Compete.
Council on Competitiveness

Technology Leadership & Strategy Initiative Winter Dialogue

Summary Report
Arizona State University
February 26, 2024

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Introduction

On February 26, 2024, the Council on Competitiveness convened its 29th Technology Leadership and Strategy Initiative (TLSI) Dialogue on the Arizona State University (ASU) campus. Nearly 30 leaders from technology companies, universities, government, and national laboratories gathered to explore the issues, challenges, and opportunities shaping the U.S. innovation ecosystem. Discussions were centered around two themes—developing the 2024 TLSI Call to Action and its recommendations, and expanding the conversation around how to build a more adaptive and agile industrial base to meet U.S. economic and national security needs for the 21st century.

TLSI Co-Chair Dr. Sally Morton, Executive Vice President, Knowledge Enterprise at ASU hosted her fellow Co-Chairs—Dr. Steven Walker, Vice President and Chief Technology Officer at Lockheed Martin, and the Honorable Patricia Falcone, Deputy Director of Science and Technology at Lawrence Livermore National Laboratory—and TLSI members and special guests.

Council President and CEO Deborah L. Wince-Smith welcomed the assembled participants, thanked Dr. Morton and ASU for hosting the TLSI dialogue, and introduced Dr. Morton for opening remarks which included thanking the ASU Knowledge Enterprise team and colleagues who helped prepare for and joined the gathering.

Overview of Technology Leadership and Strategy Initiative (TLSI) and Current Agenda

Historically, TLSI has operated as an internal think tank that informs other initiatives at the Council on Competitiveness. The nature of TLSI is one of progressivity. So while people come and go within the TLSI community, the conversation flow has evolved over 15 years.

Over the past 15 months, the TLSI community has developed a series of potential recommendations that could be formative and foundational for a Call to Action, a statement from this distinctive community, bridging multiple sectors, to inform the Nation about where it ought to be thinking about investing in talent, technology, and infrastructure to drive long term innovation, productivity, and prosperity. Part of the goal of the 29th TLSI dialogue, and guided by a conversation with the TLSI Co-Chairs, was to review a set of draft recommendations or aspirations that could be translated into action by policy makers in Washington, DC or local communities. This could include development of a powerful, compact set of recommendations, a Call to Action from the TLSI community to disseminate to the campaigns that could impact policy makers in a distinctive year in the U.S. political context, Presidential election, and changes in Congress.

Dr. Thomas Gardner, Chief Technology Officer, HP Federal; Mr. Jon McIntyre, Distinguished Fellow, Council on Competitiveness; Dr. Deborah Crawford, Vice Chancellor of Research, Innovation, & Economic Development, University of Tennessee, Knoxville; Dr. Walt Copan, Vice President, Research & Technology Transfer, Colorado School of Mines; Dr. Kim Holloway, Vice Provost, Research Development, Northeastern University; Dr. Andre Marshall, Vice President of Research, Innovation & Economic Impact, George Mason University; Dr. Sean Dudley, Associate Vice President, ASU Knowledge Enterprise, Arizona State University; The Hon. Deborah L. Wince-Smith, President & CEO, Council on Competitiveness; Dr. Steven Walker, Vice President & Chief Technology Officer, Lockheed Martin; Dr. Sally C. Morton, Executive Vice President, Knowledge Enterprise, Arizona State University; Mr. Brian Bone, Principal Director, Commercial Space Futures, The Aerospace Corporation; The Hon. Patricia Falcone, Deputy Director for Science & Technology, Lawrence Livermore National Laboratory; Mr. Mike Nelson, Vice President, Council on Competitiveness; Dr. VR Basker, Senior Vice President, R&D, PepsiCo; Dr. Erin Searcy, Acting Deputy Laboratory Director, Science & Technology, & Chief Research Officer, Idaho National Laboratory; Dr. Peter Dorhout, Vice President, Research, Iowa State University; Mr. Chad Evans, Executive Vice President, Council on Competitiveness; Ms. Jaclyn Shaw, Senior Associate Vice Provost, Research Strategy & Operations, Tufts University; Mr. Daniel Moczydlower, President & CEO, Embraer-X; Dr. Brad Orr, Associate Vice President, Natural Sciences & Engineering, University of Michigan; Mr. Kevin McGinnis, Managing Director of Strategic Technology Initiatives, Office of University Affairs, Arizona State University; Grace O'Sullivan, Vice President, ASU Knowledge Enterprise, & Vice President, Corporate Engagement & Strategic Partnerships; Ms. Margaret Donoghue, Country Head-US, CSIRO; Mr. Tom Mildenhall, Managing Director, Global Head of Technology Business Development & Venture Capital Coverage, Bank of America

Agenda

MORNING

8:00 Registration—Continental Breakfast

8:30 Welcoming Remarks and an Introduction to the Innovative World of ASU and the Knowledge Enterprise

The Hon. Deborah L. Wince-Smith
President & CEO, Council on Competitiveness

Dr. Sally Morton
Executive Vice President—Knowledge Enterprise, Arizona State University; TLSI Co-Chair

9:00 A Focus on the 2024 TLSI Call to Action

This session will review key opportunities and recommendations included in the DRAFT TLSI 2024 Call to Action, which was informed by the two 2023 TLSI Dialogues and is intended to guide the Council's 2024 policy statement that will be delivered to Congress and the administration in the fall. (The draft was shared with all TLSI members in advance of the Dialogue.)

The 2023 Dialogues focused on two critical national imperatives: (1) Building a New Agile and Adaptive Defense Industrial Base for the 21st Century, and (2) Reshaping the U.S. Innovation Ecosystem for an Era of Rapid Technological Change.

From these imperatives, eight overarching themes and 17 high-level recommendations emerged. The first three sessions of the day will assess the Call to Action and identify opportunities to enhance these recommendations for guiding U.S. technology policy.

Kick-off Discussants

Dr. Sally Morton
Executive Vice President—Knowledge Enterprise, Arizona State University; TLSI Co-Chair

The Hon. Patricia Falcone
Deputy Director of Science & Technology, Lawrence Livermore National Laboratory; TLSI Co-Chair

Dr. Steve Walker
Vice President and Chief Technology Officer, Lockheed Martin; TLSI Co-Chair

Mr. Chad Evans
Executive Vice President, Council on Competitiveness

9:15 Session 1: Review Draft Call to Action Recommendations—Building a New Agile and Adaptive Defense Industrial Base for the 21st Century

In this session, we will examine the key themes and supporting recommendations focused on modernizing the defense industrial base. See either the draft call to action—or, more directly, the addendum to this agenda—for key themes and recommendations.

Discussion Questions—Reviewing and Revising Recommendations for Modernizing the Defense Industrial Base:

1. As it relates to building an agile and adaptive defense industrial base, where might the United States' defense be vulnerable beyond those key theme/priorities identified in the Draft Call to Action? And what steps should the United States take to overcome them?
2. There are many detailed recommendations in the Draft Call to Action. Are there any you take issue with, find confusing, or could be strengthened?
3. Are there missing recommendations from the Draft Call to Action?
4. Beyond brief mentions, the Draft Call to Action does not emphasize specific technologies (e.g., AI) nor competitors (e.g., China). Would it be strengthened if it did?
5. Are there one or two priorities that should be elevated as most critical? Conversely, are there any listed that, while important, may draw attention away from the most critical recommendations and should be removed?

Kick-off Discussant & Roundtable Moderator

Dr. Steve Walker
Vice President and Chief Technology Officer, Lockheed Martin; TLSI Co-Chair

10:00 Coffee Break

10:30 Session 2: Review Draft Call to Action Recommendations—Reshaping the U.S. Innovation Ecosystem for an Era of Rapid Technological Change

In this session, we will examine key themes and supporting recommendations for modernizing the U.S. innovation ecosystem. See either the draft call to action—or, more directly, the addendum to this agenda—for key themes and recommendations.

Discussion Questions—Reviewing and Revising Recommendations for Modernizing the U.S. Innovation Ecosystem

1. As it relates to reshaping the U.S. innovation ecosystem for an era of rapid technological change, does the Draft Call to Action identify the right three key themes/priorities?
2. Are there industries or technologies that are in particular need of STEM talent?
3. Universities, businesses, government, and labor all have critical role sin upskilling and building a modern workforce? How can we foster greater collaboration and partnerships across these stakeholders to address the need?
4. How do we manage the need for international talent with the greater security risk it creates?
5. What is the role of AI in filling the talent gap? And what are the benefits and risks of AI doing so?
6. There are many detailed recommendations in the Draft Call to Action. Are there any you take issue with, find confusing, or could be strengthened?
7. Are there one or two priorities that should be elevated as most critical? Conversely, are there any listed that, while important, may draw attention away from the most critical recommendations and should be removed?

Kick-off Discussant & Roundtable Moderator

The Hon. Patricia Falcone
Deputy Director of Science & Technology, Lawrence Livermore National Laboratory; TLSI Co-Chair

11:15 Session 3: TLSI Call to Action Opportunities

In this session, we will have a more expansive conversation around the final deliverable of the Call to Action. We will consider if there are any major national priorities, themes, or recommendations missing, as well as discuss how the Call to Action should be positioned, packaged, and distributed once finalized.

Discussion Questions—Revising TLSI Call to Action and How to Promote It:

1. We all have ideas for why this Call to Action is needed—the rise of a powerful competitor that doesn't hold the same democratic values of the United States, existential challenges such as climate change and hunger, the incredible transformations resulting from advanced computing and bioscience, etc. But what is the right context to present these findings to ensure policy makers use them.
2. What are our global competitors doing today that put them at a strategic technological advantage over the United States? Are there missing recommendations to the Call to Action that might put the U.S. on more competitive footing?
3. How is the United States hindering its own progress in technology and innovation? What can be done to adapt and improve the situation?
4. What are the United States' greatest strengths in technology and innovation? How do we further exploit them?
5. What are our greatest weaknesses? How do we overcome them?
6. How does the United States maintain its global leadership as the technology standard bearer? What role does ethics play, and how do we get the world to adhere to a core set of rules?
7. In what form should the Call to Action be communicated?

Kick-off Discussant & Roundtable Moderator

The Hon. Deborah L. Wince-Smith
President & CEO, Council on Competitiveness

11:45 Session 4: Developing an Adaptive and Agile Industrial Base to Meet U.S. Economic, National Security, Energy, and Sustainability Needs

A Conversation about the Southwest Advanced Prototyping (SWAP) Hub

Arizona State University leads one of the eight CHIPS Plus Science Act-enabled and Department of Defense-funded hubs in the national Microelectronics Commons. The Southwest Advanced Prototyping (SWAP) Hub received a $39.8 million in its first year to create a regional network for microelectronics education, research, and development in the Southwest. SWAP is working to deliver rapidly flexible, scalable, and low-cost microelectronics prototyping capabilities. It unites over 150 semiconductor and defense companies, academia, and national laboratories from Arizona, Colorado, New Mexico, and across the nation to share lab-to-fab capabilities, and deliver prototype projects tailored to Department of Defense needs in AI Hardware, 5G/6G Technologies, and Commercial Leap Ahead.

Discussion Questions

1. What are the benefits of bringing together semiconductor and defense companies, academia, and national laboratories in the SWAP Hub?
2. How is ASU managing the complexity of the over 150 partners to meet the goals of the CHIPS & Science Act and enable the lab-to-fab transition of microelectronics innovations in the United States?
3. What type of organizations have thrived as partners, and which have struggled, if any?
4. SWAP Hub funding was a fraction of the $238 million total in CHIPS Act funding for eight microelectronic commons across the country. How does the SWAP Hub coordinate, collaborate, and/or compete with the other seven microelectronic commons to spur innovation and cater to the specific needs of the Department of Defense?
5. How does the SWAP Hub relate to other microelectronics efforts, including workforce development, at ASU?

