Would Admiral Rickover's method still work in today's complex acquisition S&T landscape?

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Technology Maturation and Transition Lexicon

A Very Quick History of Atomic Physics

More than 50 years of 6.2

More than 130 years of 6.1

6.1/TRL 1

6.1/TRL 2

6.2/TRL 3-5

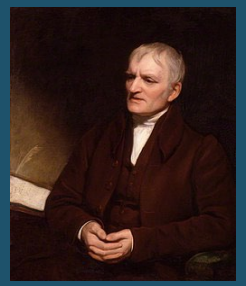
6.3/TRL 4

1766

Henry Cavendish discovers hydrogen atom

1803

John Dalton introduces ideas of atoms and molecular weights



1811

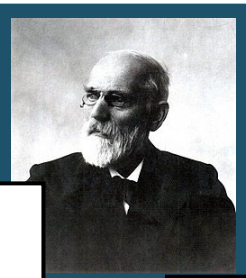
Lorenzo Avagadro equal volumes of gases should have equal molecules

1838

Richard Laming predicted subatomic particles carrying electric charge

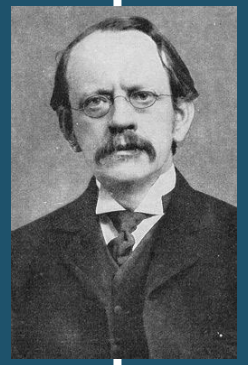
1873

Johannes van der Waals introduces the concept of weak and attractive forces of molecules



