

Industries of the Future Institutes: A New Model for American Science and Technology Leadership

President's Council of Advisors on Science and Technology

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Background and Context

- In June 2020, PCAST issued the report *Recommendations for Strengthening American Leadership in Industries of the Future*.
- The report proposed a **revolutionary new paradigm** for multi-sector collaboration—Industries of the Future Institutes (lotFIs)—to address some of the greatest societal challenges of our time and ensure American science and technology (S&T) leadership for decades to come.
- lotFIs will drive research and development (R&D) at the **intersection** of two or more lotF areas to advance knowledge in individual lotF topics and spur new research questions and domains of inquiry at their confluence.



Developing a Framework for lotFIs

- Since June, PCAST has developed **guiding principles** and additional input to help inform the design and implementation of the proposed lotFIs.
- The framework also is intended to serve as **preliminary guidance** for consideration by funders and as a starting point for discussion among those contemplating participation.



Challenges Facing the U.S. S&T Enterprise

- **Multisector Engagement:** The full potential of research partnerships between academia, government, non-profit organizations, and private industry has yet to be realized.
- **Education, Diversity, and Inclusion:** Growing the Nation's S&T enterprise will require developing and expanding the future STEM workforce.
- **Conducting foundational (i.e., basic) research** is considered high-risk because outcomes/practical application are unknown, but this type of research is critical for innovation.



lotFI Vision, Mission, and Values

- **Vision:** Science, technology, engineering, and education advances in lotF will transform American innovation, economic growth, and national security, leading to societal benefits that also ensure U.S. leadership in the technology-based global economy.
- **Mission:** Advance lotF to uplift living standards and quality of life for all Americans, and ensure American economic prosperity and national security, by actively leveraging the full innovative power of the U.S. multi-sector R&D enterprise, including National Laboratories and other government organizations, academia, industry, and non-profit organizations.
- **Values:** lotFIs model the highest standards of ethical behavior, including integrity, honesty, openness, sharing, respect, vigorous and civil debate, transparency, accountability, safety, security, and diversity in all its forms.



Key Goals of lotFIs

- Accelerate knowledge advancement through **multi-disciplinary, multi-sector, and multi-generational collaborations** across the research spectrum, from foundational research to market deployment.
- Cultivate an environment that promotes **free-flowing intellectual inquiry** and fosters creativity to address societal challenges.
- Design and implement frameworks for the **rapid development and deployment** of technological innovations.
- Shape **future scientists, engineers, technologists, and other STEM professionals** by engaging students and STEM educators.
- Serve as a **proving ground** for new, creative approaches to organizational structure and function; broadening participation; workforce development; STEM education; and methods for engaging all sectors of the American research ecosystem;
- Design and offer in-person and virtual educational and experience-based **learning programs**.
- Contribute to frameworks, policies, and practices for **responsible, ethical, and equitable design and use** of technologies of the future.



What makes lotFIs unique?

- A model that **goes beyond** existing R&D organizations such as National Labs or federally funded R&D centers.
- **Minimal regulation** and administrative processes.
- Leverage **synergy** between multiple lotF fields.
- **Agility** in operations and management.
- **Freedom** for researchers to shift their R&D focus easily in efforts to innovate and work toward the Institute's vision.
- Involvement of **all sectors** (including industry) as integral partners.
- Utilization of **diverse funding sources** beyond Federal support.
- Simple, customizable, flexible, and reasonable **IP framework**.

