Quantum Economic Development Consortium (QED-C)

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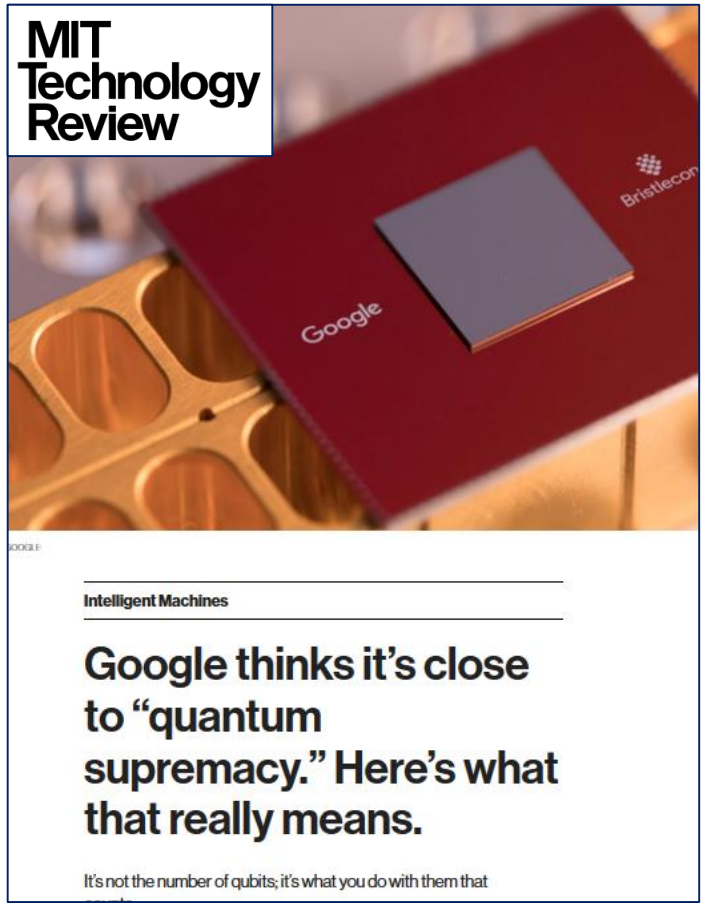
SRI International

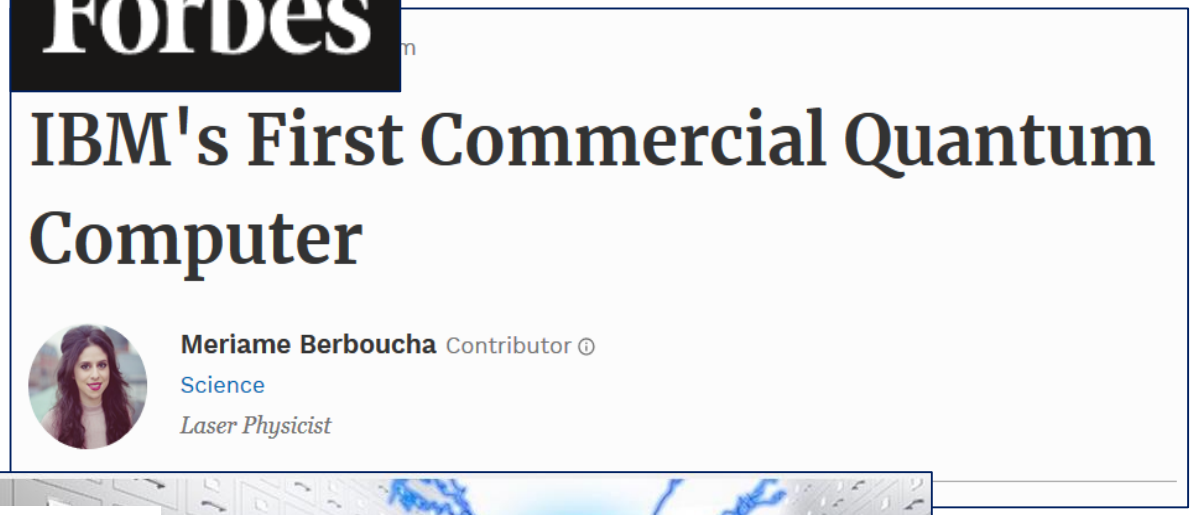
- The Quantum Landscape
- Federal Action: National Quantum Initiative
- Government-Industry Action: Quantum Economic Development Consortium

