New Models of Engagement for National Laboratories

Proposed Recommendations

Subcommittee on New Models of Engagement for Federal and National Laboratories in the Multi-Sector R&D Enterprise

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Objective and Recommendations

Objective: Determine if new collaboration models are necessary to accelerate American innovation and leadership in Industries of the Future (IotF)

Summary of Recommendations:

Establish a new type of world-class, multi-sector R&D institute, the "IotF Institutes," that catalyze innovation at all stages of R&D – from discovery research to development, deployment and commercialization of new technologies with the following goals:

1. *Collaborate across America's S&T enterprise*
2. *Drive IP terms for commercialization at scale*
3. *Leverage regionally impactful hubs for technology, economy & skilled labor*

Private Sector Key to Accelerate Innovation & Commercialization at Scale in the US

[1] *Return on Investment Initiative, To Advance the President's Management Agenda*, Final Green Paper, National Institute of Standards and Technology, April 2019, https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1234.pdf, accessed June 4, 2020.

Background and Context

The Subcommittee concludes that:

- We have a strong R&D capability & foundation in our National & Federal Labs
- Public-Private partnerships are essential to American success
- Invention is omnipresent in National and Federal Labs; **however,**
  - commercialization & innovation at scale are inhibited
  - reduction of administrative load and historical barriers are needed to accelerate innovation

The Subcommittee sees a need to leverage the strength and substantial assets of America's National Laboratories to enhance and accelerate front-to-back progress in IotF through bold new collaborative models

Concept

The IotF Institutes will bring together world-leading researchers from different disciplines to spur blue-sky discovery motivated by practical end goals, leveraging two or more IotF.

They will be unique, transformative environments that accelerate the pace of fundamental research while forging a path to commercialization of new products and services, with a goal of substantial positive economic impact for the US.

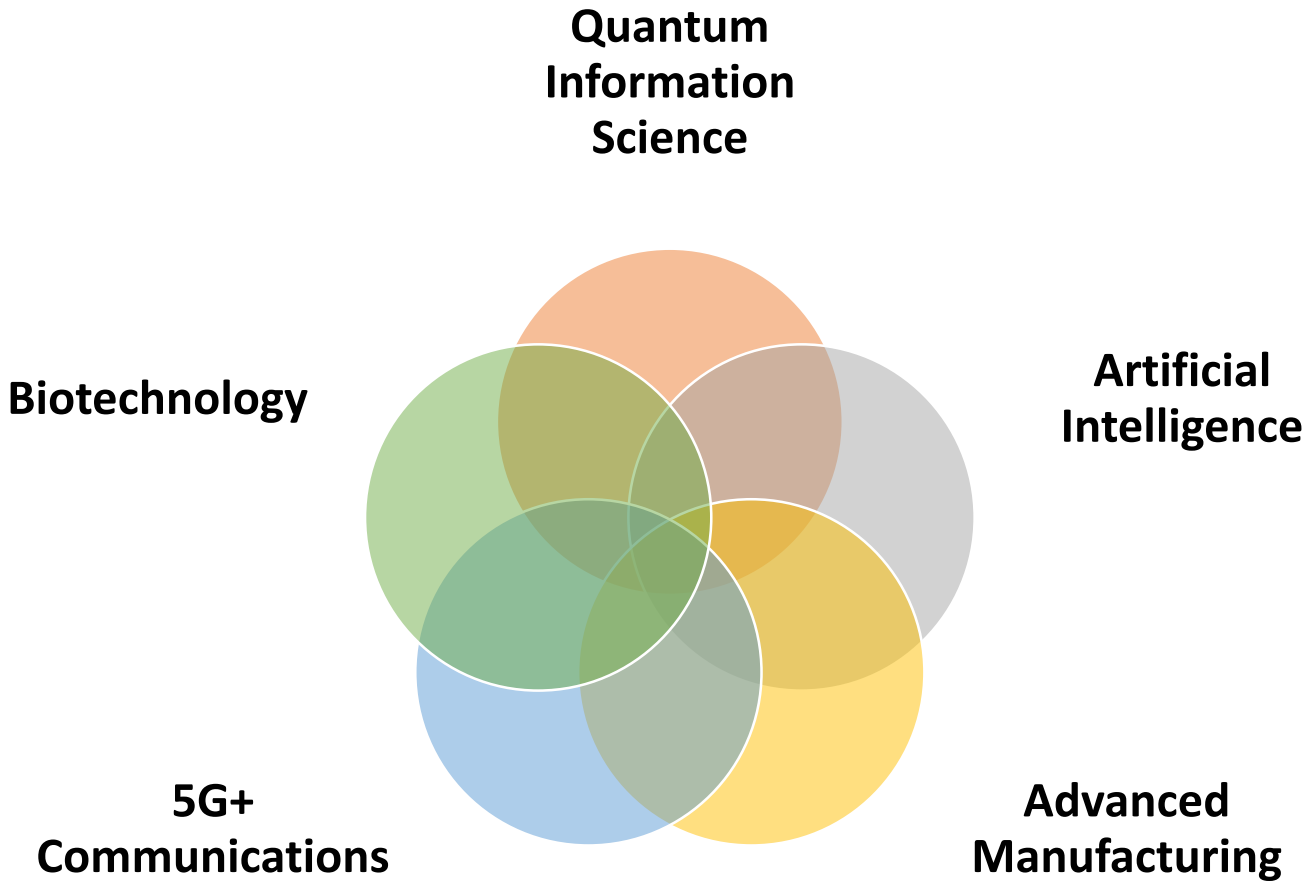
Rationale for Combining IotF Elements in IotF Institutes