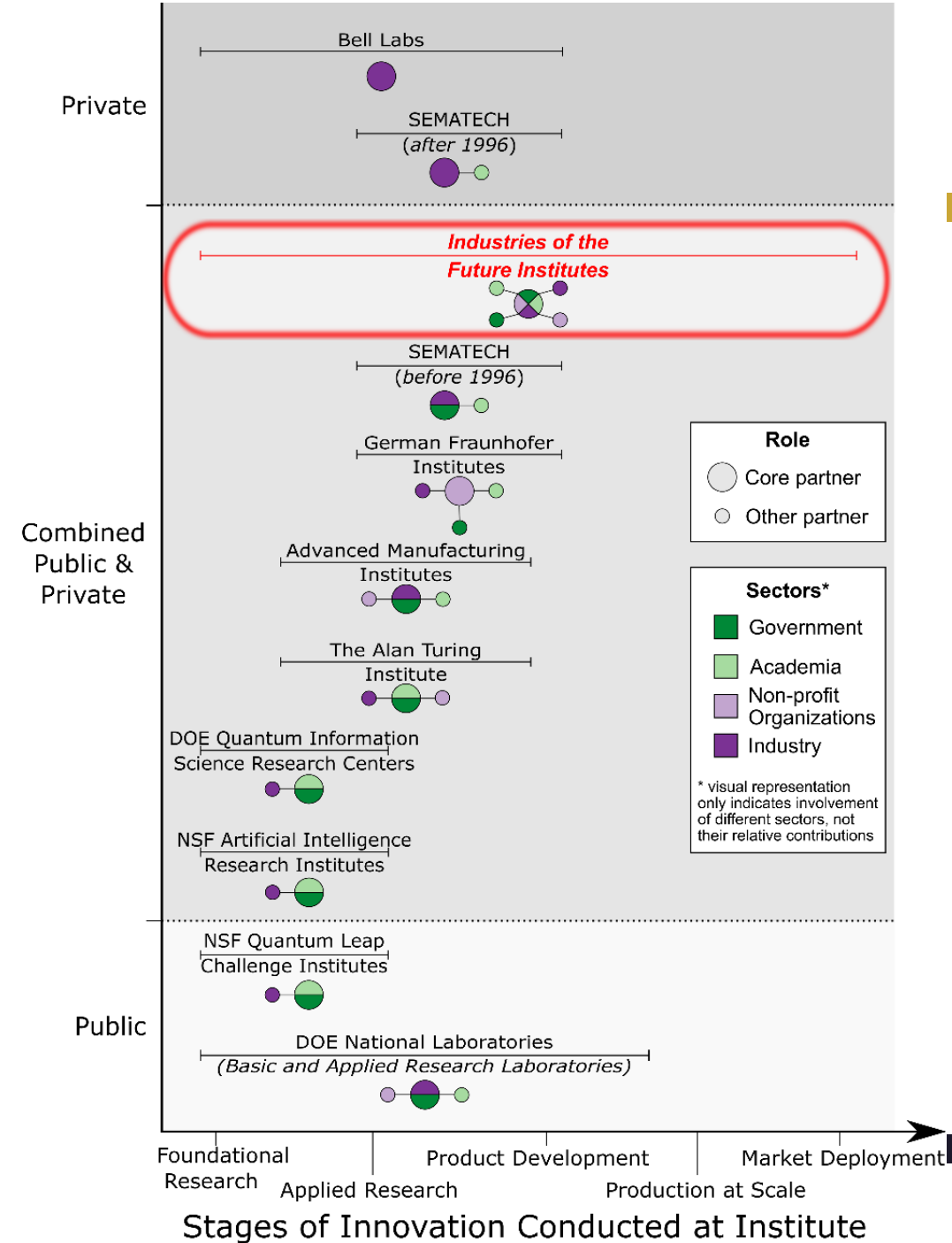


Vision for lotFI in R&D Landscape

- Depiction of several R&D organizations' research foci and participating sectors within the innovation landscape.
- lotFIs will be unique by virtue of having **core partners from each sector** and having activities that span the entire innovation spectrum.



Funding Source



Value Proposition for Participating Organizations

- **Academic Institutions** will gain new opportunities to translate their research to at-scale implementation within the lotFIs.
- **National Laboratories** will both contribute to and have access to lotFI-generated solutions to technical challenges linked to their mission objectives.
- **Private Companies** will benefit from more flexible and agile access to partnerships with the other participating sectors.
- **Non-Profit Organizations** will benefit by having direct engagement with an organization conducting cutting edge technology R&D.
- **The Federal Government** will participate as a key funder and reap the benefits accrued to society.





IoTFI Characteristics

Governance and Operational Management

- Each lotFI will establish its **own leadership and organizational structure** to reflect its objectives and activities, with some features consistent across all (e.g., Board of Directors, full-time Executive Director).
- Each lotFI's leadership structure will be **lean** to maximize resource allocation to program work and minimize overhead.
- All participating sectors should have balanced—and ideally equal—**partnership** at the lotFI coordination and oversight levels to ensure shared responsibility and accountability.
- A **National lotFI Office** should be established to enable and facilitate cross-fertilization and synergy among lotFIs.