Quantum Science & Technology Landscape

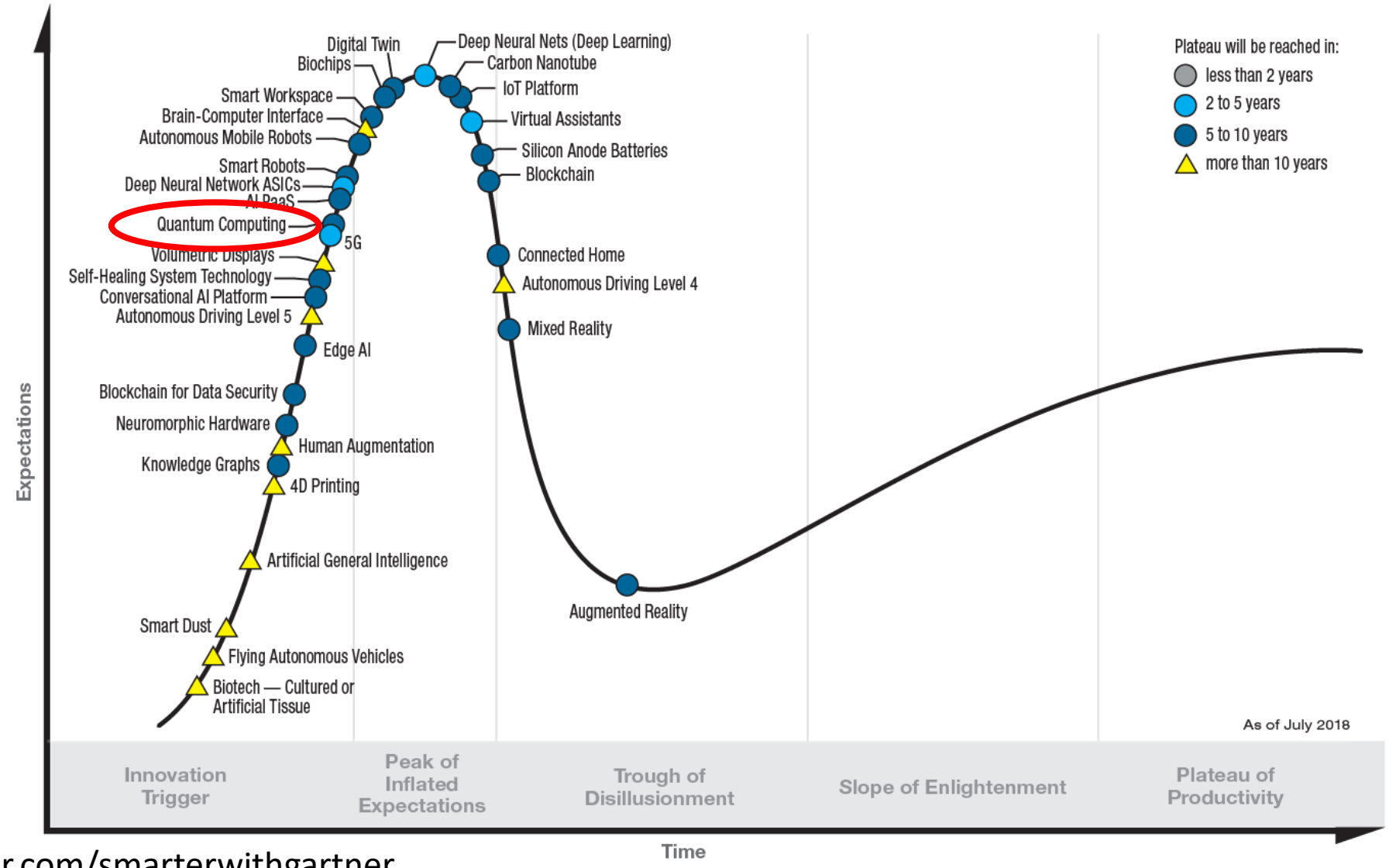
- S&T advances across many disciplines (“supply”, “push”)
  - Materials (e.g. topological insulators; atomically precise doping); devices (aka qubits) and components; coherence; error correction; algorithm development
  - Reports highlighting opportunities and applications (e.g. NSF, DOE, AFSB)
- Technology need (“demand”, “pull”)
  - Post Moore’s Law
  - More precise technology for communications, navigation, etc.
  - Post quantum cryptography (see 2018 NRC report on feasibility and implications of quantum computing)
- Industry investing heavily in R&D

