NASEM Committee on Research and Application in Team Science

Research and Application in Team Science – Meeting 3, May 29, 2024

Team Science from an R&D “Practitioner” Perspective

FIELD NOTES

Evolving Organizational Dynamics at the DOE National Labs—Implications for Diverse Team Science and Future Research Questions

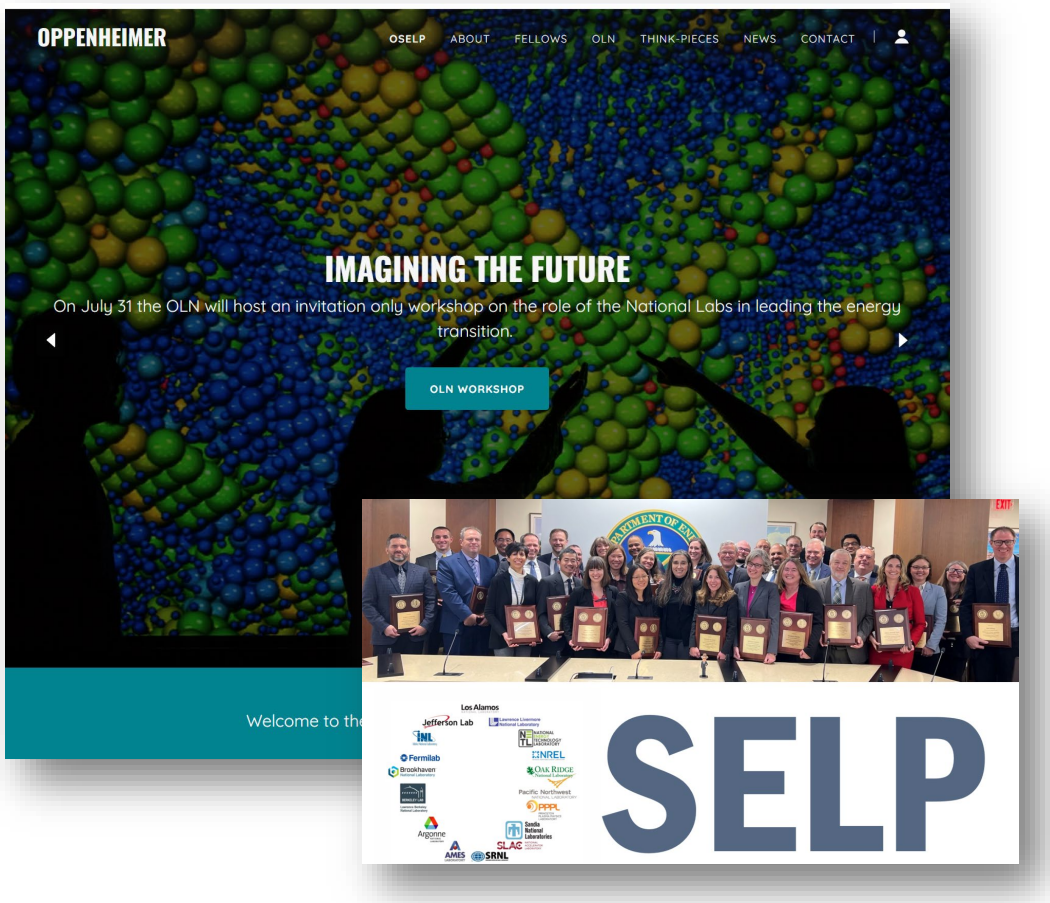
Kevin L. Doran, J.D.
Director, Oppenheimer Science and Energy Leadership Program

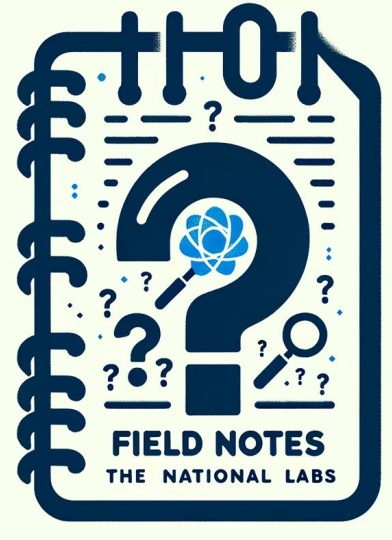
Institute Fellow & Research Professor
Renewable and Sustainable Energy Institute
NREL and CU Boulder

“Field” Notes: Evolving Organizational Dynamics at the DOE National Labs—Implications for Diverse Team Science and Future Research Questions