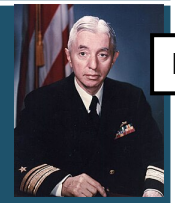
1897

JJ Thompson discovery of the electron



1900

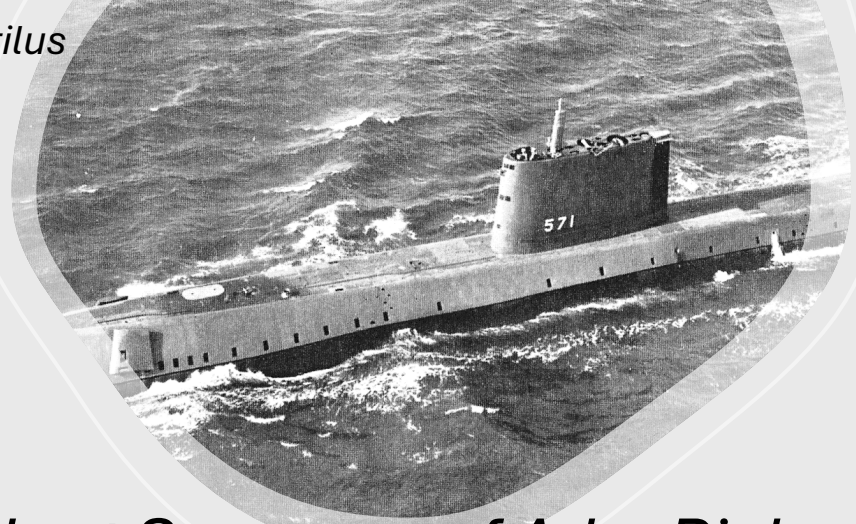
Rickover born



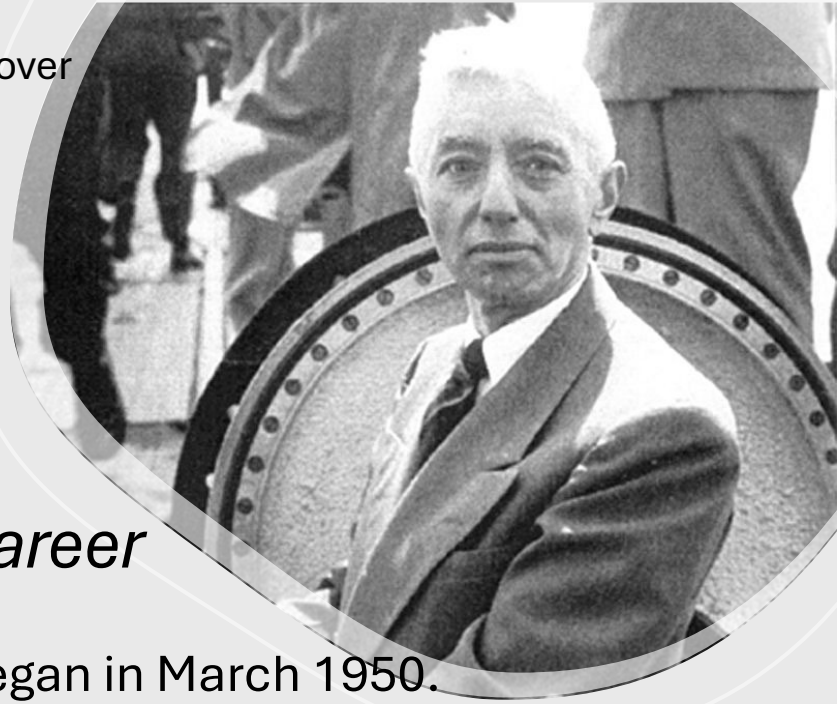
1942

- ✓ 1899 Rutherford discovers alpha and beta particles from uranium
- ✓ 1900 Planck blackbody radiation
- ✓ 1905 Einstein-photoelectric effect
- ✓ 1911 von Laue – Xrays
- ✓ 1913 Bohr quantum model of atom
- ✓ 1913 Millikan – unit of electric charge
- ✓ 1914 Rutherford nucleus made of protons
- ✓ 1915 Sommerfield – elliptic orbits/relativism
- ✓ 1924 de Mayolo – neutron, Bose-Einstein statistics
- ✓ 1925 Heisenberg, Max Born, Jordan formulate quantum matrix mechanics, Pauli states quantum exclusion principle
- ✓ 1926 Schrödinger proves matrix and wave formulation of quantum are equivalent
- ✓ 1927 Born-Oppenheimer approximation
- ✓ 1930 Dirac – electron hole theory
- ✓ 1932 Anderson discovers positron, Chadwick discovers neutron
- ✓ 1934 Fermi suggests bombarding uranium with neutrons to make 93 proton element
- ✓ 1934 Silárd discovers nuclear chain reaction is possible
- ✓ 1942 Fermi makes the first nuclear reaction