Industry Making Big Bets…





Gartner Hype Cycle for Emerging Technologies, 2018



Source: Gartner.com/smarterwithgartner

Birth and Development of an Industry

First Transistor, 1947
Shockley, Bardeen, and Brattain

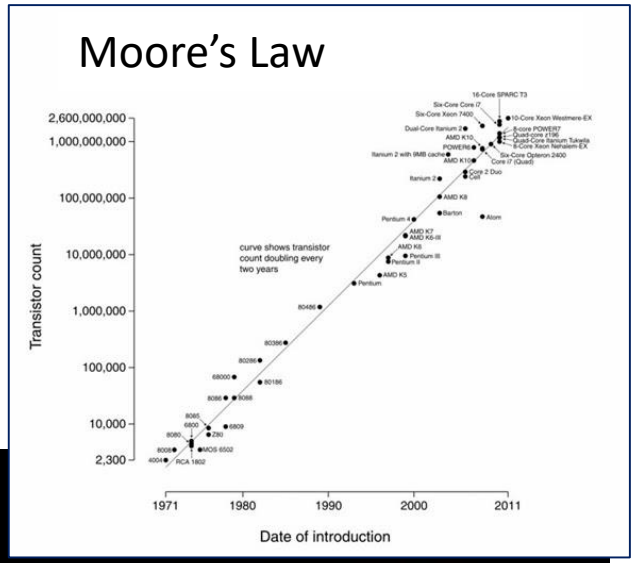
FROM LAB TO FAB

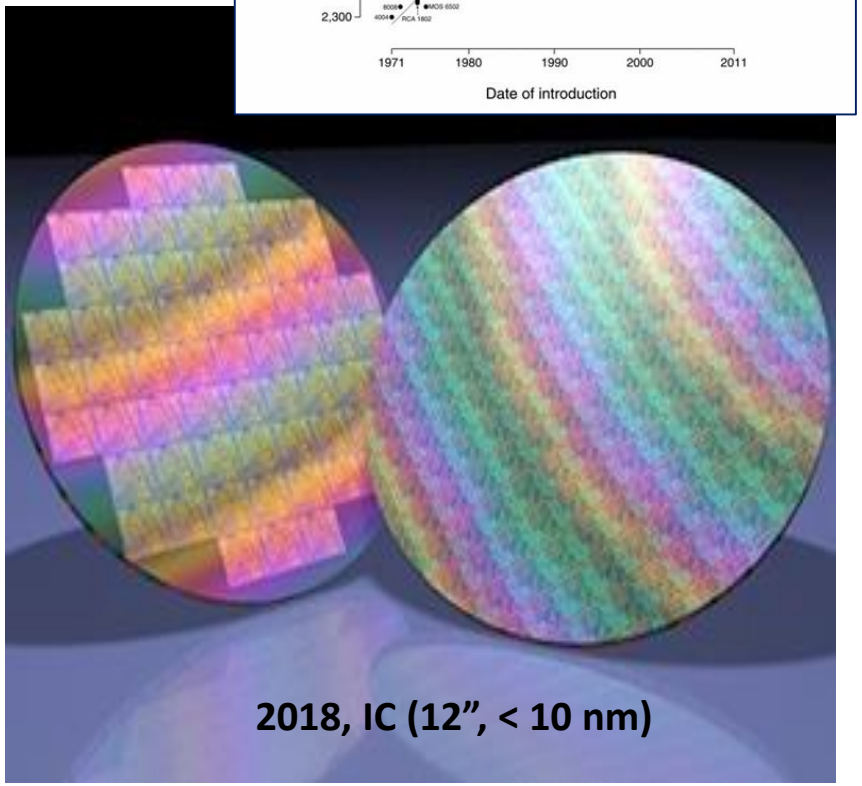
Supply Chain of Enabling Technologies

Wafer processing
- Wet cleans
- Photolithography
- Ion implantation
- Dry etching
- Wet etching
- Plasma ashing
- Thermal treatments
- Chemical vapor deposition (CVD)
- Physical vapor deposition (PVD)
- Molecular beam epitaxy (MBE)
- Electrochemical deposition (ECD)
- Chemical-mechanical planarization (CMP)
- Wafer testing
- Wafer backgrinding

Die preparation
- Wafer mounting
- Die cutting

IC packaging
- Die attachment
- IC bonding
- IC encapsulation
- IC testing





2018, IC (12", < 10 nm)

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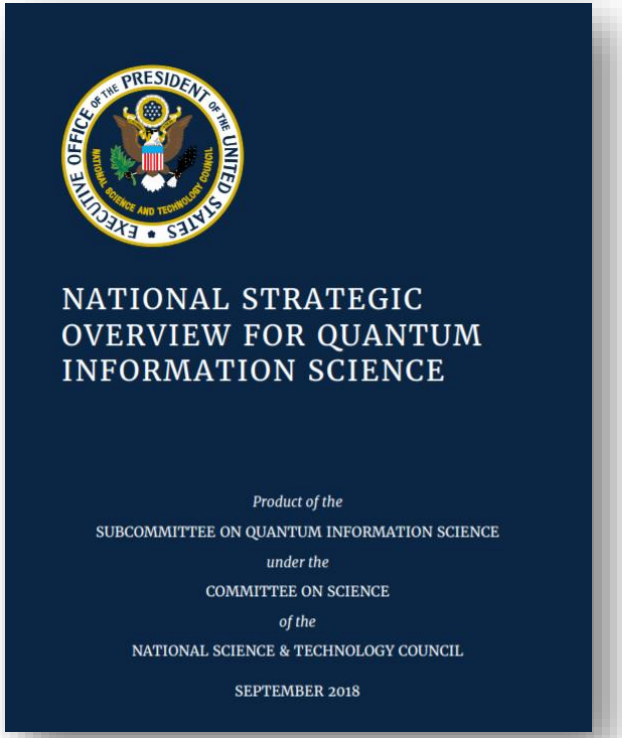
- International competition
  - EU Quantum Flagship = €1B
  - China plans to invest $10B+

Government Actions

- NSF Big Ideas included Quantum Leap (2016)
- Govt-wide research spending ~$200M-$250/yr
- Solicitations by NSF, DOE, DARPA et al.
- National Strategic Overview for Quantum Information Science released (Sept 2018)
- Quantum Economic Development Consortium (QED-C) established; partnership with NIST and industry (Oct 2018)
- National Quantum Initiative Act signed (Dec 2018)




One Hundred Fifteenth Congress
of the
United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Wednesday, the third day of January, two thousand and eighteen

An Act

To provide for a coordinated Federal program to accelerate quantum research and development for the economic and national security of the United States.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the "National Quantum Initiative Act".

