future might be addressed as a national priority. Their comments indicated a high degree of overlap between their views and the discussions among the participants.

Some key points include:

- The benefits of a co-located collaboration space whereby university, laboratory, and industry scientists can work together.
- The multiplier effect that results from effectively combining the capabilities of academia, government, and non-profits to accomplish what no single sector can on its own.
- The importance of mutual trust in building effective partnerships; and
- The need to reduce the administrative burdens and non-essential regulatory impediments for researchers in general, including university-National Laboratory partnerships.

Their focus on collaboration spaces, whether they are called Alpha Institutes, Innovation Districts, or Research Hubs was consistent with much of the discussion within the Roundtable related to a distributed model for research facilities, new avenues for collaboration other than within the geographic bounds of a National Laboratory, and the need for a more integrated university, National Laboratory, industry strategy.

7 Recommendations for Near and Mid-term Action

The Roundtable offered an opportunity to reflect on the value proposition for the university-National Lab partnership and to identify gaps to be addressed and actions to be taken to enhance the value of these partnerships. Participants identified five areas, detailed in the sections below, in which moderate near- and mid-term actions could greatly enhance the effectiveness of the university-National Laboratory partnership.

> ***Observation: Universities remain essential partners for the National Laboratories***
> *Despite pressures on universities and National Laboratories, universities remain an essential contributor to the National Laboratory research enterprise and a source of new ideas. Universities are the core foundation for the talent pipeline essential to the sustained success and renewal of the National Laboratory staff. Critically, universities constitute the strongest source of peer review that is essential to maintaining the quality of National Laboratory science.*

As critical as these partnerships are, the structural impacts caused by the pandemic and increasing financial pressures have become central concerns for many universities and will fundamentally impact future interactions between Universities and National Laboratories. University research and scientific infrastructure have been especially impacted by these pressures. These stresses have challenged the view that the University is a "lifeboat" able to rise to any problem or national priority. A new generation of strong partnerships between universities and National Laboratories could help to ensure that the "lifeboat" concept remains an apt metaphor in the future. The overarching focus of the Roundtable was about how to mobilize the best intellectual talent and create a productive working environment for the next generation of researchers that also benefits the National Laboratories.

7.1 Key Elements of the University-National Laboratory Partnership

There are many examples of successful partnerships and discussion highlighted the following three elements that should be addressed, not just in the creation of partnership structures but throughout the life of the partnership. Overall, these key elements, if properly addressed, will significantly improve the effectiveness of university-laboratory partnerships.

7.1.1 Mutual trust and understanding

Roundtable discussions highlighted the "trust gap" that impedes university researchers from seeing the National Laboratories as beneficial partners. This trust gap may only be addressed incrementally and with a growing level of interpersonal relationships, successful collaborations, and personnel exchanges. To build trust, promising areas of collaboration should first be explored through multiple, small pilot efforts rather than through larger institutional programs. The perceived "trust gap" may impede younger and mid-career faculty from fully engaging with the National Laboratories. This is partially based on their lack of understanding of the missions, the operating cultures, and the opportunities associated with the National Laboratories.

7.1.2 A common and clear understanding of which activities are best done by the Laboratory and which are best done by the university

Another key element of successful partnerships is a common and clear understanding of which activities are best done by the laboratory and which activities are best done by the university. For instance, universities are the major avenue for basic research, development of the STEM talent pipeline, and a source for world-class peer review. National Laboratories on the other hand carry out science at scale and mobilize scientific and engineering efforts to fulfill their mission and meet national priorities. The strengths of each of the partners, their respective missions, and their appropriate roles should be paramount in assigning workstreams.

7.1.3 Clear articulation of rules-of-the-road in structuring University-National Laboratory partnerships.

There should be a clear articulation of rules-of-the-road in structuring university-National Laboratory partnerships. Many of these are unclear, differ from laboratory to laboratory and from university to university, and interpretation can be fluid. For example, while no clear prohibition may exist for participation by foreign students and researchers, the process for approving such participation is often vague and daunting. It is understood that these interactions are complicated and will necessarily result in complicated governance structures, but every effort should be made to make complicated rules clear, easily understandable, and consistently applied.