- OSELP is a distinguished fellowship program that convenes leaders to explore the complexities, challenges and opportunities facing the DOE and the National Lab system.
- All 17 DOE National Labs participate in OSELP.
- Program provides an immersive, deep-dive into the intricacies of the system, exploring not just “what” the Labs do, but “why” and “how”—and “should” they do it this way.
- As OSELP Director, I have led 7 cohorts through the fellowship program.
- These “field” notes are drawn from my experiences as OSELP Director. **These views are mine alone and do not represent the views of DOE or the National Labs.**

Oppenheimer Science and Energy Leadership Program





THE APPROACH

- ✓ **Observations grouped into three categories, followed by some discussion notes.**
- ✓ **Questions on how these might impact diverse team science at the National Labs and other institutions—including implications for the pace and impact of S&T innovations.**
- ✓ **Importantly—no answers!**

FIELD NOTES
THE NATIONAL LABS

FIELD NOTE CATEGORIES

A Shift Toward Meta-System Capabilities

- ❑ Distributed User Facilities and Enabling Hubs
- ❑ Data, AI/ML, and Meta-Systems

Organizational Oversight and Management Models

- ❑ (Dis)incentivizing Systems

Evolving Dynamics in Organizational Cultures

- ❑ Shifting Demographics
- ❑ Tension Points

Potential Impact On?

- **Diverse Team Science**
- **Pace of Innovation**
- **Mission Impact**

A Shift Toward Meta-System Capabilities

Observation 1: There is increasing focus on creating systems that link distributed assets—infrastructure, data, capabilities—to enable collaborative science and technology innovation.

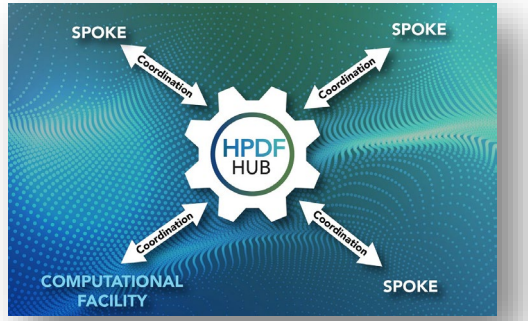
Observation 2: Significant potential exists to harness AI/ML to further leverage scientific resources both within and across institutions.

A Shift Toward Meta-System Capabilities

Discussion notes on the shift toward linked, distributed capabilities.

- The **High Performance Data Facility** (JLab lead, with LBNL; 2028) will leverage DOE's user facilities, scientific data sets, and computing resources to expand and accelerate engagement in discovery and innovation.
- HPDF will allow researchers to rapidly access data from DOE sources and facilities—including in real time.
- HPDF is a cornerstone of DOE's Integrated Research Infrastructure (IRI) program, which seeks to enable **seamless integration of scientific facilities, data management and computing to power scientific discovery**.

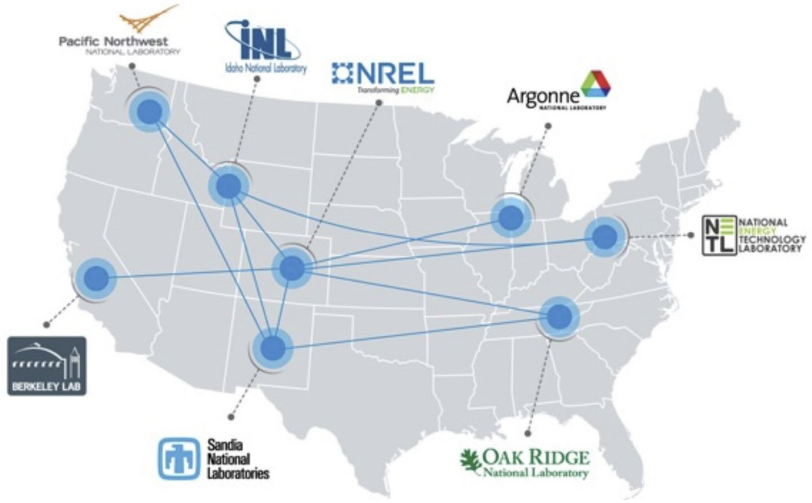
HPDF
High Performance Data Facility
A Partnership of Jefferson Lab & Berkeley Lab



A Shift Toward Meta-System Capabilities

- On the applied side, the **Advanced Research on Integration of Renewable Energy Systems (ARIES)** an example of linking distributed assets—across a single lab—to facilitate innovation.

- ARIES links distant DOE capabilities using ESnet, connecting to other DOE labs around the country and integrating mission across DOE (FECM, NE, OE, SC).



ARIES by NREL

A Shift Toward Meta-System Capabilities

- Kevin Yager and others at Brookhaven National Laboratory are using AI/ML to explore autonomous experimentation (AE) at the Complex Materials Scattering (CMS) beamline, part of BNL's National Synchrotron Light Source II.

- The team used AI/ML to automate the entire workflow of an experiment, **including decision-making**, with the goal being to "**liberate scientists to tackle more challenging and complex problems**."