6. How could the Hub model be applied for the advancement of other technologies and industries, particularly for the Department of Defense?

Kick-off Discussants & Roundtable Moderator:

Dr. Sally Morton
Executive Vice President—Knowledge Enterprise, Arizona State University; TLSI Co-Chair

Mr. Kevin McGinnis
Managing Director, Strategic Technology Initiatives, Office of University Affairs, Arizona State University

Dr. Zachary Holman
Professor, School of Electrical, Computer and Energy Engineering; Vice Dean for Research and Innovation, Fulton Schools of Engineering; Senior Global Futures Scientist, Global Futures Scientists and Scholars; Vice Dean (ACD) and Professor, Affiliated Staff and Faculty, Arizona State University

AFTERNOON

12:15 Keynote over Lunch

The Honorable Barbara McQuiston
Board Chair, NATO DIANA (Defence Innovation Accelerator for the North Atlantic), and Director of Defense for Research and Engineering, for Research and Technology U.S. Department of Defense

1:00 Group Photo

Waterfall by Fulton Center

1:10 Walk to Dreamscape Learn Experience

1:30 Dreamscape Learn Experience

About Dreamscape Learn: A collaborative venture between Dreamscape Immersive and Arizona State University, merging the most advanced pedagogy with the entertainment industry's best emotional storytelling. Dreamscape Learn redefines teaching and learning in the 21st century, while aiming to eliminate student learning gaps

2:30 Walk to World's First Compact X-ray Free Electron Laser (CXFEL)

3:00 CXFEL Tour

About CXFEL: The compact X-ray free electron laser (CXFEL) being developed at Arizona State University will be the first of its kind in the world. It will provide X-ray pulses so short that they outrun all X-ray damage processes. As a result, scientists can conduct novel science to explore the structure and dynamics of nature and materials as never before.

3:30 Golf Cart to Fulton Center

3:45 Summary Remarks/Reflections—Next Steps for TLSI in 2024

The Hon. Patricia Falcone
Deputy Director of Science & Technology, Lawrence Livermore National Laboratory; TLSI Co-Chair

Dr. Sally Morton
Executive Vice President—Knowledge Enterprise, Arizona State University; TLSI Co-Chair

Dr. Steve Walker
Vice President and Chief Technology Officer, Lockheed Martin; TLSI Co-Chair

The Hon. Deborah L. Wince-Smith
President & CEO, Council on Competitiveness

Mr. Chad Evans
Executive Vice President, Council on Competitiveness

4:00 Dialogue Adjourns

Participants

TLSI CO-CHAIRS & COUNCIL LEADERSHIP

The Hon. Patricia Falcone
Deputy Director for Science & Technology
Lawrence Livermore National Laboratory

Dr. Sally C. Morton
Executive Vice President, Knowledge Enterprise
Arizona State University

Dr. Steven Walker
Vice President &
Chief Technology Officer
Lockheed Martin

The Hon. Deborah L. Wince-Smith
President & CEO
Council on Competitiveness

Mr. Chad Evans
Executive Vice President
Council on Competitiveness

GUEST SPEAKER

The Hon. Barbara McQuiston
Board Chair
NATO DIANA & Director of Defense for Research & Engineering, for Research & Technology
U.S. Department of Defense

PARTICIPANTS

Dr. VR Basker
R&D Senior Vice President
PepsiCo

Mr. Brian Bone
Principal Director
Commercial Space Futures
The Aerospace Corporation

Dr. Walt Copan
Vice President,
Research & Technology Transfer
Colorado School of Mines

Dr. Deborah Crawford
Vice Chancellor
Research, Innovation, & Economic Development
University of Tennessee—Knoxville

Ms. Margaret Donoghue
Country Head-US
CSIRO

Dr. Peter Dorhout
Vice President, Research
Iowa State University

Mr. Sean Dudley
Associate Vice President, ASU Knowledge Enterprise
Arizona State University

Dr. Thomas Gardner
Chief Technology Officer
HP Federal

Dr. Kim Holloway
Vice Provost
Research Development
Northeastern University

Dr. Zachary Holman
Professor, School of Electrical, Computer and Energy Engineering; Vice Dean for Research and Innovation, Fulton Schools of Engineering; Senior Global Futures Scientist, Global Futures Scientists and Scholars; Vice Dean (ACD) and Professor, Affiliated Staff and Faculty
Arizona State University

Dr. Matt Hulver
Vice President of Research & Professor
ASU Knowledge Enterprise, &
Vice President & Professor
College of Health Solutions
Arizona State University

Ms. Adriana Kuiper
Associate Vice President & COO, ASU Knowledge Enterprise
Arizona State University

Dr. Andre Marshall
Vice President
Research, Innovation & Economic Impact
George Mason University

Mr. Kevin McGinnis
Managing Director
Strategic Technology Initiatives
Office of University Affairs
Arizona State University

Mr. Jon McIntyre
Distinguished Fellow
Council on Competitiveness

Mr. Tom Mildenhall
Managing Director—Global Head of Technology
Business Development & Venture Capital Coverage
Bank of America

Mr. Daniel Moczydlower
President & CEO, Embraer-X
Head of Global Innovation Ecosystems
Embraer-X

Mr. Mike Nelson
Vice President
Council on Competitiveness

Dr. Brad Orr
Associate Vice President
Natural Sciences & Engineering
University of Michigan

Ms. Grace O'Sullivan
Vice President, Corporate Engagement & Strategic Partnerships
Arizona State University

Dr. Jeff Rhoads
Vice President
Research
Notre Dame University

Dr. Erin Searcy
Acting Deputy Laboratory Director
Science & Technology, &
Chief Research Officer
Idaho National Laboratory

Ms. Jaclyn Shaw
Senior Associate Vice Provost
Research Strategy & Operations
Tufts University

Key Takeaways

"Building a New Agile and Adaptive Defense Industrial Base for the 21st Century

- **Building a new agile and adaptive defense industrial base for the 21st century is a national imperative.** While the United States has fantastic innovation, U.S. adversaries are doing just as good a job—if not better—in translating innovation into defense capabilities. Being unable to turn innovation into capability fast enough is a strategic threat to U.S. national security.
- **Due to the lack of continuity of personnel in Department of Defense (DoD) laboratories**, project champions are lost midstream, slowing momentum in the defense innovation process.
- **DoD programs aimed at engaging small innovative businesses are limited in the number they can support,** leading to the death of small businesses and start-ups with promising defense and dual-use technologies, constricting the provider base for key military technologies.
- **Research security is a significant challenge in the United States, including: the low availability of secure facilities for interactions between universities, companies, and government agencies like the DoD; getting and maintaining security clearances; and maintaining the security of defense-related research projects at universities.** Perceived as neutral grounds, universities could be a place to establish secure facilities for multiple users. Larger firms could help small businesses and start-ups fund secure facilities, and provide legal advice and other support needed to transition a nascent technology or innovation into the marketplace. Also, more training in research security is needed, including among small businesses and start-ups engaging with DoD, and among researchers and students at universities.
- **NATO is implementing new initiatives to advance technology, better leverage the technology capabilities of small businesses in the NATO countries, and speed the fielding of new technologies that enhance defense capabilities.** This includes support for technology development, test, and demonstration, and evolving a financing ecosystem for patient capital, driving out risk averse capital.

Reshaping the U.S. Innovation Ecosystem for an Era of Rapid Technological Change

- **Universities with large numbers of foreign national students face pressure from the federal government to have only U.S. citizens working on federally-supported, especially defense-related, projects.** Some defense contractors do not want certain nationalities to work on projects either. University rules and policies on inclusion may be in conflict with these federal requirements or defense contractor desires. However, as the rest of the world raises its science and technology capabilities, the United States is not going to own every technological leading edge. Funding and thought leadership on these issues is needed.
- **As the competitiveness conversation expands to economic security**—and U.S. taxpayers expect to benefit from their investments in R&D—universities are challenged to balance open basic and applied research, and the demands that economic benefits, companies, and jobs arising from publicly-funded research accrue to Americans.
- **There is concern about research security in private companies,** as the flow of international venture capital increases, for example, from the Middle East.
- **With greater engagement between universities and companies,** there needs to be greater awareness and, perhaps training, on intellectual property management on both sides.
- **The role of many universities in innovation ecosystems has evolved**. There is a greater awareness and expectation that universities are key actors in research translation and commercialization. They are leading the organization and development of new technology initiatives such as tech hubs. And they are playing a role as a convener of industry, government, academia, and others in regional innovation-related initiatives. Some universities have changed their promotion and tenure guidelines to make them more inclusive of innovation and entrepreneurship.
- **In the past few years, a lot of federal funding has gone to industry.** That has created situations where some publicly-funded research is not shared with others because it goes into proprietary space. Federal funders could do a better job of compartmentalizing what is intellectual property that needs to be protected versus what is intended to be a public good.
- **The National Science Foundation's Industry-University Cooperative Research Centers appear to be a good model to move fields forward for the public good and raise all boats in an industry.** The program provides a structure for academic researchers to conduct fundamental, pre-competitive research of shared interest to industry and government.
- **To encourage commercialization of inventions and research developed with federal funding, the Bayh-Dole Act enables contractors to retain exclusive rights to patents arising from their performance of that research or invention development.** The Biden Administration proposes to assert federal "march-in rights" under the Bayh-Dole Act as a price control mechanism, for example for drugs, by granting licenses to other parties. This action could cause imminent collateral damage to U.S. innovation by putting the intellectual property protection needed for private investment at risk.
- **A skilled technical workforce, and the technical and community colleges that develop these workers, play a crucial role in the innovation ecosystem.** And these institutions are a huge source of domestic talent. While we still need traditional skilled trades, we now need people with new kinds of

technical skills, for example, to do 3D printing, run autonomous vehicles, operate biomanufacturing facilities, and work with hydrogen.

- **The general public does not consider what the United States is facing in the global competitive landscape as a crisis.** The Council may need to make a public-facing case. In addition, the Council/TLSI should consider acknowledging the disruptive force of artificial intelligence/machine learning, both positive aspects and dangers, especially to the workforce.
- **Regulatory reforms are needed.** Regulations should have an expiration date, and obsolete regulations should be eliminated. Sherpas are needed to help small companies navigate the regulatory system. Also, the United States may wish to consider assessing potential regulatory impacts at the conclusion of key research and technology development projects.
- **A plethora of hubs and engines and other partnerships are emerging and being funded across the country**—for example, eight DoD Microelectronics Commons hubs. But looking at just this one example, we see there is no mechanism in place to encourage/make them work together, to make them cohesive. As these and other hub programs manifest across the country—funded by different agencies and departments—the nation needs to figure out how these connect together, how to best leverage them to get the most innovation, and how to transition their innovations into production.

Overview of Arizona State University Technology and Innovation Initiatives

TLSI Co-Chair Dr. Sally Morton, Executive Vice President, Knowledge Enterprise at Arizona State Uni-versity noted ASU was named the most innovative university in the country for the ninth year running, and discussed ASU's three-enterprise organizational structure. The Academic Enterprise includes the faculty, students, and educational programming involving bachelor's, master's, and Ph.D. programs. The Learning Enterprise involves programming outside those three degrees including K-gray learning and workforce development.

ASU Knowledge Enterprise. The Knowledge Enterprise is responsible for the research and economic development ecosystem of the university. There are five major areas of focus in research at ASU—advanced technology, health, space, national security, and sustainability. Knowledge Enterprise oversees 12 research institutes and initiatives, including the Biodesign Institute, home to the compact X-ray free electron laser which TLSI dialogue participants visited later in the day, as well as institutes in areas such as humanities, social sciences, interplanetary initiatives, health, entrepreneurship, environmental sustainability, and national security.