Additional complications arise from the fact that university-National Laboratory relationships span a wide spectrum including universities that are management and operating (M&O) contractors, universities that are partners with specific laboratories, and universities that have no formal partnership status. These are distinctly different operating modes and come with unique sets of contractual arrangements, administrative requirements, and regulatory frameworks. Each laboratory and each university is different in its approach and transparent and clear guidelines would greatly assist the laboratories in efficiently engaging the broadest set of universities across all partnership modes. Moreover, broader networks of university partners serve to encourage university-to-university collaborations and could reduce unnecessary competition.

> ***Observation 7.1:*** *In order to forge better university-National Laboratory partnerships, it would be beneficial if universities would become a little more like National Laboratories, and National Laboratories would become a little more like universities. This suggests that National Laboratories nurture a stronger science culture for their science staffs, and that Universities place greater value on mission-oriented research, translational research, and technology transfer, and strong management practices as a part of their purpose.*

Some participants referred to the "extractive relationship" that now exists for many university-National Laboratory partnerships that seeks to maximize benefits for each participant rather than for the partnership itself. High level agreements and operating contracts in many cases have inflated expectations of benefits on both sides. A more productive approach might be to modify procedures that would make it easier to establish the kind of researcher-to-researcher personal connections that better serve the STEM talent pipeline needs of the laboratories and could grow into more substantial collaborations to address emerging national priorities. Having established relationships around clear guidelines allows the innovation ecosystem to react to rapidly changing national priorities.

There is widespread acknowledgment that joint appointments and joint mentoring for students are an extremely valuable component of a successful partnership. Although some laboratories have hundreds of such joint appointments, others have few and are restricted to local proximity institutions. As in other aspects of the partnership model, the forced dependence on remote work could open new opportunities for joint appointments beyond local proximity and clear guidelines should be established for this purpose. Participants acknowledged the need to simplify and clarify policies and procedures for establishing joint appointments in view of the constantly evolving programmatic priorities for National Laboratories versus the relatively static nature of academic departments.

Similar comments can be made about the value of jointly advised students and the opportunity to work shoulder-to-shoulder with laboratory scientists. This valuable avenue for strengthening partnerships will also be impacted by the pandemic, yet accommodations for remote work could create additional opportunities for universities and the Laboratories.

> ***Recommendation 7.1****: The key elements for successful partnerships should be practiced and demonstrated in multiple, small-scale pilot programs. Universities and labs should develop pilot programs to boost joint faculty appointments and joint PhD programs, graduate research programs, and undergraduate scientific and technical internships. These researcher-to-researcher collaborations will contribute to a sense of common mission, enable interdisciplinary teams to form more easily and provide testbeds for experimenting with streamlined administrative procedures. A critical component is the need for all parties to commit concrete resources to the programs. These programs should also be structured to improve diversity, equity, and inclusion in universities and laboratories.*

7.2 Access to Research Infrastructure and User Facilities

Remote and in-person access to research infrastructure has been a fundamental underpinning of scientific efforts for decades but pressures to improve access increased exponentially because of the COVID-19 pandemic. Though well underway before the onset of the pandemic, these efforts have become vastly more widespread and effective in the intervening months. Experience has shown that major improvements in remote access can be achieved with minimal additional investment using creative and innovative methods. The demand will persist even as the pandemic begins to ease and universities and National Laboratories will both benefit from continuing to press for greater access for more scientists.

More generally, as universities face continued costs related to aging infrastructure and other related overhead costs there will be increased pressure to enable remote access to infrastructure and data—not just between universities but with the National Laboratories as well. Over the past several decades, university infrastructure and research equipment were already under increasing stress. Universities have found it difficult to divest themselves of aging and obsolete equipment

and there has been a demand to constantly push the cutting edge in new facilities. Collaborative plans for enabling broader remote access will reduce pressures on all to retain outdated equipment and more efficient prioritization of resources.