Independently:

Advances in each of these industries are important in their own right, with great opportunities for discovery.

Combined:

The convergence of these fields promises to accelerate progress, with the potential for profound societal benefits.



IotF Institute Features

1. **Facilitate Collaboration Across America's S&T Enterprise**
   - Portfolios of collaborative R&D projects driven by public-private partnerships
   - Expertise at the intersection of two or more IotF pillars
   - Projects ranging from fundamental research to technology demonstration
   - Complementary to established federally supported programs
   - A unique confluence of world-class researchers with a launch-pad for early-career researchers

2. **Pilot IP terms that promote translation of discoveries to solutions**
   - Incentivize participation & innovation from Industry, National Labs, Academia, & Non-profits
   - Drive development and commercialization of IotF technologies at scale

IotF Institute Features

3. Promote regional technology, economy & skilled workforce development

- Maximize multi-sector collaboration
- Serve as regional hubs for technological, economic, and skill development
- Leverage Opportunity Zones and other incentives for participation and economic growth

4. Chart a technology pathway to **Factories of the Future (FotF)**

Technology Pathway to Factories of the Future (FotF)

PCAST envisions *Factories of the Future* (FotF) that will use advanced physical and virtual assets to dramatically enhance versatility and efficiency.

- **Additive Manufacturing** technologies will provide on-demand adaptation and customization of parts, enabling on-the-spot repairs and improvements in manufacturing operations.
- **Digital Twins** allow manufacturing companies to understand their entire factory by mirroring operational performance computationally; when coupled with additive manufacturing could revolutionize mass production of goods.
- **Competitive Advantage in the Plant:** Once digital twin status is achieved, the global competitiveness of U.S. manufacturing will be greatly enhanced by facilitating prediction of failure modes well in advance of the physical realization and consequently realize associated competitive improvements in FotF output.

Technology Pathway to Factories of the Future (FotF)

- **Competitive Advantage across Supply Chains:** The digital twin concept can also be extended beyond the manufacturing plant to encompass entire supply chains; from the supply of raw materials and goods, to individual plants, to downstream distribution of finished goods.
- **Complexity Conquered by IotF:** These logistics and supply chain relationships are complex. The combination of reliable digital twins with smart manufacturing (Industry 4.0), along with emerging AI/ML and quantum computing capabilities, will enable an unprecedented competitive advantage for American industry, enabling badly needed acceleration of commercialization of innovation at scale.

Contemplated Flagship IotF Institutes

IotF Institute on integration of AI and Advanced Manufacturing:

Objective: These institute will drive innovation that supports future US competitiveness in manufacturing.

IotF Biotechnology Institute: integration of AI and advanced manufacturing in the context of biotechnology

Objective: Better fundamental understanding of phenomena within the cell. This will provide mechanistic foundations for biosecurity, food security, advanced therapies, and biosphere sustainability.