Knowledge Enterprise also provides services, the type typically done in an office of a vice president for research—research opportunity identification, proposal development, pre- and post-award research compliance and security, core research facilities, high performance computing, animal care, etc. In addition,

Arizona State University

- 177,000 students
- Roughly half on Tempe campus and half on-line
- Students from 50 states and 157 nations
- Largest engineering school in the United States with 32,000 students
- Ranked 1st in the United States and 2nd in the world for global impact
- Ranked 7th for U.S. utility patents and 9th in the world
- Ranked 1st in the United States for transdisciplinary research
- 4 campuses (Phoenix (2), Mesa, Tempe), 4 other Arizona locations
- 7 research parks
- TSMC semiconductor fab in area
- Doubled research expenditure in last ten years; $906 million in FY 2023

Knowledge Enterprise runs Corporate Engagement and Strategic Partnerships, international development, and intellectual property and technology transfer.

Large ASU Initiatives. ASU has several larger research, technology development, and innovation initiatives underway:

- **Arizona Water Innovation.** With about $40 million in funding from the State, this initiative is focused on technology governance policy around water in the region and the Southwest. It is looking at technology for water reclamation and minimization of water use and semiconductor manufacturing.
- **EPIXC.** The U.S. Department of Energy selected ASU to lead its seventh Clean Energy Manufacturing Innovation Institute—Electrified Processes for Industry Without Carbon or EPIXC. It is a coalition of private companies, national laboratories, universities, labor unions, and community partners aiming to develop and scale innovative electric heating concepts for reducing greenhouse gas emissions from industrial processes such as in the making of cement and steel.
- **Southwest Regional Direct Air Capture Hub.** With $11.6 million in matching funds from the U.S. Department of Energy, ASU will develop the hub in partnership with a range of companies, non-profits, and universities to catalyze a carbon capture industry in the region, and support a renewable energy boom in an area that has aging coal plants scheduled to be retired, and needs an industrial base that can support workers and generate tax revenue as the area transitions away from fossil energy.
- **Southwest Sustainability Innovation Engine.** With an initial $15 million grant from the National Science Foundation, ASU will lead the regional Southwest Sustainability Innovation Engine to advance U.S. innovation capacity in three interrelated areas of sustainability: water security, renewable energy, and net carbon emissions. The regional engine includes Utah, Nevada, and Arizona, which are vulnerable due to extreme aridity and heat coupled with rapid population growth. Partners include: core academic and research institutions, industry partners, philanthropic and non-profit organizations, and local governments.
- **HyPT.** Supported by a $5 million grant from the National Science Foundation, ASU will lead a Global Hydrogen Production Technologies Center with U.S. partner institutions—the University of Michigan, Stanford University, and Navajo

"The ASU charter is very inspirational. We are defined by whom we include, not whom we exclude and their success…So we always think at Knowledge Enterprise, how are we serving the charter? And I think we are trying to produce a thriving people, a thriving planet, and a thriving society. So we think of those three pillars underneath the work we are doing. And our job is to assist faculty, students, and staff to be as productive as possible in their research and discovery."

Dr. Sally Morton
Executive Vice President, Knowledge Enterprise
Arizona State University

ASU advancing semiconductor research.

Technical University. The Center will engage in a quadrilateral research partnership with Australia, Canada, and the U.K. on advancing green hydrogen for renewable energy generation.

ASU Health. ASU is launching a medical school and a school of public health technology. But beyond creating a medical school, ASU seeks to promote and improve the health of all Arizonans, for example, through community clinics. It is setting up a health observatory for the collection of data at all levels across the state to understand what is happening.

ASU, Microelectronics, and National Security. More than 200 ASU faculty work on Department of Defense-funded projects. National security projects in ASU's research portfolio have grown significantly over the last six years, and ASU expects to conduct $55 million in national security research in 2024. One very important project is the Southwest Advanced Prototyping Hub or SWAP Hub—one of the eight hubs funded by the U.S. Department of Defense for its Microelectronics Commons.

TSMC has a fab in Phoenix, Intel is building two fabs in the area, and there are semiconductor and microelectronics-related start ups and companies across the Phoenix Valley. They are locating in the area because there was an existing footprint, for example, high-tech clean space that was once a Motorola plant and purchased by ASU; available land; backing from the state; and a workforce. Early on, there was enlightened leadership from leaders of the state, such as Governor Janet Napolitano and Intel's former CEO (and Member of the Council on Competitiveness) Craig Barrett, a very powerful government-industry partnership.

With the recent CHIPS Act investment, there is a focus on including the R&D enterprise with ASU playing a key role because, traditionally, the area has

been a microelectronics manufacturing hub, but not necessarily a microelectronics R&D hub. Phoenix does not want to be a factory town only, they want to be a place for lab-to-fab transition.

Today, ASU has a $270 million partnership with Applied Materials. It is building a co-lab at the MacroTechnology Works, and just signed an agreement with NXP for their gallium nitride work also at the Macro Technology Works. ASU is bringing together industry partners in a way that will allow start-ups to have access to capabilities that, otherwise, would be a barrier for them because the equipment is so expensive. In every aspect of the research, ASU students are involved.

ASU Dreamscape Learn. Rather than going into a biology lab, students use virtual reality to conduct their lab. The outcomes are much better; it is thought that there is an emotional connection that allows them to better retain the information. ASU is trying to understand how it can help all students learn and overcome barriers to learning in subjects such as biology and mathematics that keeps them out of the STEM fields.

ASU CXFEL. Supported with $90 million from the National Science Foundation, ASU is building a first-in-the-world compact X-ray free electron laser. While the Stanford Linear Accelerator (SLAC) structure is about two miles long, the CXFEL will be radically reduced in size, and fit nearly into a traditional lab space. It will allow researchers to do real time movies of molecules in action and democratize this equipment. It is hoped that this will be a prototype enabling other institutions to build similar CXFELs, so researchers will have more access immediately and not have to wait for two years to get time at SLAC.

"I think because of ASU's size and the fact we work with community partners and industry partners, we have managed to take a lead on several of these large efforts because we are able to convene and bring together these partners in a productive way."

Dr. Sally Morton
Executive Vice President, Knowledge Enterprise
Arizona State University

ASU's Dreamscape Learn: a collaborative venture between Dreamscape Immersive and Arizona State University, merging the most advanced pedagogy with the entertainment industry's best emotional storytelling.

A Focus on the 2024 TLSI Call to Action

Kick-off Discussants

Dr. Sally Morton
Executive Vice President–Knowledge Enterprise
Arizona State University

TLSI Co-Chair

The Honorable Patricia Falcone
Deputy Director of Science & Technology
Lawrence Livermore National Laboratory

TLSI Co-Chair

Dr. Steve Walker
Vice President and Chief Technology Officer
Lockheed Martin

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Mr. Chad Evans
Executive Vice President
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TLSI participants reviewed key opportunities and recommendations included in the draft TLSI 2024 Call to Action, which was informed by two 2023 TLSI Dialogues and intended to guide the Council on Competitiveness 2024 policy statement to be delivered to Congress and the Administration in the fall.

The 2023 Dialogues focused on two critical national imperatives: (1) Building a New Agile and Adaptive Defense Industrial Base for the 21st Century, and (2) Reshaping the U.S. Innovation Ecosystem for an Era of Rapid Technological Change. From these imperatives, eight overarching themes and 17 high-level recommendations emerged.

SESSION 1

Review of Draft Call to Action Recommendations—Building a New Agile and Adaptive Defense Industrial Base for the 21st Century

Kick-off Discussant and Roundtable Moderator

Dr. Steve Walker
Vice President and Chief Technology Officer Lockheed Martin
TLSI Co-Chair

TLSI participants examined key themes and supporting recommendations focused on modernizing the defense industrial base. Dr. Walker explained that one of the impetuses for starting a conversation in 2023 on a new defense industrial base was a strategy put in place at Lockheed Martin called 21st Century Security. That strategy has three pillars—innovate with urgency, digitize, and partner.

Innovate with urgency is about the technologies Lockheed needs to pay attention to. Four years ago, Lockheed established a kind of one-stop-shop to feed out technologies to the business areas. Underpinning digitize and partner was the realization that a lot of that technology, such as machine learning, is not led by the defense industrial base. Rather it is being led by others in the commercial sector and by ideas germinating in the university community. So, Lockheed seeks to partner with the commercial sector and universities to bring their technologies and ideas into the defense sector and procure them for the warfighter.

National imperative to build a new agile and adaptive defense industrial base for the 21st century. Bureaucratic rigidity in the defense industrial base and the DoD has led to delayed uptake of many new technologies. We have fantastic innovation in this country, but the issue is turning that innovation into capability that U.S. warfighters and allied forces can use. In this regard, U.S. adversaries are doing as a good a job—if not better—than we are. Being unable to turn innovation into capability fast enough is a strategic threat to U.S. national security.

We need to ensure knowledge and technology transfer from the commercial sector and universities to DoD is as frictionless as possible. That requires addressing some cultural and operational barriers. Over the past ten years, DoD has tried to make it easier for small companies and others to work with the Department. The services and the Office of the Secretary of Defense have created about 80 new organizations for small companies and venture capitalists to interact with DoD and figure out what the needs are. However, this may not be working as well as hoped.

How do we overcome some of these separations, boundaries, and barriers and create a more competitive, innovative, and integrated innovation ecosystem? An acquisition reform mandate is not going to get the job done. It is going to require DoD, the defense industry, the commercial sector, and the university sector to come together and figure out this challenge.

Points of Discussion

Lack of continuity of personnel at Department of Defense laboratories. Projects often seem to be on a good transition path, but then there is a critical loss of personnel as the project is trying to bridge the valley of death. Once that champion or champions are lost, it does not matter what is happening on the corporate side.

For example, there is significant turnover now at Edwards Air Force Base and the Air Force Research Laboratory which is hindering work on solid rocket motors. Due to their geographic locations, these are not places where many people want to work. DoD is putting significant resources toward improving commuting experiences out of Palmdale and other places. But companies are paying workers a lot closer to Palmdale, reducing the need or incentive to drive to Edwards AFB, another hour into the desert. That is leading to a brain drain at a critical place, impacting what is happening in Ukraine and other places around the world.

Historically, defense laboratory consistency and continuity—where managers, leaders, experts have stayed for 20-30 year careers – has been critical to the overall DoD innovation ecosystem, as DARPA program managers change relatively more frequently. But, as an example of the challenge, a dialogue participant reported on having a contract to produce solid rocket motor manufacturing technology. It is a 24-month contract, but they are on their fourth technical point of contact due to attrition at the Air Force Research Laboratory.

DoD programs aimed at engaging small innovative businesses can leave them short of needed resources—precipitating their early demise. For example, the Air Force STRATFI program has worked very well in selectively taking a company and elevating it. But, as a result of a matching funds requirement on the companies, VCs, and inside DoD, there may be only one small business in an tech area that receives all the money and resources, when, in fact, many small business innovators might be needed to create a robust, sustainable ecosystem. Rather, six or seven firms often perish in ushc situations. That is a problem in fields like solid rocket motors, where there are only two or three legitimate capabilities in the United States because we are not moving a cohort of businesses along. We are only moving one in a significant way.

In a similar historical example, in the early days of parallel super computers, a range of companies initially occupied and thrived in that ecosystem. But, once the government put resources into Thinking Machines and secured a first machine at Los Alamos National Laboratory, all the money dried up for all the other companies. They went out of business, and we did not have all those multiple paths moving forward. It seems there is a need to maintain a competitive ecosystem.