One major impediment to this is the challenge of access to infrastructure and data security. To be maximally effective, data and infrastructure sharing programs need to come with minimal restrictions on sharing and publication. At the same time, universities need to understand and work within the security limitations that are a necessary part of National Laboratory operations. National Laboratories should look for robust methods to maintain the necessary security measures and at the same time optimize the exchange of information needed to sustain a robust research environment and mission capabilities.

> ***Observation 7.2:*** *Broader remote and in-person access to research infrastructure and data will benefit universities and National Laboratories. Major stresses have been brought about by the COVID-19 pandemic for both universities and National Laboratories. But these pressures also offer opportunities to re-think how the university science community can access and make the best use of these national investments, thereby improving its own research efforts and enabling the universities to grow the STEM talent pipeline so critical to the missions of the National Labs.*

These trends bring into focus the view that access to national facilities, a hallmark of the National Laboratories, is increasingly important for university researchers. Such access in the future must be able to accommodate remote users. Looking across the research enterprise, duplication, and an inability to field the needed cutting-edge facilities has led to inefficiencies. National Laboratories need to work together to optimize the shared suite of research facilities. The Roundtable discussion illustrated several models that would enhance access to a distributed network of research facilities and equipment. These could be based on regional or university specific partnerships. Such approaches would result in a strong presence of National Laboratory researchers in the community beyond the local environment.

Not only will distributed facilities and remote access be a necessity, but these trends are also likely to be much more aligned with the next generation of researchers. This has already proven to be the case for astronomy for which remote observing is now the preferred approach.

> ***Recommendation 7.2:*** *Universities and National Laboratories should work together to develop pathfinder programs to improve access to the most important instruments and data sources and to determine best practices that can be applied to develop a more distributed system of research nodes and access to research equipment and instrumentation.*

7.3 Workforce Development and Interdisciplinary teams

National Laboratories tend to work on broad initiatives, including Grand Challenges, that require collaborative teams with expertise in multiple disciplines. New research directions and technologies tend to emerge at the interfaces between disciplines. A good example is Artificial Intelligence (A.I.)- assisted co-design for electronics which is at the interface of multiple research areas including computer science, materials science, photonics, etc. National Laboratories are often in need of a STEM workforce that is trained and able to work at these interfaces.

Observation 7.3: *Education is a core function of the university complex and the STEM talent pipeline that flows from universities is critical to providing the necessary workforce to the National Laboratories. In turn, the National Laboratories can be a source of training in interdisciplinary research teams.*

Universities, working with the Labs, can develop programs that would provide this workforce: the essential components are shared programs for undergraduates, graduates, post-docs, and faculty that connect university partners with mission needs and research infrastructure at the Labs. This entails a strategic approach to workforce development beyond simple campus recruiting. Laboratories need to become more engaged in the development of training programs tailored to their needs. We are witnessing a global trend in which universities are changing their curriculums, implementing "work integrated learning" concepts, and methods that help students "learn by doing." Industry is taking advantage of this new paradigm and the National Laboratories are uniquely positioned to play a major role in the STEM workforce of the future. This goes beyond simple internship opportunities that, while important, do not constitute a long-term strategy for creating lasting relations. Rather the National Laboratories can take their research challenges to university partners and work with them to implement valuable solutions including the development of adapted curricula.

Joint appointments, jointly mentored students, teaming relationships and access to interdisciplinary research teams are all critical in strengthening the talent pipeline. Some laboratories recruit well nationally, some do not. There is a tendency to focus on existing or established university alliances rather than reaching out to the universities where specific, required expertise exists. A broader national effort to reach out beyond local universities enriches and diversifies the scientific quality of the laboratories.

University-National Laboratory partnerships tend to be essentially bi-lateral. Given the interdisciplinary nature of National Laboratory research programs and the uniqueness of some university research programs, there are significant opportunities for strategic inter-university partnerships that would support National Laboratories. Excellent examples exist of strategic inter-university alliances that add value to the participating partners. Such alliances could be specifically aligned to a grand challenge program, a "moonshot" initiative, or simply a research program at a National Laboratory. Specifically, for workforce development programs such an alliance could provide for shared coursework and tuition agreements.

