

Enhancing Multi-Sector Engagement in IoT Research and Innovation

Proposed Recommendations

**PCAST Subcommittee on American Global Leadership in
Industries of the Future**

June 30, 2020



Subcommittee on American Global Leadership in Industries of the Future

Subcommittee Chair

Darío Gil
IBM Research

Subcommittee Members

Dorota Grejner-Brzezinska
The Ohio State University

A.N. Sreeram
Dow, Inc.

Hussein Tawbi
M.D. Anderson Cancer Center
University of Texas

Birgitta Whaley
University of California, Berkeley
Lawrence Berkeley National Laboratory

National Science Board Liaisons

Suresh Garimella
University of Vermont

Daniel A. Reed
University of Utah

Subject Matter Experts

Michael Kratsios
OSTP

Lynne Parker
OSTP



Background and Context

- AI, QIS, 5G, Advanced Manufacturing, & Biotechnology are critical Industries of the Future (IoT)
- The Subcommittee was asked to identify meaningful, near-term actions that could be taken to accelerate progress in the IoT
- The Subcommittee focused on AI and QIS, and on deepening multi-sector engagement



Priorities

- *Advance the lotF to keep the U.S. at the leading edge of scientific discovery*
- *Leverage lotF discoveries and technology to improve the Nation's ability to respond to critical challenges, such as global health crises*
- *Enable Accelerated Discovery across S&E by combining AI, QIS, & HPC*
- *Ensure an AI- and QIS-capable workforce*



Artificial Intelligence

- AI has emerged as one of the most important technologies of the era, affecting all industries and economies
- Advances have been driven by algorithmic advances, exponential growth in computing power, and availability of data
- AI is playing an important role in knowledge capture and analysis to improve understanding of and response to COVID-19
- Many Federal activities are underway
- The Subcommittee sees a need to increase investment and strengthen multi-sector partnerships for AI R&D



AI Recommendations

1. Grow Federal investment in AI R&D by 10x over 10 years

Table 1. Proposed Federal Budget Ramp for Non-Defense AI Research

2020	2022	2024	2026	2028	2030
\$1B	\$2B	\$4B	\$6B	\$8B	\$10B
Consistent with 2021 Federal Budget Request		Recommending sustained investment growth of \$1B/year in non-defense research funding through 2030			



AI Recommendations

2. Accelerate translational research in AI

- *Encourage all U.S. Federal agencies to elevate the importance of partnerships with industry to develop & deploy AI applications at scale*
- *Create “AI Fellow-in-Residence” positions in Federal Agencies*
- *Pioneer and scale novel academia-industry AI partnership models*



AI Recommendations

3. Create National AI Testbeds

- *Secure U.S. industry investment pledges to support core AI infrastructure*
- *Expand the ongoing NSF-based programs to establish national AI research centers and infrastructure*
- *Direct the AI Science mission at the National Labs and across Federal agencies to drive the technical foundation for doing AI-powered science*
- *Task Federal Agencies such as NIST and NIH to curate, manage, and disseminate AI-ready large data sets*



AI Recommendations

4. Foster increased international collaboration in AI with key U.S. Allies

- *Establish international partnerships in AI R&D*
- *Define joint international research programs in AI*

5. Attract and retain the best global talent in AI

6. Establish an AI maturity model

- *NIST should lead, working with other Federal agencies and industry*
- *U.S. industry should become an active stakeholder in the creation of precision regulation to create trustworthy AI*



AI Recommendations

7. Drive opportunities for AI education and training*

- *Secure U.S. industry pledges to scale investments on training and education of the U.S. workforce in AI*
- *Develop AI curricula and performance metrics at K-12 through postgraduate levels and for certificate/professional programs*
- *Train a highly skilled AI workforce at secondary schools and universities*
- *Create incentives, recruitment and retention programs for AI faculty at universities*
- *Increase NSF and Department of Education investments in AI educators, scientists and technologists at all levels*



Quantum Information Science

- Includes quantum computing, quantum communications & networking, quantum sensing & metrology
- Collectively, these areas represent the next frontier in the worlds of information processing and computation, secure communications, novel navigation systems, and beyond
- Many Federal activities are underway
- The Subcommittee proposes recommendations including cross-sector partnerships, to help accelerate U.S. Leadership in QIS R&D



QIS Recommendations

8. Engage industry in building world-class quantum infrastructure at scale

- *Invest in design, construction, and deployment of high availability quantum computing systems*
- *Develop a roadmap to at least double system performance annually*
- *Build cloud-based quantum computational centers and associated services*

9. Invest \$100M annually over 5 years to create Federally funded National Quantum Computing User Facilities

- *Leverage output of the industry investments in building quantum computers, make critical resource available to scientists at US national laboratories and universities*



QIS Recommendations

10. Lead the world in the creation of a Quantum Internet and Intranet

- *Develop common infrastructure for new quantum communication technologies, exploit synergies between quantum computing and communication*