Another more timely example: Space Force is struggling to integrate commercial technologies into its programs—to leverage tools already in the toolbox, and move things forward in the acquisition process. Space Force is trying to fill that gap with SPACEWERX, which is the space arm of the Air Force's AFWERX. SPACEWERX is trying to carry a cohort of small businesses further through that process with its Technology Readiness Level (TRL) Bootcamp. Together as a group, four or five companies that graduate from an SBIR Phase 2 project are offered access to SPACEWERX laboratories and technical expertise. SPACEWERX pays for that access, choosing companies based on their complementary technologies in a particular technology area that could work together for 4-6 months. They get more exposure to the program offices that would potentially incorporate those technologies later on in the deployment chain.

But larger commercial companies, some that are very innovative like Space X, cannot access these funds or support due to their size; they get locked out because SBIR money must go to small businesses. There is no ability right now for DoD to gain confidence in dual use capabilities that could be adopted today. There is a small business track and nothing else right now. We need a commercial capability funding program—similar to the Air Force

STRATFI funding initiative for small businesses—but open to all businesses in the innovation ecosystem, including larger businesses.

DoD's Manufacturing Capability Expansion and Investment Prioritization program (MCEIP), an industrial investment program spun out of the Defense Production Act Title III, is important. It has focus areas that include commercializing research and development investments, and scaling emerging technologies. MCEIP invested $1.2 billion in FY 2023. The request for FY 2024 is $2 billion.

In many universities, the traditional mindset about research translation and technology commercialization is changing. Universities are leading the organization and development of new technology initiatives such as the DoD Microelectronics Commons, bringing entities to the table and developing partnerships. The universities can play a larger role and act as systems integrators in national security, defense technology, and industrial strength by bringing these evolving roles more fully into that arena.

Two-track acquisition system. There could be a two-track acquisition system—one for things that take a long time to develop such as an F-35, and a second track for software development that needs to move faster—but making sure those two tracks talk to each other so hardware and very complex systems are designed in a way to enable updating the software more easily than we can today. Also, how do we get better at the whole defense acquisition process without getting bogged down in lots of new laws that are trying to fix things at the edges?

Security and performing classified work. Dialogue participants had a long discussion around secure facilities, security clearances, and research security:

- **Secure facilities.** Some interactions between universities, national laboratories, the private sector and DoD need to take place in secure facilities. But not every university has one, and it is a challenge to find a sponsor to build those facilities even when there is a nexus of talent and capability. A dialogue participant provided an example: when working in infectious disease research in intelligence fusion centers, the intelligence community, universities, and USDA laboratories came together to talk about zoonotic threats. All of the meetings were done in secure facilities. It took many years of work to bring the USDA National Bio and Agro-Defense Facility to Manhattan, Kansas, and it will be an important focal point for national security around bio- and agro- defense.

  In its BRIDGES initiative, DARPA provides a $50K Phase 1 award for a company to write a paper about its technology, and DARPA sponsors them for a secure facility clearance. If you do everything right the first time and submit all paperwork correctly, that clearance process takes 18 months minimum. That is a huge problem when product life cycles in the innovation base are 18 to 24 months. With clearances for defense counter-intelligence a priority, the timeline for clearance could be 24-36 months.

  Larger firms could help small businesses and start-ups fund secure facilities, even providing legal advice and other support needed to transition a nascent technology or innovation into the marketplace. A larger company with deeper pockets could help keep the smaller company afloat while waiting to complete the clearance timeline. However, smaller firms and start-ups may be reluctant to work with larger companies, such as defense primes, because they are worried about protecting their intellectual property, and they may be competing against traditional companies. There is also reluctance to work with DoD University Affiliated Research Centers; small firms and start-ups are afraid the UARC is going to take their ideas, give it to the lab, and then the lab will reissue that requirement as something for someone else to build. So partnering with an independent entity could be preferable and make them feel comfortable about maintaining and protecting their intellectual property.

"When I was Assistant Secretary of Commerce, there was something called the Intelligent Manufacturing Systems Initiative the Japanese put together at the height of all the trade and technology concerns between our two nations. Before we knew it, the Japanese government, MITI, had done this on the industrial side, put out this call for proposals in these very advanced areas, and they had conferences all over the country. It was a perfect example of creating knowledge through strategic convening and providing access. Leaders across Japan saw the value."

The Honorable Deborah L. Wince-Smith
President and CEO
Council on Competitiveness

If universities in partnerships with DoD were given facility clearances now, companies with technologies of interest to national security could have a means to partner and shorten some of the clearance timeline. Then companies would not need to invest and build their own secure facilities; they could access facilities in areas near where they are headquartered and where they work. Some domains, for example space and aerospace, are very capital intensive, and require a lot of investment in physical infrastructure. Innovators with disruptive technologies might first go to the venture capital world but, right now, money is tight. So universities could step in and open up their labs and infrastructure to support that.

Universities may be the place to go, but you must protect the research being done there. It is challenging if you don't have the right facility, and particularly challenging when the research requires U.S. citizenship, while universities have people from all over the world. Another complication is that large universities such as Arizona State University and Purdue have the resources to participate, but the R-2s and HBCUs may not have the needed equipment, labs, and people despite a strong desire to be part of the ecosystem. Could they participate in other facilities and integrate their assets if they have them?

One participant suggested that we may not want the U.S. academic enterprise so tightly linked to classified defense facilities, because that may not create a welcoming research environment for students who cannot qualify or who do not want to get a clearance as a sophomore in college. Instead, universities could use industrial base capacity, form industrial partnerships for advancing research that allow the flexibility to perform basic and applied research, and classified research in particular areas. Instead of depending on one champion in the government that might be lost, develop a champion there.

- **Security clearances.** Many universities have a large number of cleared faculty. But they cannot hold over the next generation of workers and keep their security clearances alive, even during a workforce shortage. It is not unusual to have students come back or veterans, for example, who have an active security clearance. But unless the university has a contract that allows it to hold the clearance, they cannot keep it active while the student pursues further education before they reenter the workforce. Could universities have a temporary holding zone for the clearances of its personnel, especially with 18-month clearance backlogs?
- **Research security.** Some universities are very security focused and have infrastructure that enables their work, for example, with DoD. However, other universities are not as mature in their security focus and may need training around this issue. This is also an issue across the larger innovation base. Those working on defense-related technology may be more savvy, but a lot of small companies are very focused on their disruptive technology and not thinking about who might want it. A dialogue participant cited a case of a foreign entity stealing intellectual property about seeds grown in specific conditions. The biologists who were doing that research had no clue that anyone outside of the United States would be interested in stealing that technology. We need to make researchers more aware of research security.

  The issue goes beyond those who are engaged in research. Students will take a picture of their latest spectrum in chemistry or product in the laboratory, and tweet about it or put it on the latest social media outlet. They will share this information freely, and we have competitors all over—they could be down the hall or around the globe. Releasing that information before publication or in some other way is problematic.

In terms of research security, universities can have students from as many as 150 countries. Almost all of those students are good actors, but there is a needle in the haystack problem that keeps some defense contractors for wanting universities to allow certain nationalities to work on projects. That could violate university rules and policies. This tension is hard to deal with at a university and, increasingly, in the innovation and start-up world as well. The pressures being felt at universities are exacerbated by the fact that university policies do not support the position of government agencies. So they are being pressured to do things that policy does not support, and put in an untenable position. Training is inconsistent. It is agency by agency. And, if you have a faculty member who is getting funding from NSF and DoD, it is chaotic.

Funding and thought leadership is needed in this space. It is an incredibly thorny problem with a huge risk window. If we do not get it right, it can undermine the value that the universities bring with this culture of innovation.

The NSF has realized the critical importance of maintainning the research culture that drives U.S. prosperity. It has developed a new program on Research Security focused on understanding research security threats, mitigation and prevention, and the international dimensions of programs/projects. This includes the protection of intellectual property, working with foreign entities, and compliance, but also on working with international partners without alienating them. However, they do not necessarily want to focus on classified research, so this may be something other agencies want to consider. Hopefully, the investments NSF is making in research security will address approaches and policy changes that will allow universities to address foreign influence and security considerations, while maintaining an inclusive research culture.

- **Security and managing intellectual property.** Institutions need to foster a culture of managing intellectual property, and research security is part of that. If there are going to be university-industry-government partnerships or university-industry partnerships, there are going to be students doing internships or co-ops or some connectivity with industry. Moreover, the vast majority of graduates is not going to go into academia, but rather to the private or government sector. It would do students a tremendous service if universities had regular conversations with them about managing intellectual property, so they go into those internships at businesses with an awareness of how to manage and protect what they are creating—not so much from the point of view of getting rich with a new patent, but rather building a workforce by preparing students ready to go into the private sector.
- **Value proposition for universities**. Universities could lean into their ability to convene which provides a lot of value to large and small companies by providing neutral ground to talk about ideas and thought leadership, as well as access to infrastructure—that is the value on the commercial side. Universities get the value of understanding real world problems but, ultimately, they want funding for research and to do the work, and research security could be a major obstacle for unlocking the value to universities. Unlocking the value for the universities and getting them to participate in meaningful ways needs to be addressed. They could develop portfolios of basic and applied research, and develop programs around newer fields such as quantum engineering, but also programs in the basic sciences required to stay competitive. They could develop basic research programs to fill the knowledge gaps associated with applied research projects, and address the security issues along the TRL levels.
- **Security and international collaboration in research.** There is a tremendous defense and economic opportunity with U.S. allies, because there are research institutes, university resources, and talent across the 32 NATO countries. The needs for security go beyond armaments, for example, the needs for food security and energy security. So, getting the allied nations to invest in those areas is going to be important, rather than having those investments go elsewhere and innovations developed by adversaries. This could also counter influence from China's Belt and Road Initiative and similar things in countries that are not yet close allies of the United States. The NATO DIANA program is focused on developing the framework for innovation within NATO because of the security interests and the interoperability that NATO allies must have.

In addition to research security in defense and government funding at universities, there is increasing focus on research security in private funding, for example, funding coming from the Middle East.

Funding in the bioeconomy is starting to come from Qatar, the UAE, and Saudi Arabia. One dialogue participant said that, in the venture capital world, it is the only place left to get money, and it is easy to get. If a company needs $100-$300 million to keep the company running, they know there will be, perhaps, a more expedited due diligence process. That is a reason why the venture capital world is going to Saudi Arabia (for example, its Prosperity Seven VC fund) and other nations in the Middle East.

Currently, investors from Anglophile and the Five Eyes partners that make non-controlling investments in U.S. critical technology businesses are exempt from mandatory filing under CFIUS. But other U.S. allies such as France—which has a very large sovereign wealth fund, is investing a lot in space, and wants to be the space headquarters for Europe—are not exempt from the rule. So, there is a gap in the U.S. ability to leverage that money. There is a lot of work being done across technology in a lot of these countries with which we do not have formal relationships.

Australia's superannuation assets are around $4 trillion. The investments have been very conservative and traditional, for example, in real estate. How do you open up the aperture for riskier or different types of investment, for example, into the innovation ecosystem? This may be something for the technology statecraft agenda and reviving bi-national conversations.

SESSION 2

Review of Draft Call to Action Recommendations—Reshaping the U.S. Innovation Ecosystem for an Era of Rapid Technological Change

Kick-off Discussant and Roundtable Moderator

The Honorable Patricia Falcone
Deputy Director of Science and Technology
Lawrence Livermore National Laboratory
TLSI Co-Chair

TLSI dialogue participants examined key themes and supporting recommendations focused on reshaping the U.S. innovation ecosystem for an era of rapid technological change. Building on the previous session's discussion on the defense innovation ecosystem, Dr. Falcone set the stage for a discussion about the broader U.S. innovation ecosystem and in the context of an unusual time of rapid technological change and changing global conditions. This evolving environment has created the need to manage new tensions between being open and closed, who's in and who's out, and maintaining the inclusiveness we believe innovation demands.