The effects of the COVID-19 pandemic will continue to have a significant impact on the STEM talent pipeline in the way students are recruited and trained, and in the ways the National Laboratories engage with students. The potential exists for the loss of a generation of scientific talent from the hiring pause/freeze due to the pandemic and revenue shortfalls at universities. As reflected in this Roundtable and in other recent reports, pilot programs and other small-scale steps are important as a model for durable university-National Lab relationships as the pandemic begins to ease.

Universities and National Laboratories are also in competition with industry for top STEM talent and often find it difficult to compete with salaries and benefits that industry can offer. More robust connections to a rich and varied research infrastructure available at the National Laboratories is one possible way to mitigate industry's advantage in recruiting. Major M&O university contractors have a substantial advantage in recruiting top talent linked to their access to laboratory infrastructure and instruments and richer compensation. Nonetheless, universities with less formal relationships with the National Laboratories have immense stores of STEM

expertise that should be aggressively sought by National Labs. The relative deficit in U.S. students entering STEM fields as compared to other countries is also a significant and growing challenge. Remote student learning and other impacts on traditional academic training will only make this more important.

> ***Recommendation 7.3:*** *Joint development of interdisciplinary teams of STEM talent between universities and National Laboratories should be a high priority for both. National Laboratories should develop strategic approaches with their partner universities that engage students beyond the normal campus recruiting and enable distributed interdisciplinary teams to seamlessly work together.*

An important issue is the role that foreign students and faculty play for Universities vis-a-vis National Laboratories. Universities have generally embraced the intellectual capabilities of foreign students as part of the overall pursuit of academic excellence. University researchers seek international collaboration and close ties to foreign colleagues. Many National Laboratories, however, have had to restrict access by foreign nationals due to mission constraints and federal national security policies. Balancing the national security concerns with the benefits of enriching collaborative efforts by using the contributions of scientists and students from around the world poses a major challenge to forming cohesive university-National Laboratory partnerships. While the Roundtable did not propose any special remedies or recommendations, this issue deserves future consideration.

7.4 Innovation Clusters

Laboratories of the future will need to continue to look for innovative ways to access the type and quantity of interdisciplinary expertise—wherever it is found—to ensure they will be able to continue to carry out their missions. Just as challenges become ever more complicated and inherently interdisciplinary, the expertise required to address these challenges becomes ever more distributed. Bringing the right group of experts together to address the challenge of the day will require new modes of interaction between federal, state, academic, and industrial institutions.

The concept of creating innovation clusters[4] was raised multiple times during the Roundtable to address this need. Clusters may take on different forms; “co-located collaboration space”, a “district; a ‘hub”; a “GULP”; depending on how geographically distributed it is, though the overarching concept is the same: rather than bringing the problem to a National Laboratory, take the problem to a region where the expertise exists not only to perform the basic research but to develop the industry that will eventually add economic value to the region and the country. This concept requires partnerships among National Laboratories, universities, industry, and government (city, state, federal). Excellent examples of such clusters exist in the US (Research Triangle, NC; San Diego, CA; Boston, MA; Chicago, IL) and abroad (the Basque region, Spain; Hamburg, Germany) and have proved successful in providing substantial economic value to the region concerned. Hence a cluster may take on the minimal form of a jointly operated research center on a university campus or may expand to multiple institutions working together, co-located or not, on a specific research goal.

Although the notion of a cluster may be variable, it allows geographically distant universities to participate, either directly or remotely, to the benefit of all partners. It also enables multiple assets to be brought to bear on the “moonshot” or “grand challenge” initiatives that would

[4]Michael Porter, https://www.hbs.edu/faculty/Pages/item.aspx?num=47438

address key national priorities. A key component of a successful cluster will be the development of staffing models appropriately adapted to the cluster, ranging from simple joint appointments between National Laboratories and universities to implementation of fully staffed public-private partnerships.