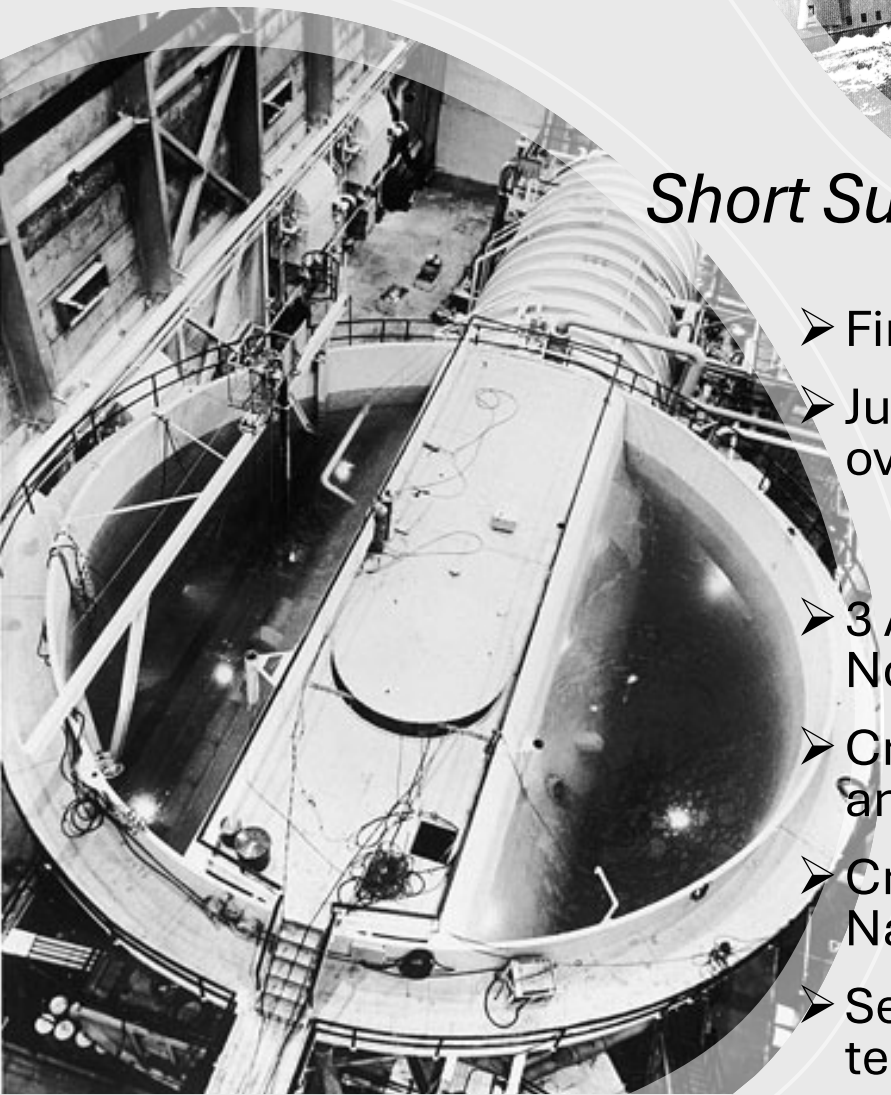
USS Nautilus



Admiral
H.G. Rickover



S1W Reactor Core



Short Summary of Adm Rickover's career

- First conceptual nuclear submarine began in March 1950.
- July 1951, U.S. Congress authorized Admiral Hyman G. Rickover to oversee the development
  - ✓ Held positions Navy's bureau of ships and atomic energy commission
  - ✓ Allowed him to navigate bureaucracies. He became **requirements and acquisition stakeholder**
- 3 August 1958, USS Nautilus completes submerged journey in the North Pole
- Created the Naval Reactor Program with a committed workforce and was able to take high risks and take full responsibility
- Created a nuclear-powered fleet for the Navy and catapulted the Navy's propulsion technology far ahead of the Soviet Union
- Secured budget to appropriately resource the nuclear reactor technology