In engaging in international research collaborations, there is a body of rules for working on classified research. But researchers working under federal government grants do not always know what rules apply. National Security Decision 189 directs that, to the maximum extent possible, the products of fundamental research—defined as basic and applied research in science and engineering—remain unrestricted. But researchers have to make judgements about new technology, for example, in terms of export controls or proprietary research.

More recently, the conversation has expanded to the concept of economic security; that is, if taxpayers are paying for the research performed at U.S. universities and national laboratories, then they deserve the benefits of that research, and the companies and jobs that come out of it. That is what research institutions do not quite know what to do, and they are being pushed up into earlier Technology Readiness Levels. How do they continue to have fundamental research—defined as basic and applied—fully open, except if it is going to create value for a company and jobs we would like?

Draft TLSI recommendations focus around three themes:

- Changing the Culture of Research and Innovation Ecosystems
- Enhancing the Innovation Workforce in Critical Technologies and Industries
- Building Innovation Ecosystems through National Domestic Strategies

Points of Discussion

Some of the discussion points that arose in Session 1 were directly relevant to themes of Session 2 and have been included here.

Call to Action framing. The U.S. innovation ecosystem is the global benchmark for collaboration among different actors, how technology gets transferred to innovative companies, and in generating start-ups.

"The U.S. population is just 4.5 percent of the people on the planet, so we know that we are not going to own the edge on every technological change. That is the bottom line. We have to adapt and evolve the culture and the systems that are deployed in research and innovation."

Dr. Patricia Falcone
Deputy Director of Science and Technology
Lawrence Livermore National Laboratory
TLSI Co-Chair

While there is a need to communicate a sense of urgency in the Call to Action, it should recognize the great model we have in place. There are very successful programs that should be called out in the Call to Action, for example, accelerators for technology commercialization that leverage federal funding, such as the Small Business Innovation Research program. In terms of the sense of urgency, maybe not as much about the lack of maturity in the system, but room to improve. There is always going to be a tension between academia and industry; they serve different purposes, so there is always going to be a challenge in getting them to work together. The urgency we need to face now could probably be better framed in terms of what are the real challenges, the missions, why do we have this feeling we need to do better, to be faster, to accelerate—taking something that is working very well to the next level.

One suggestion was to identify high stakes challenges—such as the energy transition or national security—as a catalyst, and incentivize government, industry, and academia to come together to address them, for example, redefining how the economy works in a very short time frame in response to the climate emergency. Then frame the recommendations around how we can be fast or effective enough to tackle those challenges.

Critical technology strategies and TLSI Call to Action. Three national technology strategies are under development and expected to be released in the near future—a National Science and Technology Strategy from the Director of the White House Office of Science and Technology Policy; and two commercial space strategies, one from the Office of the Secretary of Defense and the other from Space Force. Should these strategies be released prior to the TLSI Call to Action, these strategies, particularly the one from OSTP, should be taken into account and referred to.

In addition, as the federal government is making historic investments in building the innovation system, the Council may want to emphasize the need to invest in production and commercialization of the technologies being advanced through federal funding. This could include advocating for upgrade of the Stevenson-Wydler Act, greater flexibility in contracting vehicles, and the ability to establish foundations and non-profits to benefit federal missions. For example, the flexibilities available to the federally Funded R&D Centers (FFRDCs) are not available at some national laboratories, for example, the National Energy Technology Laboratory, a government-owned/government-operated laboratory.

Federal government authorizations vs. appropriations, continuing resolutions, and funding uncertainty. Congress has authorized more money than it has appropriated, there is a lot of competition for funds, and people and places are still being left behind. It matters given the scale of technology and the scale of resources needed to do real work and be inclusive. Some efforts that have been appropriated have not spent some of the funds yet, for example, the U.S. Department of Commerce funds appropriated under the CHIPS Act, and some of the infrastructure funds appropriated to the U.S. Department of Energy. But it is hard to spend money and takes time.

Operating on a continuing resolution constrains spending of new appropriations and new starts. Universities and businesses cannot go on for months, or keep the workforce or activities going without any indication of the funding stream or a budget. In addition, authorizers often create authorizing legislation or language for new starts, but appropriators do not want to fund it or put it forward. So federal agencies may get the requirement to do work but without the money to do it. Then authorizers want to see the strategy or outcome report.

Integration across and sustainability of technology hubs. The United States is making an unprecedented investment in hubs—tech hubs, hydrogen hubs, carbon capture hubs, the microelectronics commons, and NSF regional engines. However, there does not seem to be coordination at a national level. Instead of a shotgun approach, how can we make these as productive as possible for the Nation, align their resources, and leverage their intersections? Many of these hubs are being funded on a time-limited basis, for example, five years of government support or matching funds, so there is concern about their longer-term sustainability, particularly in the absence of government support.

The role of many universities in the innovation ecosystem has evolved. In many universities, the traditional mindset about research translation, the priority for patenting, and technology commercialization is changing. There is a greater focus nationally and globally on the role intellectual property plays and the build out of innovation ecosystem. As a result, universities are leading the organization and development of new technology initiatives such as tech hubs. They are playing a role as convener of industry, government, academia, and others in regional innovation-related initiatives. For example, Arizona State University and Purdue played key roles in bringing entities to the table in developing partnerships that have won millions in federal grant support.

There are initiatives promoting a shift in research institution culture. The P-Tie (Promotion & Tenure–Innovation & Entrepreneurship) movement, made possible by support from the National Science Foundation, is a strong advocate for changing promotion and tenure guidelines to make them more inclusive of innovation and entrepreneurship. Scores of universities that belong to P-Tie have already made changes in their promotion and tenure guidelines. Also, NSF's I-Corps, the NSF-supported Industry-University Cooperative Research Centers, other government programs, and the Coulter Translational Research Partnership are encouraging researchers to think about closer interactions with industry. For example, in match-making, I-Corps pairs researchers with MBAs and business professionals. Building on this significant shift, we want to see more, prioritize investments in these areas, and grow and expand the programs that are making a difference.

A dialogue participant pointed to a study of the relationship between corporate R&D and public science, including knowledge, human capital, and invention. The study found that, over the long-term, R&D by established firms is affected by the scientific knowledge generated by universities only when it is embodied in inventions or PhD scientists. And inventions from universities and public research institutes substitute for corporate inventions and reduce the demand for internal research at corporations. Advances in knowledge have little or no response, raising questions about the belief that public science feeds into corporate R&D through knowledge spillovers.[1] The study suggests the expansion of public science in all its forms may not equally lead to sustained productivity growth.

Resources for technology transfer, intellectual property management, and commercialization. Every university, with some exceptions, will say they are working on this bucket of issues, but many do not have a lot of resources to do that. A possible recommendation would be including a small percentage of the funds in a research grant to be devoted to

1 The Effect of Public Science on Corporate R&D, Ashish Arora, Sharon Belenzon, Larisa Cioaca, Lia Sheer, and Hansen Zhang, National Bureau of Economic Research, November 2023.

technology transfer operations for education, outreach, and domestic and global patenting. In today's global economy, an inventor needs global intellectual property protection not just a U.S. patent.

Proprietary vs. non-proprietary in government-funded research, technology development, and collaborations. In the past few years, particularly in attempts to bridge the valley of death, a lot of federal funding has gone to industry. That has created situations where some publicly funded research is not shared with others because it goes to industry and into proprietary space. Federal funders could do a better job of compartmentalizing what is intellectual property that needs to be protected versus what is intended to be a public good. For example, billions of dollars have been invested in research from which all of us or an entire industry could have benefited, but that learning was limited to one country or one company. It is put in a box, especially if the project was not successful or perceived not to be, then all of that learning is lost.

However, when picking winners, others might die; but these others might benefit if only what is truly proprietary is compartmentalized. In some fields, such as nuclear, without investing big dollars, it is hard to do anything or move anything forward. You could distribute the investment over a lot of people or companies and more would get funds, but nothing moves.

Also, a pre-competitive consortium, for example, on autonomous vehicles could have auto manufacturers, legal and insurance companies, etc., in addition to researchers and technology developers. Because, for autonomous vehicles to be successful, you need the technical aspects as well as the policy and other aspects at the pre-competitive stage.

When defining research, focusing more on outcomes and prioritizing market needs and use cases from the beginning can create tension because it involves the management of intellectual property. Sometimes, a tight hold on intellectual property gets in the way of collaborations with other companies, and in developing and operating hubs.

A dialogue participant pointed to a model deemed successful—NSF's Industry-University Cooperative Research Centers (IUCRC). The program provides a structure for academic researchers to conduct fundamental, pre-competitive research of shared interest to industry and government organizations. These are consortia in which members collectively envision and fund research. There are about 80 IUCRCs across the country focused on a wide range of research and technology of strategic interest to U.S. industry. It does a good job of separating pre-competitive and competitive research. With pre-competitive research, competitors can come to the table to move fields forward for the public good, a space in which the United States invests too little—raising all boats to a certain level, and then fighting from there.

IUCRCs have a membership fee that industry members pay, around $50,000 per year, with about a dozen members contributing to each consortium. A board that manages the IUCRC votes on projects. There are around 300 universities that participate in these 80 centers, and about 2,000 industry members. The larger IUCRCs do a couple million dollars of work a year, with investment in time and talent from both the university and industry. Universities that participate in several IUCRCs have graduate students working and it creates other avenues for potential partnerships and ideation.

There are workforce development benefits. At George Mason University, about 35 percent of students who worked on IUCRC projects go on to work for member companies. And this is a good way to translate technology out of the university—hire the students who work on the program and that helps de-escalate some of conversations around intellectual property. IUCRC industry members sign a non-exclusive, royalty free license agreement. Having a government agency in there with a well-established intellectual property policy, potential industry members may not agree with that policy but, because 2,000 industry members have signed-up, one can ask "what is so special about a company that would prevent it from signing this agreement?" George Mason gets agreements signed that way by having a standard agreement and many other signatures.

In terms of collaboration across the IUCRCs, they pick and choose what they are going to do, and tackling larger challenges of national interest would generally require enlistment of multiple IUCRCs. But, even if several are aligned on a challenge, they do not have an incentive to come together, and they are focused on their partner base. Additional incentives would be needed.

SEMATECH was industry formed with a federal subsidy. And, over time, this yielded benefits to the overall semiconductor industry. But there is a need for patience over the longer-term. When the government withdrew its support, SEMATECH collapsed under an attempt to privatize the model of a public-private partnership. There are lessons to be learned. These consortia, including some of those the government is currently funding, are expected to have a life of their own after the initial tranche of federal funding. It may be important to rethink that model, particularly in areas, such as nuclear, where major investment is required.

Recognizing the role of the skilled technical workforce in the innovation ecosystem. Technical and community colleges are important to the U.S. innovation ecosystem and, in most places, greatly underfunded. They largely educate and train domestic students—a huge source of domestic talent. They should be included in the Council's conversation and report on innovation.

In the United States, there used to be a nationwide focus on developing the workforce in skilled trades. Vocational and technical education programs were stopped for a lot of reasons but, in doing so, we created a talent gap. We should revisit that in terms of the whole workforce development continuum, from skilled trades to PhDs and doctors of engineering, everyone that is included in innovation ecosystems.