Engagement Opportunities by Sector

Entity	Recommendations
Industry	• Industrial partners including those with proven delivery at scale should participate in proposals for the IotF Institutes to accelerate the impact of IotF on manufacturing. • Develop reliable digital twins which leverage on AI/ML and QIS, and reliably predicts performance and failure modes of Factories of the Future (FOTF)
Academia	• Proactively adapt curricula in STEM disciplines for IotF • Promote cross-discipline efforts rooted in data science • Foster collaboration to drive integrated efforts across IotF • Partner with National labs and industry for IotF Institutes

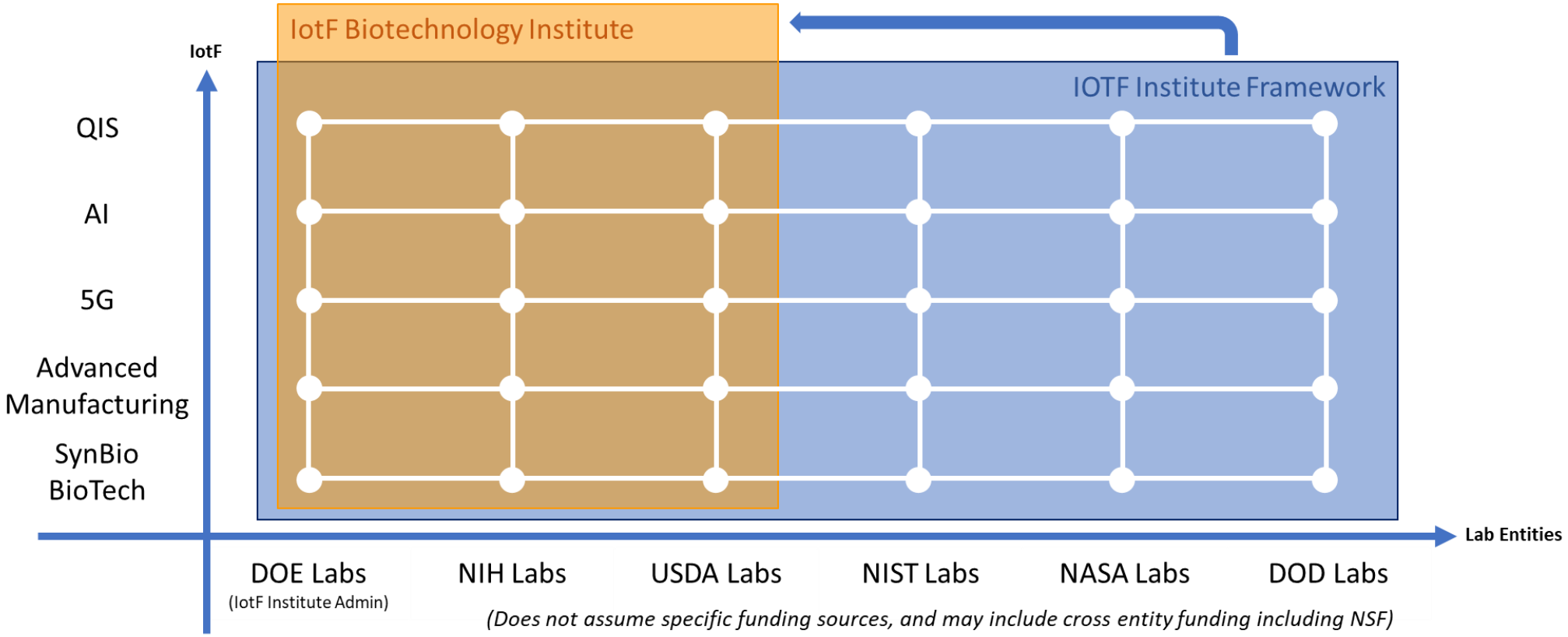
[1] https://www.energy.gov/labcommission/downloads/final-report-commission-review-effectiveness-national-energy-laboratories

Engagement Opportunities by Sector

Entity	Recommendations
Federal Government	• Establish framework for IotF Institutes administered by the DOE • Work with Industry to establish Intellectual Property terms for the IotF Institutes • Expand the capabilities of the domestic manufacturing supply chain via digital twins. • Leverage the Economic Opportunity Zone approach to incentivize economic development

[1] https://www.energy.gov/labcommission/downloads/final-report-commission-review-effectiveness-national-energy-laboratories

IotF Institutes: Broad Impact on America's Lab Enterprise and IotF



Strategic Recommendation to Federal Government:

Introduce policy in the near term formalizing the design and implementation of IotF Institutes.