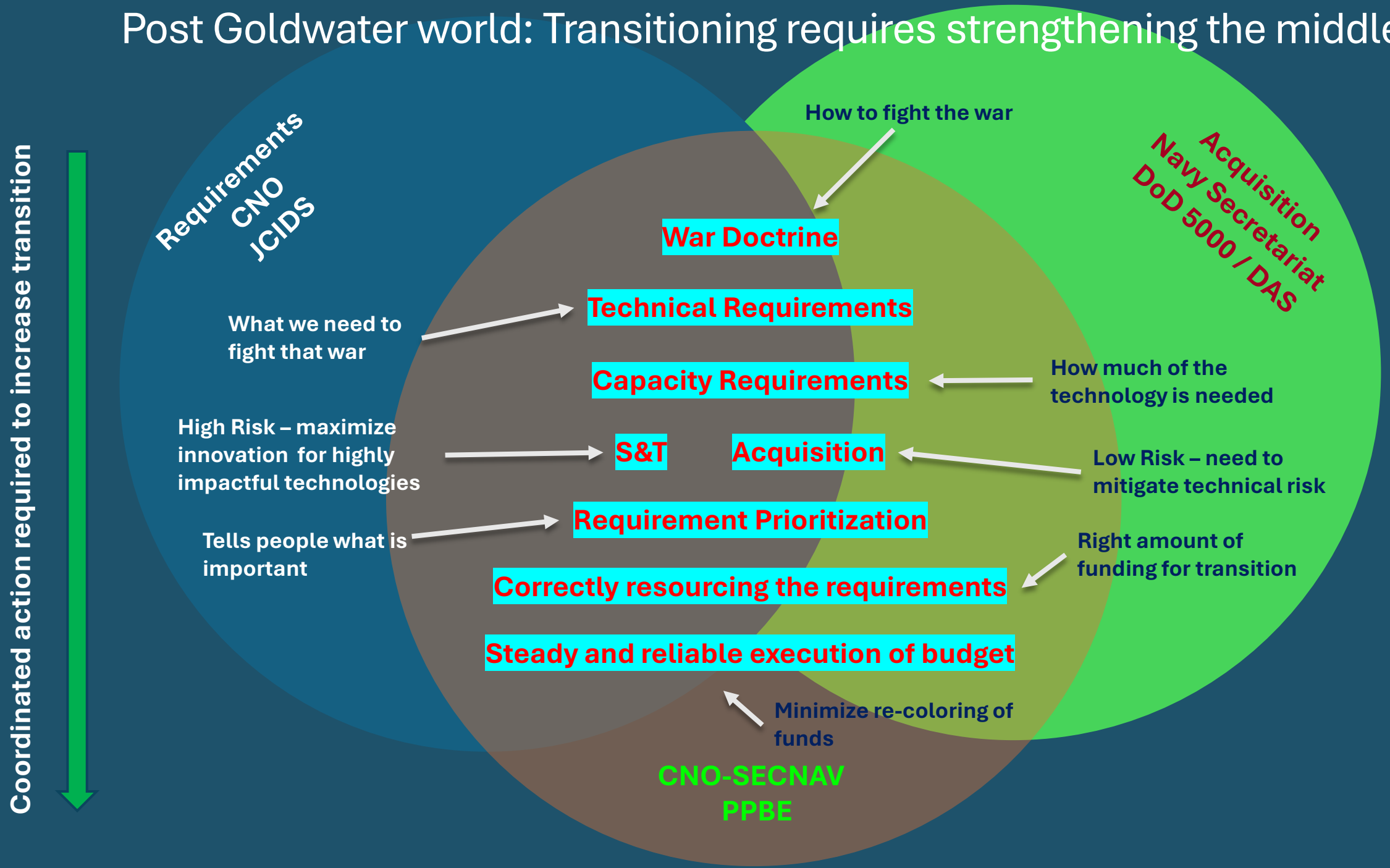
Challenges Admiral Rickover Faced

- Rickover had to transition from scientific thinking to engineering thinking.
  - ✓ Methods were different.
  - ✓ Methods of science is suitable for exploration (no timeline, discovery, no transition path, seeking to acquire knowledge through answering series of complex questions).
  - ✓ Methods of engineering is meant for technology development (timelines, application, transition paths, seeking to apply acquired knowledge to solve a pragmatic problem).
- Competing priorities
  - ✓ Navy was focused on competing in the strategic missions
    - ✓ Competing against Air Force for delivery of strategic weapons – focused on arming carriers
  - ✓ USS Nautilus completed voyage across the North Pole showed the importance
  - ✓ Another innovative technology was in development – AEGIS radar
    - ✓ Nuclear engines and AEGIS filled different mission needs
  - ✓ Warfighter resistance for adoption– Diesel vs Nuclear reactors
- The valley of death – 6.3 to 6.4 has two major barriers.
  - ✓ Crossing over the 6.3 line requires a change in community mindset. At some point the science stops and technology begins. Different communities have different approach to the problem. Largely technical challenges.
  - ✓ Cross over the 6.4 line is a political problem. Requires stakeholder adoption and commitment.
    - ✓ Good requirements are key.
    - ✓ Rickover had to go directly to the CNO and SECNAV.