We need to reinvest in skilled trade development and consider what that looks like. There used to be work release programs so that students who wanted a job were permitted to work at local businesses and take a restricted number of high school courses. Some kids went to build houses and became plumbers. And today, we still need those skills and jobs filled. But today we also need people to do 3D printing, run autonomous vehicles, and work with hydrogen—much more technical skills. For example, Illinois's Fermentation and Agriculture Biomanufacturing Tech Hub won U.S. Department of Commerce designation as a Tech Hub, enabling them to compete to receive $40-$70 million in implementation funding. Two local tech schools are involved because there currently are not enough people with the skills to operate the plants and manufacturing facilities.

There needs to be more pathways from the community college to a master's or PhD, even if students are working in industry because they are the future domestic workforce. And there is a need for mapping, rafting together programs so people have real pathways.

Quantum engineering is another example. There is no sense of how someone with that interest can progress. And even for quantum programs that do exist, we do not know where all of those exist – much less which are proving to be successful. Programs around quantum are still focused too much on physics and have not transitioned to engineering. We need to help these organizations progress. However, with respect to mapping in quantum, there is ambiguity in technology spaces, and no sense of how to define what is happening beneath those terms nationally, or where to improve, how to improve, what's connected to what, what's working, or what's not.

Colleges are shooting everyone toward a PhD, for example, in the field of physics. Professors are trying to replicate themselves, instead of recognizing that most people are not going to become a professor; they are going to be highly skilled, working on plant floors and places doing manufacturing. Members of the Manufacturing USA innovation institutes may have some good lessons learned.

STEM pipeline. In recommendations on the STEM pipeline, including K-14 and the role of community colleges, the Council may want to address the role of influencers of the next generation, particularly guidance counselors, school principals, and educators. There have been a lot of recommendations also on the use of programmatic challenges, such as robotics competitions, to engage a much larger K-12 population, and some of those have proven performance in building STEM career awareness.

Role of immigration. Immigration could help fill workforce gaps. While there are political considerations, in the history of the United States, immigrants and entrepreneurship go hand in hand.

SESSION 3

TLSI Call to Action Opportunities

Kick-off Discussant and Roundtable Moderator

The Honorable Deborah L. Wince-Smith
President and CEO
Council on Competitiveness

In this session, dialogue participants had a more expansive conversation around the final deliverable of the Call to Action. They considered national priorities, themes, and missing recommendations, as well as how the Call to Action should be positioned, packaged, and distributed once finalized.

Deborah Wince-Smith indicated the Call to Action should acknowledge where we are as a nation, our system, and the things we need to do now to propel it into this new world being defined by disruption and accelerating change, and the need for agility. Then, recommend concrete actions.

She encouraged participants to focus on what would be in a very high-level TLSI ten point action plan for U.S. technological leadership to drive productivity, prosperity and national security. This includes big and disruptive concepts, and big changes we could make. She indicated that, perhaps, many of the recommendations in the current draft fall into the tyranny of incremental improvements—a little bit of change versus some of the big things we need to do and some of the emerging new models that could be drawn upon to illustrate some of them.

In terms of audience, we have a presidential election this year, and will provide these recommendations to both campaigns. Recommendations will be featured at the Council's National Competitiveness Forum, and also as part of the National Commission's phase two report. Also, how can we work with other organizations to elevate these messages: if we lose our technological leadership, if we lose our ability to rapidly commercialize at scale these new products and services and, if we don't have the workforce, we are not going to be an economic and national security leader.

Points of Discussion

- **What is the right context to present findings in the Call to Action?** The world is becoming, at least politically, so much more personal. Most of the suggestions are structural and are not going to have much public appeal. Perhaps the only way to have impact is to make a public-facing case that is not aimed at policymakers, but aimed at the general public. Think about how well this country responds to disaster crisis. Yet, the general public does not consider what we are facing now from the global competitive landscape as a disaster crisis. Does that case need to be made—for example, painting a popular vision of what could happen if we do this well, or painting a dystopian vision of what might happen if we don't do it well? Perhaps we should not look for others to make that case.

  The Science is Us campaign may offer a model to draw from. It creates personal stories and narratives about science and who is a scientist,

and makes the case that a scientist is not exactly who you think she might be—she might look really different than the preconception in your mind. The goal is to effect change at the local, regional, and state levels, particularly in states where there are very contested political issues. Currently, the campaign is working in 5-6 states to try to change that story about why science matters and who's actually conducting the science.

At its beginning, Science is Us did several national polls and research with the National Science Foundation to document science's impact on the economy. Because, you may not think you are a scientist, but your job is actually directly related to the science enterprise. So maybe you should think of yourself as a scientist because your salary and standard of living is coming from that, which has increased six percent over the past ten years due to the contributions you and your organization made.

In the United States, science is seen as elitist, and we have to consider that when communicating about science and leading the Call to Act narrative with its benefits. We need also to include the concept of prudence in research, because there is controversy now, for example, in many types of research; and we must address the fact the everyone brings bias, but we are aware of the bias in science and there are self-correcting mechanisms to address that. Many people do not believe scientists because they feel scientists are talking down to them. So, a critical learning is to express humbleness and humility through the prism of: we are prudent about what we work on, we are aware of our bias, there are self-correcting mechanisms, and these are the benefits of science.

- **Ingredients in regional innovation ecosystems.** A possible recommendation could be to learn what the ingredients of the regional innovation ecosystems are, because we must have a country that has innovation capability and outcomes throughout our country.
- **Regulatory reforms.** Every regulation should have an expiration date. For every regulation that comes in, one needs to go out. A committee is needed to identify obsolete regulations that we can get rid of. In addition, any flexibility that is given, for example, clearances, is perhaps given for ten years, so it does not have to be fought over every year. We need sherpas to help small companies navigate the regulatory system, whether that is on research security or health care. Regulation needs to be reviewed on a regular basis.

  A recent Defense Science Board brief on space acquisition found that, from a legal perspective, there are very few barriers to going fast, implementing dual use technology, and enabling an innovation ecosystem. But the further down in the process and organization, the more conservative that opinion gets. The further down

you go, you get more layers of regulation and policy and then, once it is there, it is there forever. Usually it is because there was bad behavior somewhere in the past, and the reward for bad behavior is more regulation and policy that controls or tries to prevent it.

At the end of projects that are part of EU technology challenges, the EU evaluates if there is a need or not for regulatory action, whether regulations need to be updated or changed, particularly in areas such as health and biotech. They are enabling windows of innovation, not just with the project, but on the regulatory side. Could that be done in federal acquisitions, for example, do a pilot in a challenge area and, if it works, advocate for expansion to regulators?

- **Precompetitive vs. proprietary.** Some in high-tech—NVIDIA and Microsoft for example—are saying everything is a platform. Our goal should be to create platforms where the value created on the platform is symmetric. If it is precompetitive, it it should be open to trusted networks or to the public, depending on what it is. But on proprietary things, all the restrictions will have to be there. We may need to take a platform-based approach and have value creation as our metric.
- **Artificial Intelligence/Machine Learning (AI/ML).** At the beginning of the Call to Action, the Council/TLSI should consider acknowledging the disruptive force of AI/ML, both positive aspects, but also dangers, especially to the workforce. There could be tension, for example, as we try to increase throughput in the technical education pipelines—AI/ML is a double edged sword there. There could be guidelines or at least an acknowledgement that AI/ML should not be considered as a panacea for all our wealth and speed; it is dangerous when you suddenly put a lot of people out of work.

  This is a space where we are falling behind very quickly because we are not taking advantage of that, especially in the national laboratory system, out of an an abundance of caution, which is appropriate in some instances. But we are not at the cutting edge anymore or anywhere near it now. Also, where do we apply it? Perhaps we need a discussion of where it can be applied for the most benefit. And we need a discussion about the whole challenge, including national missions and imperatives, and having a cyber resilient, cyber secure digital black box going forward,

SESSION 4

Developing an Adaptive and Agile Industrial Base to Meet U.S. Economic, National Security, Energy, and Sustainability Needs

A Conversation about the Southwest Advanced Prototyping (SWAP) Hub

Kick-off Discussants and Roundtable Moderator

Dr. Sally Morton
Executive Vice President–Knowledge Enterprise
Arizona State University

TLSI Co-Chair

Kevin McGinnis
Managing Director, Strategic Technology Initiatives, Office of University Affairs
Arizona State University

Dr. Zachary Holman
Professor, School of Electrical, Computer and Energy Engineering

Vice Dean for Research and Innovation, Fulton Schools of Engineering

Senior Global Futures Scientist, Global Futures Scientists and Scholars

Vice Dean (ACD) and Professor, Affiliated Staff and Faculty

Arizona State University

Arizona State University leads one of the eight CHIPS Act-enabled, Department of Defense-funded hubs in the national Microelectronics Commons. The Southwest Advanced Prototyping (SWAP) Hub received a $39.8 million grant in its first year to create a regional network for microelectronics education, research, and development in the Southwest. SWAP is working to deliver rapidly flexible, scalable, and low-cost microelectronics prototyping capabilities. It unites more than 150 semiconductor and defense companies, universities and community colleges, tribal communities, and national laboratories from Arizona, Colorado, New Mexico, and across the Nation to share lab-to-fab capabilities, and deliver prototype projects tailored to Department of Defense (DoD) needs in AI hardware, 5G/6G technologies, and commercial leap ahead technologies.

SWAP benefits to the university, companies, and region. In bringing this ecosystem together with 150 partners, there are both benefits and challenges. One of the great benefits to the university is directing its energy and innovation. Academia may expend a lot of effort on the wrong topics. But when performing research closely linked to industry, there is a better chance of working on topics and problems where, if solved, will have impact.

The benefits to the company depend on the size and status of that company. For example, there are a lot of small companies in SWAP, many of them focused on a relatively narrow value proposition as they must be as a start-up company. They have limited

resources and need a lot of support both upstream and downstream. They can find both at the university and among the SWAP hub's diverse community. In contrast, large companies can operate independently and have a tendency to become insular. But SWAP incentivizes those companies to partner.

There are also geographic and placed-based innovation benefits. Prior to its development into a microelectronics hub, Arizona never had a national laboratory or defense-focused R&D enterprise. There have been those in New Mexico and other parts of the country, but they are largely a product of World War II. Arizona has reached a point in development in the region where it is ready to participate more fully in that R&D enterprise. The SWAP hub brings together this region in a way never done before, for example, a close partnership with places such as Sandia National Laboratories. Also, as the first DoD program emerging from the CHIPS Act, the SWAP hub brings together many small companies, giving DoD access to non-traditional performers. They may have exciting ideas, but don't necessarily know how to work with DoD. SWAP is serving as a kind of coach or mentor, helping them find pathways into DoD. SWAP aims to grow beyond the region; they already have national level partners and partners across more than 20 states.

SWAP value-proposition for partners. There is an appreciable amount of funding partners can compete for, and a strong sense of fear of missing out. SWAP is built with capabilities available to everyone on a pay-per-use basis for winning projects. A lot of those capabilities are available at ASU, but also at other places. For smaller companies, access to capabilities is a large draw factor, for example, working with ASU and its core facilities and access to unique tools. For larger companies, it was large dollar signs. Also, Sandia brings some classified facilities to the table. Put all of these different capabilities together into a process flow, and you can create prototypes for the first time.

One of SWAP's key focus areas is extreme environments—nuclear radiation, high temperature, and high voltage. In SWAP's region, with Sandia National Laboratories and others, there is a unique set of testing infrastructure that can be used to qualify prototypes for space-based applications. That's another thing that brought a lot of companies into the fold.

Facilities challenge. Semiconductor R&D is incredibly capital intensive, and ASU is fortunate as it owns a former Motorola fab, a facility no other university in the country has. But it is not just about keeping the fab running, it is also about installing and maintaining very expensive equipment. ASU partnered with Applied Materials to install $270 million of 300 millimeter equipment and the associated construction projects. Good research is done with good tools, not just physical equipment, but also virtual software equipment, and unique research is often enabled by unique tools. So the question is how do you build and install those tools faster so you can speed up learning cycles and stay ahead.