The laboratories should strive to create new opportunities for broader university participation, remote collaborative groups, and communities of interest. Universities should look to form inter-university consortia that mobilize the strengths of the respective universities to address the multi-disciplinary challenges facing those labs while building the skillsets within their student and faculty that are also sorely needed by industry.

New models should extend the laboratory presence into new geographic areas based on economic principles i.e., the full set of capabilities available in a region, including universities, industry, workforce, and natural resources. The shared sense of mission and mutual investments will build trust among participants, foster new ideas, and incentivize participants to work for a common goal.

> ***Recommendation 7.4:*** *National Laboratories and universities should create distributed research nodes around common challenges and universities should enable interdisciplinary teams by forming inter-university consortia/alliances that bring together the complementary expertise that will be required. Partnerships between National Laboratories, universities, industry, and State institutions should be implemented to develop regional clusters of appropriate size to meet a defined grand challenge or "moonshot" initiative.*

7.5 Administrative Burdens and Contract Complexity

Participants agreed that the complexity of the administrative, contracting, and regulatory framework affects the ability of universities and National Labs to form effective and mutually beneficial partnerships. The administrative burdens affecting the M&O contractors and those affecting Universities are different in character, but both affect the state of health of the science and engineering environment.

Regarding the administrative burdens on M&O contractors, a great deal of attention has been paid to the expensive and sometimes counterproductive transactional oversight by NNSA and the Office of Science. The Congressional Advisory Panel on the Governance of the Nuclear Security Enterprise (the Augustine-Mies report) has documented numerous unnecessary micromanagement practices and has called for a continuous improvement process.

The tripartite relationship among the government, the university, and the laboratory was developed to allow the Lab to operate in a flexible way to maximize its science mission. However, these boundaries have moved in the direction of more administrative restrictions, more significant government oversight, and excessive reporting mandates.

One significant factor in the evolution of DOE Laboratory contracts has been the emergence of for-profit institutions as M&O contractors with attendant complexities regarding ownership of intellectual property. This issue will also affect the way future partnership models will work.

Less attention has been paid to the corresponding administrative burdens on universities, but they too are part of the overall challenge. Although the university community is generally aware of

the realistic need to embrace the complexity of the DOE system rather than advocate major changes, there nevertheless is a need to review, revise, and simplify rules and regulations—where possible—to achieve a mutually-beneficial outcomes.

> ***Observation 7.5:*** *Administrative requirements remain a significant impediment to effective university National Lab partnerships. Reducing administrative and regulatory burdens for the National Laboratories and universities has been a common issue over the past several decades, yet little progress seems to have been made. The complexity and administrative burden of contracts and use agreements continues to grow.*

For their part, government officials have recognized these issues, but it remains unclear where real regulatory and policy impediments exist as opposed to perceived impediments and false assumptions. In addition, there may be unexplored administrative and contractual tools that could be readily implemented. For example, DOD has implemented contracts under its "Other Transaction Authority" statute to streamline agreements for basic, applied, and advanced research projects. These would be ideally suited for many university contracts by DOE.

One major example of the impediments caused by overly complex contractual requirements is the way in which universities access National Laboratory facilities and equipment. The National Laboratories have powerful instrumentation and computing equipment but tapping into it has not been effective or streamlined for universities because of the difficulty in navigating contractual and administrative roadblocks.

> ***Recommendation 7.5:*** *The Department of Energy, in partnership with the leadership at the National Labs and universities, should develop and experiment with streamlined contracting models that facilitate more flexible partnerships between universities and National Laboratories and different ways to balance the risk exposure for both. Whenever possible, new contracting models should recognize the value of universities as critical intellectual partners rather than simply contractors with obligations for deliverables.*

7.6 Conclusion

The URA Roundtable on Effective University-National Laboratory Partnerships—A Look to the Future sought to identify actionable recommendations that would improve the way universities and National Laboratories collaborate to advance the interests of the Nation. In panel sessions and group discussions participants provided their views of the current pressures affecting universities, the effectiveness of current models of interaction between universities and National Laboratories, and ideas for new models that would improve outcomes for both parties.