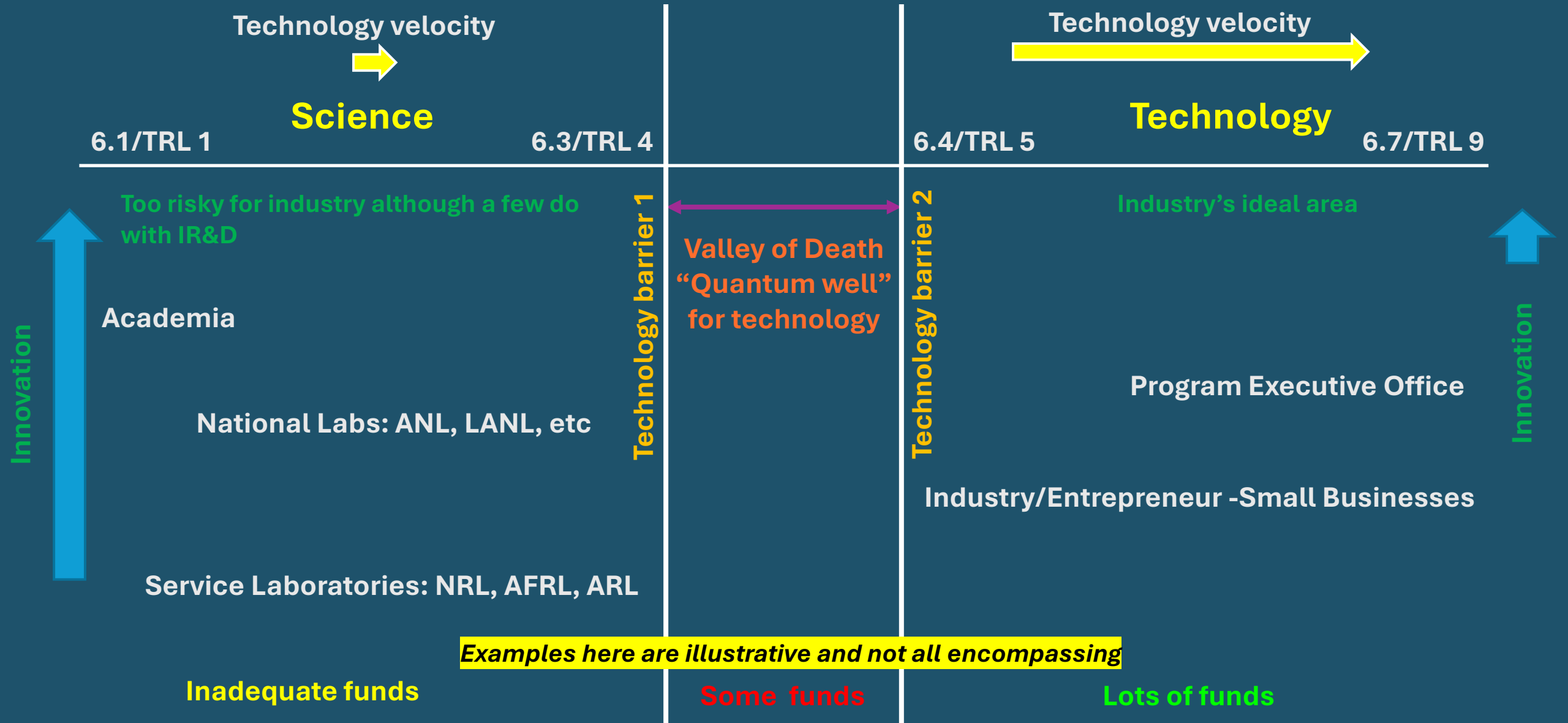
Significant landscape change since Rickover's era: Goldwater Nichols Act of 1986

- Passed to resolve many of the joint operations woes.
- Clear military chain of command from operational commanders through the SECDEF to the President.
- Service Chiefs are responsible for the training and equipping forces, while explicitly clear that they are not in the operational chain of command.
- Chairman of the Joint Chiefs of Staff (JCS) is elevated above the other service chiefs being the military advisor to the President.
  - ✓ Creation of Vice Chair – oversees the Joint Requirements Oversight Council (JROC).
- Requires military personnel entering strategic leadership roles to have experience working with their counterparts from other services.
- Creation of organizations for the services to collaborate when developing capability requirements and acquisition programs
  - ✓ Establishment of USD Acquisition
- What are the consequences?