SWAP membership agreement and intellectual property. In a joint enterprise, there are multiple companies potentially creating new intellectual property and working together for the first time. SWAP has taken a structured approach to intellectual property management, for example, through its core facilities model in which companies can access SWAP's key capabilities. SWAP has a membership agreement that lays out the intellectual property terms. When SWAP has big successes, when products and prototypes commercialize, there will be questions about how that gets divvied up. For example, how might that success allow SWAP to continue and expand beyond the five-year window of DoD investment? One of the unique things about the model is that, if prototypes are successful, DoD can scale production and acquisition using its "other transactions authority," and immediately transition them to large defense programs.

The SWAP membership agreement used to onboard companies leverages and builds on things that the university already knows how to do relatively well and its tech transfer organization—Skysong Innovations. It is very flexible and able to negotiate any deal with any company. With that flexibility, one challenge with a new company is where to start the negotiation. Having a small menu of options is a great starting

place, for example, a royalty bearing exclusive option for an exclusive license or a non-exclusive royalty free license. SWAP has adopted one of these and used it in the membership agreement.

As the organizing partner of SWAP, ASU is like the center of a wheel, and will have spokes with the same membership agreement with a company. But SWAP will not enforce agreements around the perimeter of that wheel; that is, if another university is a partner, SWAP will not enforce any contracts between that university and a company partner. SWAP recommends they sign the same membership agreement between them that they each signed with SWAP. Also, structurally, to exist for a long period of time and evolve, SWAP can add members and has a low barrier to entry.

SWAP has mechanisms for sunsetting members that are no longer relevant. SWAP started by having categories of partners: capabilities partners that bring equipment and software made available to everyone on a pay-per-use basis, project partners that have successfully proposed with other hub partners to an RFP issued annually by NSTXL on behalf of DoD to fund prototyping projects that use hub capabilities and their own capabilities accessible only to them, and a couple other types of partners. Project partners will naturally sunset when their projects sunset, and then they go into a "waiting room" where they have the opportunity to join teams, propose new projects, and become relevant again to the hub. So they are affiliated with the hub in that they are eligible to apply for projects, but go back to an inactive status when their project ends and they must reapply. However, they can use hub capabilities on a pay-per-use basis if they bring dollars from a different source. It is important for sustainability of the hub that it is not resourced from a single source.

Competing for DoD project funding and proposal development. DoD has asked for projects, and each hub in the Microelectronics Commons can submit 15 proposals. SWAP had 78 projects proposed in concept papers by its members, and SWAP has a methodology for adjudicating among them.

Proposals submitted to SWAP by project teams are reviewed confidentially although, if projects are selected for funding, the project title and abstract will likely be released publicly. But, proposal information or the technology created are not available to everyone in the hub.

There are two proposal stages. The first was competing for selection and award of funding as one of the eight Microelectronics Commons hubs, and that was for building the infrastructure and capability. The second is an annual cycle in which hubs propose projects. For the first stage, ASU had faculty involved from the start, from 2020, and grew that group capability; SWAP has six capability areas, for example, new materials and circuit design. Prior to submitting the first phase hub proposal, ASU held an open competition in which faculty and others could apply to be a capability area lead. So each of those areas has a person who is the lead. They are not all faculty members because some of them are at other hub partners. They were then empowered to innovate within their capability area.

Once selected as a hub, SWAP is submitting 15 project proposals. All of them have university partners and faculty who are principal or co-principal investigators. The best composition for project teams tends to be university researcher, university faculty member, large defense systems integrator, defense prime, and a small company working together, and ideally a national laboratory. With all of those ingredients, the team can come up with some exciting innovation that hopefully yields a prototype that transitions to a defense system. SWAP also created a great recruiting opportunity, and ASU has done a lot of faculty hiring around SWAP.

National security controls. China would want to know everything SWAP is doing, presenting a hard question about national security controls. SWAP wants to create open innovation, but protect things that are potentially sensitive. SWAP partner Sandia is very familiar with working with export controls and in a classified environment, while SWAP/ASU has a more open innovation model. However, there is the possibility to transition—either through Sandia or

SWAP corporate defense industrial base partners—to more secure environments. So the key is going to be knowing a transition is needed. SWAP has research security programs in place, but it is important to know when a project gets to a point where it needs to be in the hands of more secure partners.

Outcomes, metrics, and impact. As an applied, higher technology readiness level (TRL) program, SWAP's metric delivering to DoD functional prototypes applicable in defense systems. SWAP is looking at the capabilities and effectiveness of those prototypes over time, for example, energy efficiency and improvements in swap (size, weight, and power). There is also the speed of delivering those prototypes. There are other metrics around how capable those prototypes are such as are they being used in defense systems and have they transitioned.

Workforce development. We need trained U.S. citizen performing projects, in part, because a lot of SWAP partners, such as Sandia and defense industrial base companies, can only hire U.S. citizens. And we are not training nearly enough of them, including women and BIPOC. Every SWAP project and the capability areas have roles for students. The projects are a workforce development and training opportunity for students and not just graduate students. So undergraduates are involved to the extent possible.

Coordination among U.S. hubs. There are eight Microelectronics Commons hubs across the country, and there has yet to be a way for all of them to work together and make them cohesive. Also, there are other hub programs being created, for example, the Department of Commerce is setting up hubs and hubs are going to continue to be put into place across the country. We need to figure out how all that connects together, and how SWAP members of these various organizations and hubs can get the most innovation and transition their prototypes into production.

KEYNOTE ADDRESS SUMMARY

NATO Defence Innovation Accelerator for the North Atlantic (DIANA)

The Honorable Barbara McQuiston
Board Chair, NATO Defence Innovation Accelerator for the North Atlantic (DIANA)

The NATO alliance is facing changes, challenges, and disruptions. NATO has been a diplomatic body, and an armaments body due to the need for interoperability across countries in the alliance. But NATO's security challenges go beyond diplomatic and armaments to include food security, energy security, climate security, and dual use technology that can contribute solutions to these challenges but also pose threats. Ukraine is the poster child for how technology can be a game-changer, and it was an eye opener for a lot of the militaries to see how quickly you could stand up capabilities, which is what they want to be able to do.

Seeking different models for innovation and how NATO countries work together, NATO often looks at the U.S. model and innovation engine. One idea was the Defense Innovation Accelerator for the North Atlantic (DIANA) and the NATO Innovation Fund. These new sister organizations are supported using joint funds that are not part of the two percent common funds, although their budget is distributed in the same way, for example, the United States paying 16 percent of the total DIANA budget. The NATO Innovation Fund is a limited partnership and also separate. DIANA's headquarters is in White City at Imperial College in London.

While some may worry about why the United States is funding companies in other countries, a lot of U.S. companies want to connect with those companies and a lot of companies set up manufacturing in the United States. There is a lot of opportunity for economic development, we are creating a more common market across 32 countries for security, and the U.S. defense strategy depends on our allies.

DIANA. DIANA is modeled after the U.S. Small Business Innovation Research program. In DIANA, challenges are issued, and research institutes, universities, and entrepreneurs can compete for grant funding by submitting proposals on those challenges. In 2023, DIANA launched its first three challenges focused on security and interoperability, sensors and surveillance for coastal maritime areas, and microgrid technology. These challenges received 1,300 proposal from across the alliance, particularly from Canada, the United States, and the U.K., but an incredible distribution across all the NATO countries. Proposals are very short, modeled on those submitted to AFWERKS or SOFWERX.

In NATO, there is a group of 7,000 engineers and scientists, but DIANA also pulled together people with business and other backgrounds to help on the proposal review process. The budget allowed for 44 out of 1,300 proposals to be selected in the first three challenges.

If NATO countries had many companies submit proposals that were not selected for funding, DIANA is encouraging those nations to see these as good

candidates for their own national innovation programs. It is a teachable point about what it means to be competitive, especially across 32 countries. But, the important thing is that NATO is rewarding and promoting innovation across the alliance.

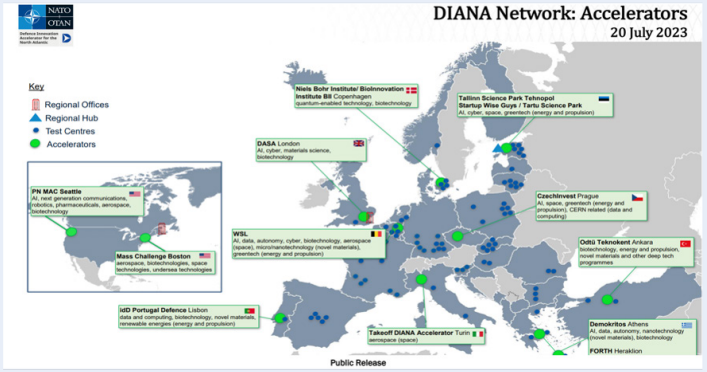
DIANA's three phases. In DIANA's six-month Phase 1, selected innovators and companies work on ideation, and evolving their proposed technology solutions and their businesses.

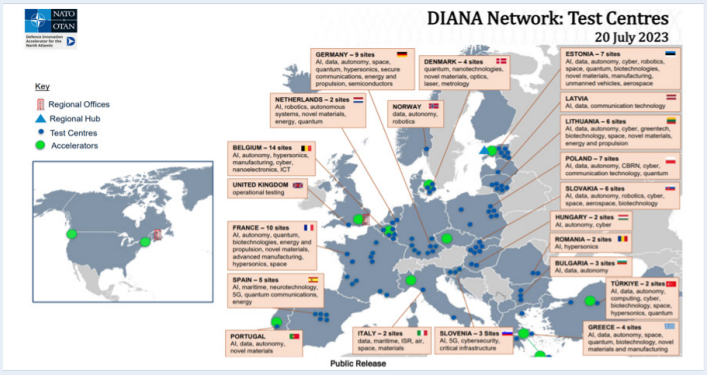
In Phase 2, successful ideas are selected to move into test, acceleration, and demonstration. DIANA has accelerators and test centers, and another 90 test centers are coming on board. Initially, DIANA did not have Congressional authorization, and could not use government laboratories and personnel for its programming. So it looked to universities and FFRDCs. It is using two accelerators in the United States—the MIT MassChallenge and the Pacific Northwest Mission Accelerator in Seattle—and Engineering Research Centers and FFRDCs for test, experimentation, and development.

MassChallenge works with start-ups, and helps network throughout the community there and the defense industry. At the Pacific Northwest Mission Accelerator Center, there is a lot of parallel work, the Navy, investment, university work, and large companies—helping create an ecosystem.

The first cohort going through MassChallenge gets the accelerator commercialization curriculum developed by MIT MassChallenge and Starburst, focused on topics such as the dual use nature of the technology, raising capital, Intellectual property protection and strategy, understanding the threat space, navigating the defense ecosystem and its complex internal systems, and how to do business with DoD. There are demo days, industry days, and connections with some potential end users. Industrial partners can be a mentor and register on the DIANA website. This is a pilot phase, and DIANA will be getting feedback from this first cohort of companies.

DIANA's Phase 3 is rapid acquisition and adoption of key technologies that are successful, for example, moving the technology to the warfighter or one





of the NATO nations, or working with the industrial base to quickly adopt the technology. The intellectual property stays with the company. This is dual use technology, so there has to be a good commercial case.