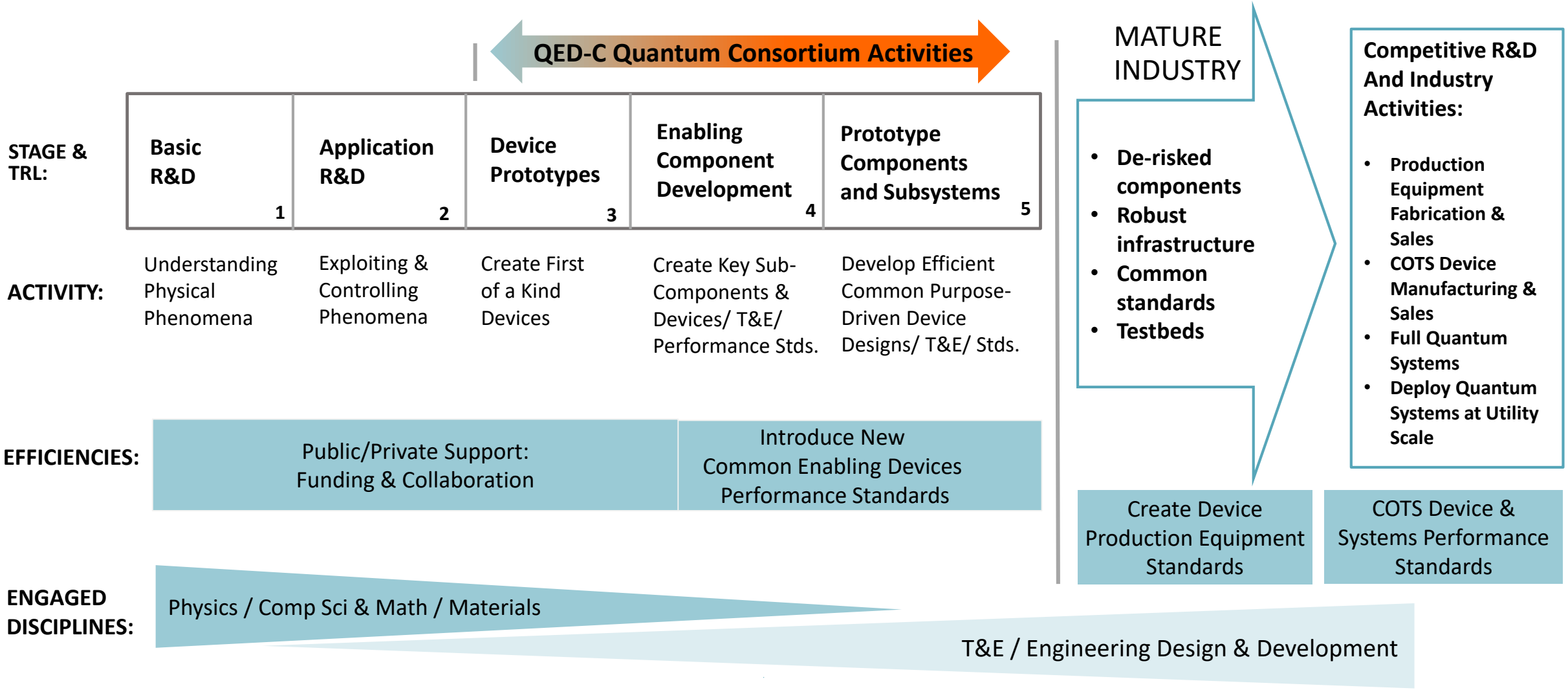
(b) TABLE OF CONTENTS.—The table of contents of this Act is as follows:

NQI Act* Establishes a Multi-agency Program

- Support research, development, demonstration and application of QIS&T
- Grow researchers, educators, and students (= “Quantum workers”)
- Improve QIS&T interagency planning and coordination (interagency group, coordination office, strategic plans, annual budget reports)
- Facilitate collaboration among government agencies, national labs, industry and universities
- Promote development of standards for QIS&T security
- Establish an outside advisory committee
- Terminate 11 years after enactment (unlike NNI)
- NSF and DOE to fund research centers
- NIST to convene a quantum consortium

**Modeled after the National Nanotechnology Initiative*

Quantum Enabling Device Development Continuum



SRI: At the intersection of Discovery and Innovation

LEGACY: Founded by Stanford University in 1946

GLOBAL: 63-acre headquarters in Silicon Valley and 21 locations worldwide

- 1900 staff members
- $483M in annual revenues

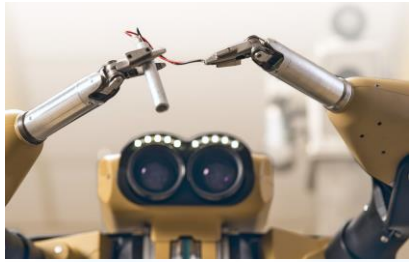
INNOVATE: >$4B in research investment over last 10 years

- 4,000 total patents, 500 disclosures per year
- 1,000 R&D projects per year
- >25,000 total final reports