"AE should play a role in [foundation] models. AE could leverage such a model to provide high-quality physics-grounded decisions (even before the first data point has been collected)."

(K. Yager, 2023)

A Shift Toward Meta-System Capabilities

Questions to consider related to team science

- ❑ How can this shift toward linked capabilities and systems be **more fully leveraged** to improve diverse team science?
- ❑ What **other distributed resources** could be similarly linked into an integrated discovery ecosystem?
- ❑ What **barriers** need to be addressed for diverse communities to engage in these or similar initiatives?
- ❑ What Communities of Practice should be created to ensure **broad engagement** in these types of efforts?
- ❑ What **new organizing models** might be used to link interdisciplinary and transdisciplinary communities?
- ❑ What **new disciplines** might emerge that blend, e.g., AI/ML expertise with domain knowledge to harness linked systems?

Organizational Oversight and Management Models

Observation: DOE's use of Management and Operating (M&O) contractors to execute the mission of its 16 Government-Owned, Contractor-Operated National Labs has proven **exceptionally successful** at catalyzing S&T innovation.

As currently structured, aspects of the model may incentivize strategies, reward systems, and organizational structures that complicate the goal of advancing large-scale team science.

Organizational Oversight and Management Models

Discussion notes on potential impact of current models and the goal of advancing large-scale team science.

- Current process can make it **difficult for new organizational entrants** to compete, as they may lack “DOE” equivalent qualifications that make them competitive bidders.
- Process can also make it harder to **introduce diverse leadership** that does not have DOE experience.
- Contractors can become more **risk adverse**, particularly in periods closer to potential contract extensions.
- The model can incentivize leadership to **prioritize growth in new program areas** not substantively connected to the core historical capabilities to hedge against funding vagaries.
- The model can lead to **incentive structures** that reward senior leaders for growing their respective portfolios, but not for collaborative efforts.

Organizational Oversight and Management Models

Questions to consider related to team science.

- Might the lack of organizational diversity that results from the current process result adversely impact team science, as repeat players could be **less likely to consider** new models, new ideas, and be less willing to perturb the system?
- Are the reward structures in place by some entities **detrimental to incentivizing** team collaborations within the lab, across labs, or with other partners?
- Might efforts to expand in programmatic scope to address funding vagaries **dilute effective teaming** efforts in main-line domains or have other **unintended consequences**?
- Does the construct increase the potential for **goal misalignment** between teams?

Evolving Dynamics in Organizational Cultures

Observation 1: The demographics of National Lab staff are changing. Average lab staff are younger and have been **employed at the lab for significantly less time** than in previous years.

Observation 2: There is a growing tension between open science cultures and the need to maintain research security postures, due both to **geopolitical dynamics** and **expanding program portfolios** that move labs into sensitive domains.

Evolving Dynamics in Organizational Cultures

Discussion notes on tensions between open science and research security.

- On changing demographics—from the 2023 LLNL Annual Report: "**Nearly half** of our employees have been at the Laboratory less than five years." From the LANL website, 2024: "**over 50%** of the Lab's workforce has worked at the Lab for less than five years. Additionally, this has resulted in a situation where there is an increased early employee need **for improved mission connection**."
- Many of the National Labs are moving into new program areas, including NNSA and national security work for those Labs that **have not typically been engaged in these areas**.
- Growing geopolitical tensions are pushing agencies and policy-makers into **more highly-controlled regimes** for many types of research. As a result, there is a **growing tension** between the culture of open science that leverages large teams and research security policies and concerns.

Evolving Dynamics in Organizational Cultures

Questions to consider related to team science.

- How should institutions adapt to having such a high percentage of workers that have only been there a short while? What **training** and **mentorship** is needed?
- With a growing percentage of “new” researchers, how should the National Labs intentionally work to create **teaming cultures**?
- Often learning how to **navigate large S&T organizations**—or across them—takes many years. How can institutions help the newer staff do this faster, with more confidence? What lessons can the labs learn from other institutions and sectors?

Evolving Dynamics in Organizational Cultures

Questions to consider related to team science.

- What impact will the increased focus on research security have on **collaborative team science**—between the National Labs and domestic university partners, international collaborations, or within the National Lab system?
- What **approaches** could be used to support portfolio growth into sensitive areas while also ensuring collaborative team science is not unduly impacted?
- What **best practices** are peer institutions in other countries using to address concerns to protect collaborative team science while also addressing legitimate research security issues?

Conclusion

- In exploring the relationship between team science and DEIA, as well as best practices, barriers, impacts, examine the **structures and underlying conditions** that shape what is possible related to team science.
- What **research questions or policy issues** exist at these structural levels relevant to advancing diverse team science?