DIANA has a working group on rapid adoption. The NATO Support and Procurement Agency has been doing rapid acquisition for Ukraine and other things. DIANA has been able to authorize a sole source acquisition for Phase 3 small lots because Phase 1 and Phase 2 are competitive. A measure of success is having one or more NATO countries adopt a successful solution through DIANA. DIANA wants to be able to pool money for small lots, have the countries receiving the solution train together, and see it in the field. While there is a lot of focus on programs of record, we need to think about multiple pathways for deployment.

A lot of the ideas coming through DIANA will need to be integrated into platforms or scaled up and implemented across the board. That could include manufacturing and other capabilities. To support scale-up, the DoD Office of Strategic Capital has

loan capability, and can provide patient capital as a government loan. But the most important thing is to link to that end user acquisition, and then use public and private capital to work together to fund the scaling up of these capabilities.

NATO Innovation Fund (NIF). The DIANA cohort of companies have been competitive, have demonstrated or experimented, and know more about how to design their product for security challenges. This is where the NIF comes into play. With 24 NATO countries participating, it is the first multi-sovereign fund making investments in defense and security technology and performers. The NIF is a limited partnership based in Luxembourg. There is an NIF board that manages that partnership, and a NATO board around that with the participating countries. However, the United States has not yet joined the NIF. The fund will invest in start-up companies, some of which might want to be in DIANA while other may not need it. The fund has raised €1 billion being used for seed rounds, with the first six or so deals closing in the first quarter of 2024. The NIF is looking for industry partners to start working with some of these companies and provide mentorship.

NATO investor network. DIANA is working to build up the investor network. DIANA is like a front door where you knock into NATO for venture capital and funding. But there are levels of diligence, due to national and economic security, so it is important to drive out adverse capital when creating the ecosystem and connecting people to financial and industrial partners. The NATO Innovation Fund has different levels of due diligence, but similar principles.

DIANA status and future. DIANA is in a pilot stage, and not up to full operational capacity. While three challenges were issued in 2023, five challenges are planned for 2024, when all of the staffing should be in place. Now with authorization, DIANA can go into any federal government laboratory. But this is something that has to work on a more commercial timeline.

DoD has a Multidisciplinary University Research Initiative (MURI) for basic research. There are also bi-lateral multidisciplinary research initiatives in which the United States funds research at U.S. and other universities in U.S.-allied and partner countries. DIANA is considering developing BURIs focused on basic research prior to DIANA activities.

NATO has done a lot of work in developing emergent and disruptive technologies and strategies, for example, in quantum, AI, and biotech. NATO wants to focus on how to better fund these technologies, but within guidelines of practice and use—how democracies become agile and innovative but in smart and responsible ways. A lot is based on looking at In-Q-Tel, the National Cyber Force in the U.K., and models of how to make these companies and disruptive technologies successful.

NATO is starting to look at the convergence of technology, for example, AI and material science, and biotech and AI. It is important for universities to think about not being quite as stove-piped in disciplines, and providing more avenues where this interchange happens.

NATO wants to look at the strategic impact of patient capital. Since this capital comes from the NATO nations, it can take a little longer timeline and reduce some of the risk. While DIANA grants supporting test and experiment help de-risk development of a technology and, then, with the NATO Innovation Fund, NATO is able to fund and build a portfolio.

Activity across NATO

- Many universities and research institutes in the EU have shunned work with defense and on weapon systems. However, with the challenges of energy security and other things, there is more embrace and excitement. The EU now has the European Defense Fund. They are doing projects, and these countries are realizing what core competencies and assets they have to bring to bear, and the research institutes, universities, and start-ups are jumping on board on dual use technology and this ecosystem is being developed.

- Estonia is big on digital security, especially on the financial side. DIANA is standing-up a hub there. Canada has a hub, and DIANA is looking at Vancouver and Halifax. So on the data security side, it will be important to look at the companies coming through there.
- Denmark just launched its quantum strategy, where the Niels Bohr Institute is located next to start-up companies, building out an area for quantum start-ups. Denmark has been big in biotech, and has many start-ups now.
- Turin is building Space City around their aeronautics and aerospace capabilities. A lot of work with NASA goes on in Torino and Italy, so they have a lot of start-ups in space. Turin is the site of a DIANA accelerator, next to the Polytechnic University. Leonardo and other companies are involved in that.

Points of Discussion

CFIUS. A dialogue participant asked if CFIUS was being adjusted to account for countries that are not on the excepted nations list.[2] Ms. McQuiston indicated she hoped CFIUS could be modernized in safe and secure ways, especially as some of the countries involved in DIANA stand up their own security and vetting.

CFIUS is focusing on areas of technology that match a lot of what DIANA is working on, for example, novel materials, energy for propulsion, hypersonics, and space technology—seeing commercial dual use potential in these technologies. Some technologies are obvious, but others not quite as obvious, but this is where CFIUS wants to concentrate on the market, resilience, infrastructure, and security. In terms of the protection process, unlawful transfer of intellectual property is a big one, as well as infiltration within physical assets and influence within the capital market.

Start-ups and small businesses in the long game. A dialogue participant asked about coaches and mentors within the broad community. Start-ups and small companies supported with patient capital need to know if they are still on target for what someone would buy or need. There are cases of companies developing things where it took 7-9 years before their first sales. They also need guidance on issues such as the need for security features on a product. Guidance along the way can make a big difference on what they build, and knowing if it lines up with what people, nations, or companies will buy.

2 Countries on the CFIUS excepted list include Australia, Canada, New Zealand, the U.K., and Northern Ireland.

Conclusion

In wrapping up the dialogues, TLSI participants took tours of Dreamscape Learn, and the Compact X-Ray Free Electron Laser (CXFEL).

They returned to the meeting space, where Deborah Wince-Smith thanked the Arizona State University team for hosting and their work in support of the gathering. TLSI co-chairs thanked participants for their great comments and robust conversation, and indicated that the next step is to develop ideas that have been gathered for a succinct Call to Action, and think about audience, how to package, and partnering with other entities to get the information out.

Upcoming Events. Council Executive Vice President Chad Evans reviewed key upcoming events. The next TLSI dialogue is planned for October 31st in Washington, DC. It will be a special event—TLSI's 15th anniversary and Dialogue 30.

There will be three regional Competitiveness Conversations in 2024 and plans are underway for 2025.

- The first will be held April 25-26 at the campus of Vanderbilt University in Knoxville, in partnership with the University of Tennessee. The themes will be advanced mobility, the future of energy, and the future of manufacturing.
- On August 6-8, the Conversation will move to Boise, Idaho and convene at Boise State University in partnership with Idaho National Laboratory. The themes will be the future of energy including advanced nuclear energy, clean tech, cyber security, and microelectronics.

Dreamscape Learn. A collaboration between Dreamscape Immersive and Arizona State University merges the most advanced pedagogy with the entertainment industry's best emotional storytelling.

CXFEL. The compact X-ray free electron laser will be the first of its kind in the world. It will provide X-ray pulses so short they outrun all X-ray damage processes. As a result, scientists can conduct novel science to explore the structure and dynamics of nature and materials as never before.

- On September 9, the Conversation will move to West Lafayette, Indiana and convene at the Purdue campus. As a regional event, it will include leaders from Illinois and Indiana, as well as from the University of Illinois and Argonne National Laboratory. The themes will be chips, qubits and molecules.
- Dates are forming for 2025, and Conversations are expected to convene in Columbia, South Carolina; San Antonio, Texas; Norman, Oklahoma; Santa Fe, New Mexico; Boston, Massachussetts; Salt Lake City, Utah; Denver, Colorado; and, Pittsburgh, Pennsylvania.

The 2024 National Competitiveness Forum will take place December 2-3, in Washington, DC, and will coincide with release of the second report of the National Commission on Innovation and Competitiveness Frontiers.

On November 11-15, the 2024 Annual Meeting and Global Innovation Summit of the Global Federation of Competitiveness Councils will be held at Queen's University in Belfast. The theme will be on place-making innovation.

Addendum: Key Themes & Recommendations in Draft 2024 Call to Action

Overview. The draft 2024 TLSI Call to Action delineates two primary focus areas, extensively deliberated upon during TLSI Dialogue 27, convened by Lockheed Martin at its Advanced Technology Center in Palo Alto, California, on June 29, 2023, and TLSI Dialogue 28, organized by the U.S. Department of Energy's Lawrence Livermore National Laboratory in Livermore, California, on September 21, 2023. Below, we outline the core themes and recommendations from the draft 2024 Call to Action, accompanied by links to comprehensive summaries of the 27th and 28th TLSI meetings in 2023.

Key Themes from Building a New Agile and Adaptive Defense Industrial Base for the 21st Century

Linked full summary report of TLSI Dialogue 27, convened by Lockheed Martin at its Advanced Technology Center in Palo Alto, California on June 29, 2023.

Theme 1: Develop an adaptive and agile industrial base to meet U.S. economic, national security, energy, and sustainability needs.

1. Facilitate faster transitions of new technologies into defense systems and to the warfighter by streamlining processes and reducing bureaucratic barriers.

Theme 2: Optimize the growing defense reliance on new knowledge and technology developed in the commercial sector and universities.

2. Embrace and leverage leadership in emerging technologies from commercial firms, high-tech start-ups, universities, and national laboratories.

Theme 3: Lower Department of Defense cultural barriers to increased use of commercial technologies, and reforming acquisition to speed insertion of cutting-edge technology.

3. Reform the federal acquisition, contracting, and program management culture to encourage risk-taking, new partnership approaches with the commercial sector, and the acquisition of technologies from nontraditional sources.

Theme 4: Embrace the emerging parallel system for defense innovation.

4. Reduce barriers and increase support for small businesses, start-ups, and nonprofits to engage with the Department of Defense, and work to prevent the loss of potentially valuable technologies from these nontraditional partners when they go defunct, as many do.
5. Address financing gaps for the development and scale-up of technology needed in national defense.

6. Enhance the role of universities in national security, defense technology, and industrial base strength by aligning their research focus with translation and commercialization.
7. Enable greater access to restricted defense data for commercial firms and universities to facilitate AI training and data analytics projects.

Theme 5: Deploy technology statecraft with strategic allies.

8. Strengthen alliances and international cooperation to build strategic capabilities, enhance readiness, and address critical supply chain issues.

Key Themes: Reshaping the U.S. Innovation Ecosystem for an Era of Rapid Technological Change

Linked full summary report of TLSI Dialogue 28, organized by the U.S. Department of Energy's Lawrence Livermore National Laboratory in Livermore, California, on September 21, 2023.

Theme 1: Change the culture of research and innovation ecosystems.

1. Foster collaboration and partnerships between government, industry, and universities to promote innovation and align with broader national interests.
2. Focus more on demand-driven investments and projects that prioritize market needs and use cases rather than solely relying on basic research.
3. Accelerate the adoption and scaling of pilot and demonstration projects to attract private investment and achieve faster returns on investment.
4. Encourage a cultural shift in research institutions to prioritize research translation, technology transfer, and collaboration with businesses for commercialization.
5. Explore alternative forms of research translation beyond traditional commercialization to maximize the impact of research on technology development.

Theme 2: Build innovation ecosystems through national domestic strategies.

6. Foster inclusivity and broaden the national innovation ecosystem to include under-tapped communities and regions, increasing overall capacity for innovation across the United States.

Theme 3: Enhance the innovation workforce in critical technologies and industries.

7. Invest in workforce development to meet the demand for scaling emerging technologies and ensure continued U.S. leadership in critical and emerging technologies and industries.
8. Promote a positive narrative about the importance of technology development and translation for national and economic security, and shape to resonate with career seekers.
9. Address negative perceptions about science and engineering, particularly among young people, to foster interest and participation in these fields.

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For more information, please contact:

Mr. Chad Evans
Executive Vice President
cevans@compete.org

Council on Competitiveness
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