11. Attract and retain the best global talent in Quantum Information Science and Technology

12. Foster discovery-based science across all sectors

- *Explore the frontiers of QIS and related technologies and build top-level intellectual capacity at the boundaries of both foundational and applied research*



QIS Recommendations

13. Provide curated access to quantum technologies

- *Develop three-way alliances between sectors to speed development of practical quantum computing applications*

14. Create a pre-competitive quantum research collaboration

- *Industry supported academic teams to influence long-term development of hardware, work with QED-C to realize 5-year programs*

15. Create Foundational Discovery Institutes

- *Develop academic-industry consortia focused on foundational and blue-sky research in QIS, facilitated by private foundations and government agencies*
- *Establish academic teams to target crucial issues for quantum technologies*



QIS Recommendations

16. Educate to build a quantum-enabled workforce

- *Lead the world in creation and delivery of quantum educational and training programs at all levels, including pre-and post-college and non-skilled workforce*
- *Leverage academic-industry partnerships to create new curricula, teaching across traditional disciplinary boundaries of science and engineering, co-teaching by lab, industry, and academic scientists*
- *Create novel industry-relevant training and skills-based certification programs*
- *Leverage federal programs to establish new QIS hiring and internships, cross-disciplinary training, and to drive diversity and inclusion in the quantum workforce*



QIS Recommendations

17. Build international R&D collaborations at the Frontiers of QIS

- *Develop small scale discovery-based partnerships between US universities and selected foreign university partners to explore fundamental research in key areas*

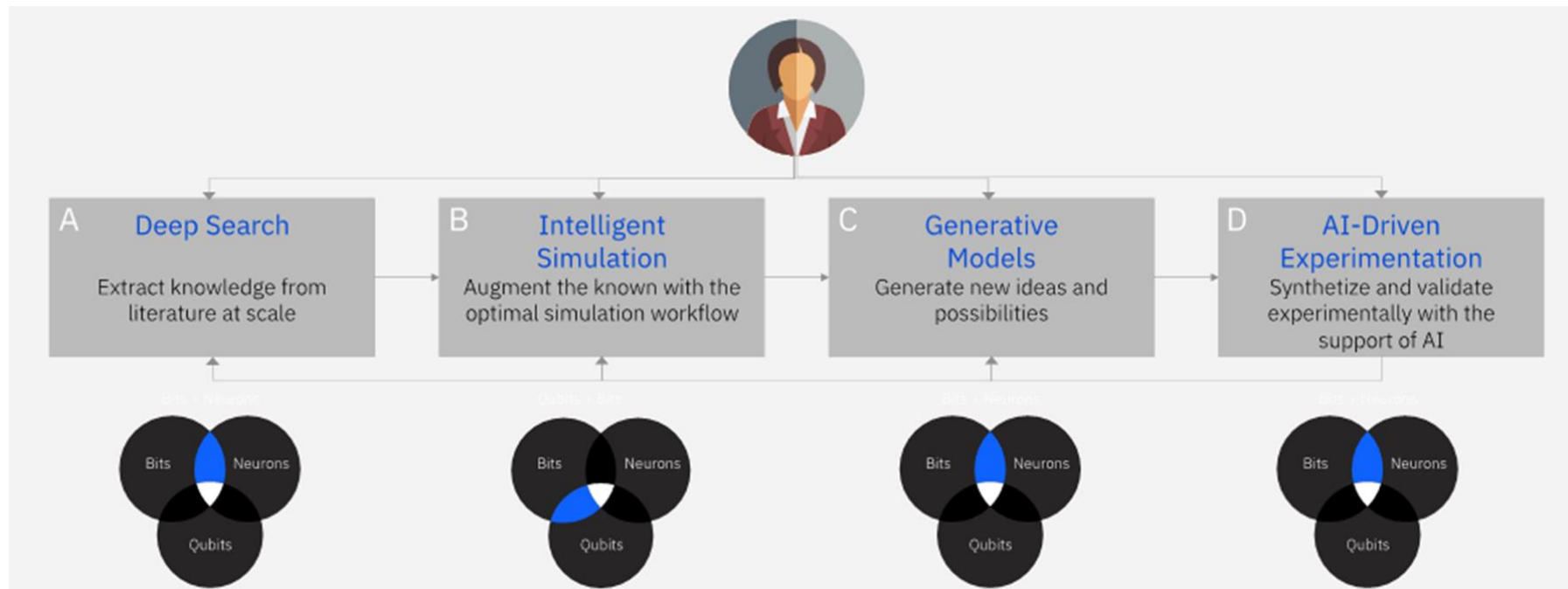
18. Foster national security

- *Continuously evaluate security implications of QIS*



Accelerated Discovery

- Combining the complementary capabilities of AI, QIS, and HPC has the potential to transform discovery across all areas of S&T
- The U.S. should prepare now to harness the power at this convergence



Recommendations for Accelerated Discovery

19. Expand and redefine the mission of the National Strategic Computing Initiative

20. Pilot the *Accelerated Discovery* Workflow in the Newly Proposed lotF Institutes*

21. Re-energize and scale up the Materials Genome Initiative (MGI)