LAB to MARKETPLACE: helped create hundreds of billions of marketplace value

- 60+ spin-off companies

MANAGING THE QED-C



QED-C Mission and Goals

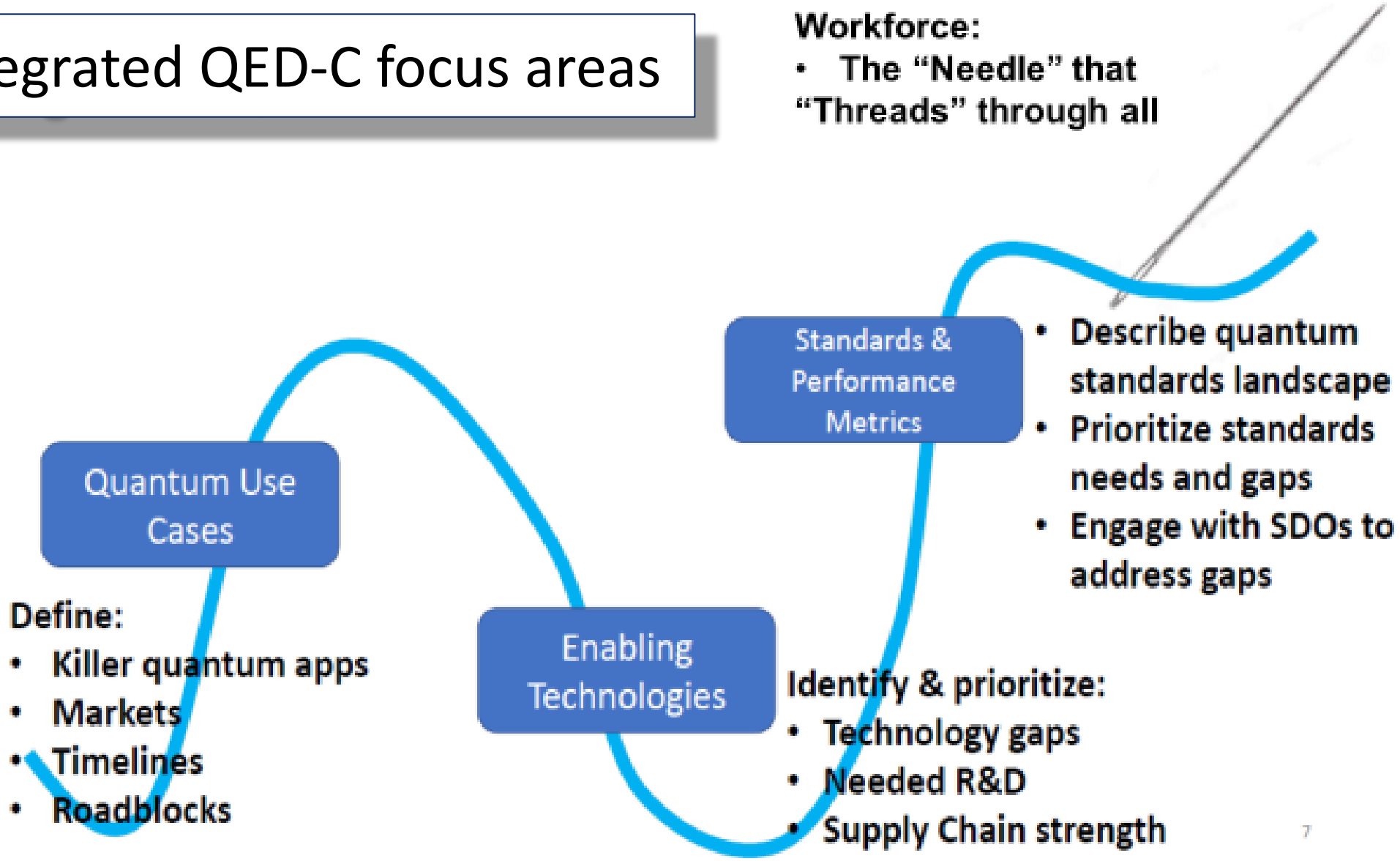
MISSION

- Strengthen U.S. leadership in the quantum technology industry

GOALS

- Facilitate industry coordination and interaction with Government agencies
- Provide a collective industry voice in guiding R&D investment priorities, standards needs, and quantum workforce issues
- Identify use cases and address gaps in enabling technology (mid-TRL) and infrastructure, performance metrics and standards, and workforce

Integrated QED-C focus areas



QED-C Membership

Voting Members:

- U.S. companies that are part of the quantum industry ecosystem
- U.S. Government agencies

Non-voting Members:

- Foreign companies and partnerships (non-U.S. majority-owned)
- Universities
- National laboratories and other FFRDC’s
- Standards development organizations
- Professional societies

QED-C LOI Signatories

- Amazon
- AO Sense
- APS
- ARM
- AT&T
- Atom Computing
- BAE Systems
- Boeing
- Boston Consulting Group
- Bra-Ket
- Caltech/ INQNET
- Citi
- Cold Quanta
- Corning
- Colorado School of Mines
- Entanglement Institute
- Fieldline, Inc.
- GE Global Research
- General Dynamics Mission Systems
- GMU
- Google
- Harris
- Honeywell
- HPD
- IBM
- Intel
- IonQ
- Janis Research
- Keysight
- KLA-Tencor
- Lake Shore Cryotronics
- Microchip/ Microsemi
- Montana Instruments
- NuCrypt
- Photodigm
- Photon Spot
- Psi Quantum
- QC Ware
- QPRI
- Quantum Circuits, Inc.
- Quantum Xchange
- Qubitekk, Inc.
- Raytheon / Raytheon-BBN
- Rigetti
- Rydberg Technologies
- SEMI
- SkyWater Technology Foundry, Inc.
- Stable Laser Systems (SLS)
- SRI
- Toptica
- Vescent Photonics
- Zapata Computing
- Zyvex Labs

US Government Representatives

- NIST
- DOE

Summary

- **QED-C is off to a fast start with 53 non-govt + 2 government members**, including most U.S. quantum industry companies and their suppliers (equipment, components, etc.); membership categories defined for foreign, academic, and other entities
- **QED-C is tackling the barriers** to realizing the widespread benefits of quantum science and technology
- **QED-C is a public-private partnership** that will be guided by industry needs and will enhance government efforts to help the quantum industry of today and tomorrow to flourish in the United States.

For more information about the QED-C or to become a member contact:

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Celia Merzbacher, Associate Director – Celia.Merzbacher@sri.com