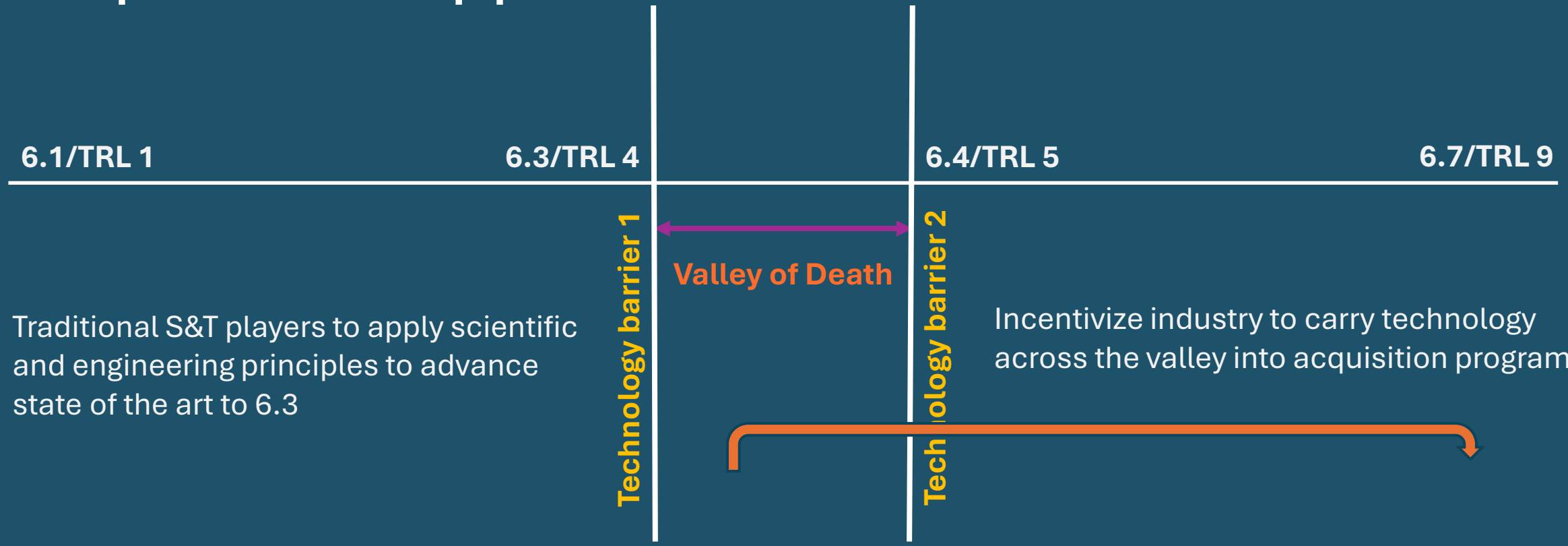
Post Goldwater world: Transitioning requires strengthening the middle



Transition under the DoD S&T framework



A potential approach for transition



- Identify key technologies inside the valley of death that have potential to close capabilities gap or provide future technology needs
- Provisionally license the technology to industry to advance the technology into the market for full maturation and commercialization
- Apply standard commercial acquisition process (FAR 12) for acquisition of the technology or use CSO
- Develop shared license agreement with industry to maintain positive control of the technical baseline
- In the current S&T landscape, one has to be creative and be risk tolerant

Can Adm Rickover still do what he did today?

Final take aways

- Science vs Engineering
  - ✓ Understand the mindset and leverage strengths and weaknesses of each level of effort
  - ✓ A compelling narrative
  - ✓ 6.1/6.2 need to be resourced and scaled correctly to leverage revolutionary 6.4 efforts if disruptive technologies are to be realized
  - ✓ Government technical workforce must be just as strong as industry's
- Look for and acquire creative contracting strategy
  - ✓ Workforce needs to be trained and would be willing to take on more risks
  - ✓ Existing tools exists such as CSO, OTA-P, etc. should just as easily accessible as the FAR
  - ✓ A creative IP strategy is needed
- Technology that has the highest impact will have largest inertia and will require a champion with clear roles and responsibilities placed on people moving the technology across the TRL lines.
  - ✓ Reduced regulations and bureaucratic inertia are necessary
- Goldwater-Nichols Act had significant and lasting impact on the DoD. Alignment between DAS, JCIDS, and PPBE are paramount in moving critical technology forward
  - ✓ Clear war doctrine (i.e. gap analysis and how to fight the war)
  - ✓ Scientists and warfighters need a venue to directly interact to develop the technology
  - ✓ Willing to take on writing riskier requirements (systems level analysis to drive requirements)
  - ✓ Reduce and control requirements creep and have clear responsible parties

Backup

Outline

- Current DoD Lexicon for S&T
- A short history Atomic Physics through the lens of the current S&T Framework
- Short summary of Admiral Rickover's career
- Discuss the challenges that Admiral Rickover had in transitioning novel nuclear reactor technologies to the fleet
- Significant landscape change since Rickover's era: Goldwater Nichols Act of 1986
- Touch on the current technology framework, the requirements, acquisition and budgeting process and how those things impact S&T
- Offer tools and potential way forward
- Final take aways