It is clear from these discussions that the ever-evolving relationships between universities and National Laboratories remain a critical underpinning of the vitality of the research enterprise and the ability of the National Laboratories to continue to carry out their missions. Greater emphasis on piloting joint research and academic programs—faculty, graduate, and undergraduate; improved remote access to scientific data and infrastructure; and aggressive experiments to reduce administrative burdens will enhance collaborations and point the way to more effective future partnerships. Continued improvement is required to ensure that National Laboratories have robust access to the Nation's best and brightest scientists and engineers and that universities can take full advantage of the powerful scientific capabilities and research infrastructure resident within the National Laboratory system.

There is no “standard model” for university-National Laboratory partnerships that will guarantee success. The Roundtable discussions highlighted the diversity of models, experiences, and opportunities, some of the major successes cited in research partnerships, regional innovation ecosystems, and strong workforce development programs that deserve to be considered as policymakers and research managers look for new models to implement.

APPENDIX A

UNIVERSITIES RESEARCH ASSOCIATION
Roundtable on Effective University-National Laboratory Partnerships
A Look to the Future

Day One, October 14, 2020

11:00-11:15 1. Welcome and Setting the Scene – Marta Cehelsky, Executive Director, URA

11:15-11-30 2. Goals of the Roundtable – Betsy Cantwell, Chair

11:30-12:00 3. Panel 1: Current context for National Laboratory/University Partnerships; Existential Challenges to Academia (and how that might relate to National Labs)

- Emmanuel Giannelis, Cornell University
- Theresa Mayer, Purdue University
- Daniel Jaffe, University of Texas, Austin

12:00-12:30 4. Panel 2: Best Practices in National Laboratory/University Partnerships: The Good, the Bad, the Untried

- Research, student pipeline, and technology development from a University Standpoint
- What does the changing landscape for the University "business model" suggest for future models in these three areas?
- What has worked in the past, how can that be better implemented?
  - June Yu, University of California System
  - Stacey Patterson, University of Tennessee System
  - Juan de Pablo, University of Chicago

12:30-12:45 5. Break

12:45-1:45 6. Discussion - All participants

- What should be the goals of the National Lab/University system?
- What are the key elements of a successful partnership?
- What should be avoided?
- Gaps – what is not being done and should be?
- Real and perceived barriers to impactful partnerships.

1:45-2:00 7. Summary of Day 1 – Betsy Cantwell, Chair

All times are Eastern Daylight Time (EDT)

UNIVERSITIES RESEARCH ASSOCIATION
Roundtable on Effective University-National Laboratory Partnerships
A Look to the Future

Day Two, October 23, 2020

11:00-11:05 1. Welcome—Marta Cehelsky, Executive Director, URA

11:05-11:10 2. Overview of Day 1 Discussions—Betsy Cantwell, Chair

11:10-11:30 3. Setting the stage, OSTP perspective
Kelvin Droegemeier, Director,
White House Office of Science and Technology Policy

11:30-12:10 4. Panel 3: Reinventing the National Laboratory/University Partnership—Blue Sky aspirations, the ideal partnership

- Padma Raghavan, Vanderbilt University
- Laurie Locascio, University of Maryland
- Lora Weiss, Pennsylvania State University
- Richard Reeder, Stony Brook University

12:10-12:20 5. Break

12:20-1:15 6. Facilitated Discussion

- Extracted key points from Day 1
- Does the changing research and innovation landscape enable new partnership opportunities?
- What new elements should be considered?
- Other key partners

1:15-1:20 7. Break

1:20-1:40 8. DOE Perspective, Dr. Chris Fall, Director, DOE Office of Science

1:40-1:50 9. Summary of Roundtable Discussions – Betsy Cantwell, Chair

1:50-2:00 10. Concluding remarks– Marta Cehelsky, Executive Director, URA

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