Personnel and Staffing

- Research projects will **team** individuals from multiple disciplines, sectors, and backgrounds across all career stages.
- lotFIs will operate flexible **personnel structures** to allow the seamless flow of researchers, faculty, technologists, and others between their home institution and the lotFI.
- Each lotFI will prioritize having **diversity**—in all its forms—in every element of the organization.
- lotFIs will recruit both **domestic and international** talent.
- lotFIs should **compensate** their interns, students, and fellows sufficiently to enable participation regardless of socioeconomic status.



Mentorship

- lotFIs will be well-situated to provide a truly **unique mentorship experience** because they are multi-sector, cross-disciplinary, and multi-generational organizations.
- Research has shown **mentorship** is a key factor in improving STEM graduate degree completion rates.
- Students and early-career professionals may not have access to mentors with experience **outside of academia** to inform them of the myriad career options available to someone with their expertise.
- Evidence suggests **mentorship** is linked to increased job satisfaction, career success, organizational commitment, and higher job performance for mentees.
- lotFIs should ensure their researchers have **protected time for mentorship**, the **option to choose their mentor**, and the option to have multiple mentors from across the participating sectors and scientific disciplines.



Foundations for the Future STEM Workforce

- Education, Training and Professional Development
 - Opportunities for professional development and mentorship will be **intrinsic** to each Institute’s design and available to all members of the lotFI community, at every career stage and organizational level.
- Community Outreach and Inclusion
 - lotFIs will support their **local communities** by engaging individuals with little previous experience or opportunity in STEM to help promote excitement, enthusiasm, education, and skills development in lotF-related areas.
 - Each lotFI will create an “in-house” program to provide “up-skilling” and re-skilling training and job placement assistance for **local and regional workers**.
 - The National lotFI Office should offer lotF **certificate programs** (in-person and virtual), with assistance in development and course teaching from staff at the individual lotFIs.



Business Structure

- Structuring lotFI operating partnerships as **Limited Liability Corporations (LLCs)** is likely the most appropriate framework given lotFI goals and activities.
- An LLC would provide **flexibility** to determine how to manage financial support from participating organizations and companies, business income from licensing fees for commercialized products, and benefits from the lotFI inuring back to the lotFI participants.
- The lotFIs may also choose to set up separate but parallel 501(c)(3) **charitable foundations**.



Funding

- **lotFI seed funding** is envisioned to come from multiple Federal agencies.
- Over time, the preponderance of funding would come from **participating organizations** beyond Federal agencies.
- Funding profiles are expected to vary among individual lotFIs to be **tailored** to each institute's specific work.
- **State and local governments** also can provide support to attract lotFIs to their region.



Intellectual Property Management

- lotFIs will establish a simple, customizable, flexible, and reasonable **IP master agreement framework** to create favorable conditions across the innovation spectrum for participation and contribution from lotFI partners.
- Enhance **IP protection** for AI-related assets (such as software) while ensuring ease of sharing information and capabilities for the benefit of lotFI research.
- A trusted, independent, **neutral party** could manage complex data sets for the common good of the lotFI without divulging competitive secrets.
- **Flexibility and breadth** will be essential to encourage participation from all sectors of the S&T enterprise and for all players along relevant value chains.



Program Evaluation and Defining Success

- lotFIs will be successful if they contribute to the **generation of new knowledge and practical deployment** of technology that advances areas of national need—e.g., empowers the economy, creates high-paying jobs, supports national security, and improves the health and well-being of all Americans.
- Progress should be measured, but with **low administrative burden**.
- lotFIs could develop a 10-year **strategic plan** (updated bi-annually) and a bi-annual business plan stating annual goals, objectives, and metrics for success.



Summary

- PCAST believes lotFIs have potential to **fill important gaps** in the U.S. R&D landscape by bringing together experts from all stages of the innovation spectrum, across all sectors of the R&D enterprise, and across multiple generations, to work at the intersection of two or more lotF areas.
- lotFIs are designed to spur innovation by serving as a **proving ground for new approaches** to governance, IP management, and innovative research.
- This framework is not intended to be prescriptive but rather to provide **broad contours and inspiration** to the scientists, engineers, and innovators across all sectors who will come together to breathe life into the lotFI concept.



Next Steps

- Obtain input from the research community and others who may be interested in participating in lotFIs:
 - Possible request for information (RFI)
 - Convening sessions via associations, the National Academies, and others
 - Town hall listening sessions

