DCN #

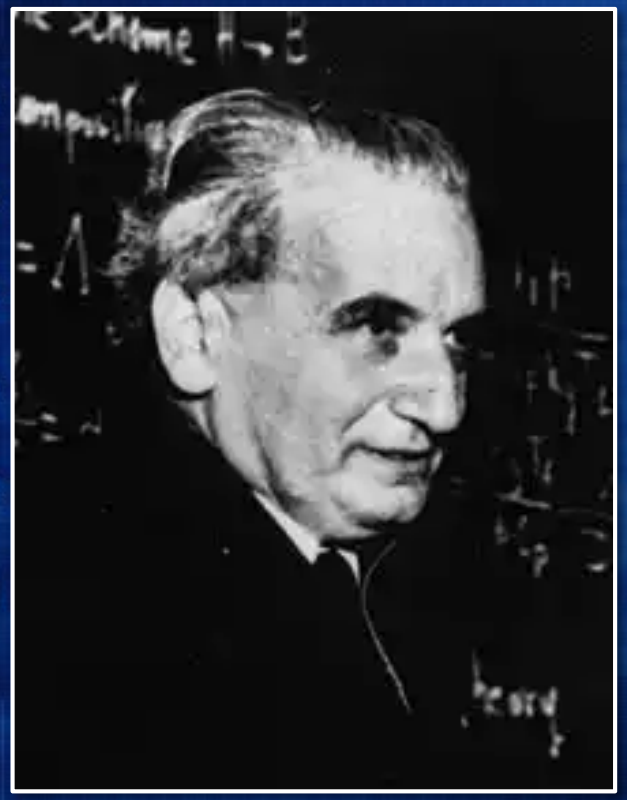
The Office of Naval Research

Sponsor update to the NASEM, Transportation Research Board, Marine Board

Dr. Thomas Fu. SES
Mission Capable, Persistent and
Survivable Naval Platforms Department

Fall Meeting, November 2, 2022

NRE Portfolio Management



Von Kármán at the Caltech Jet Propulsion Laboratory in 1950

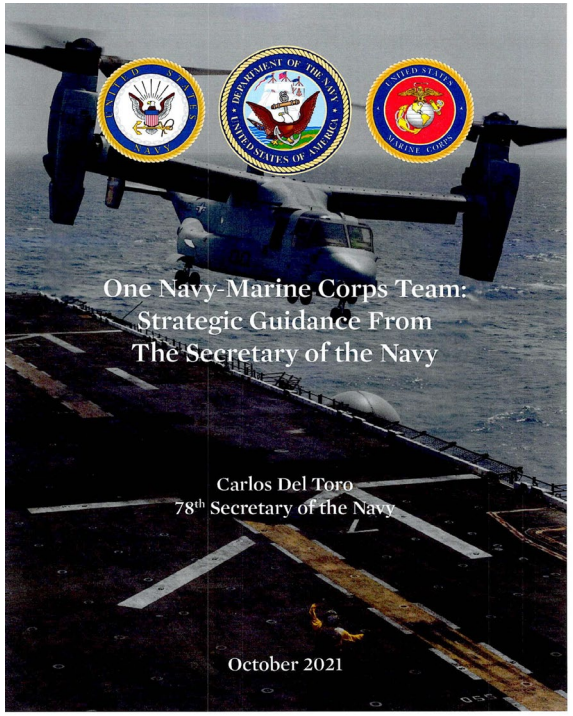
*An engineer who received the first National Medal of Science in 1962

"Scientists study the world as it is, engineers create the world that never has been."

Theodore von Kármán*

This is essentially ONR's mission. We study the world in which we live, because we must operate, function, and win in that world. But we also create the Navy that has never been. ***This is exactly how we reimagine Naval Power.***

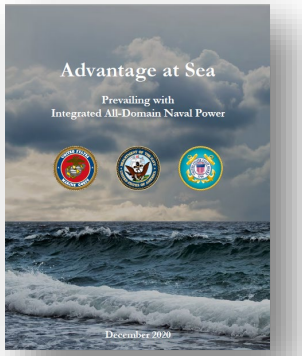
SECNAV Strategic Guidance



"Since my confirmation as the 78th Secretary of the Navy, I have characterized the most pressing challenges facing the Department of the Navy as the ***"Four Cs": China, Culture, Climate Change, and COVID***. The People's Republic of ***China represents the pacing challenge*** against which we must plan our warfighting strategies and investments. Cultural challenges that we must tackle include confronting sexual assault and harassment, ***promoting diversity, equity, and inclusion,*** preventing suicide, and demanding integrity and accountability across our naval leadership. ***Climate change poses a rapidly intensifying spectrum of risks*** to our operating environment, our allies and partners, and our planet. And ***COVID has posed an unprecedented test of the resilience*** of our people, their families, and our health system. We must tackle these Four Cs with a sustained sense of urgency and a strong bias for action."

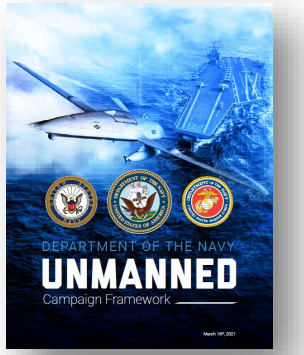
As President Biden stated in his March 2021 Interim National Security Guidance, "our world is at an inflection point." In the President's words, ***"The United States must renew its enduring advantages so that we can meet today's challenges from a position of strength."*** The Navy-Marine Corps Team is one of America's unmatched enduring advantages, and will be a vital part of realizing the President's vision.

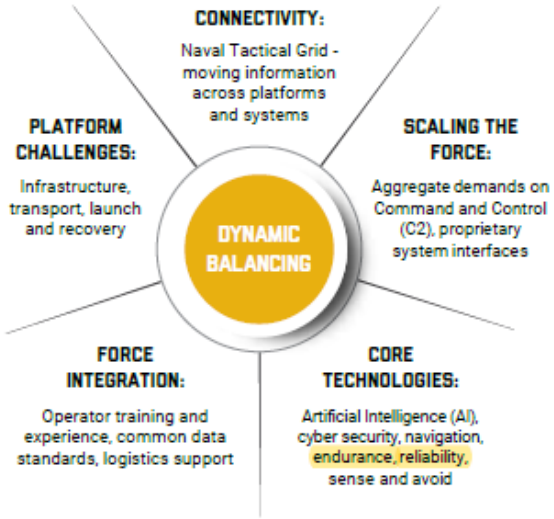
Strategic Guidance

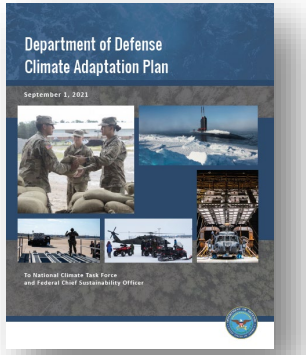


"New and converging technologies will have profound impacts on the security environment. Artificial intelligence, autonomy, additive manufacturing, quantum computing, and new communications and energy technologies could each, individually, generate enormous disruptive change."

Executive Order 14008: Tackling the Climate Crisis at Home and Abroad

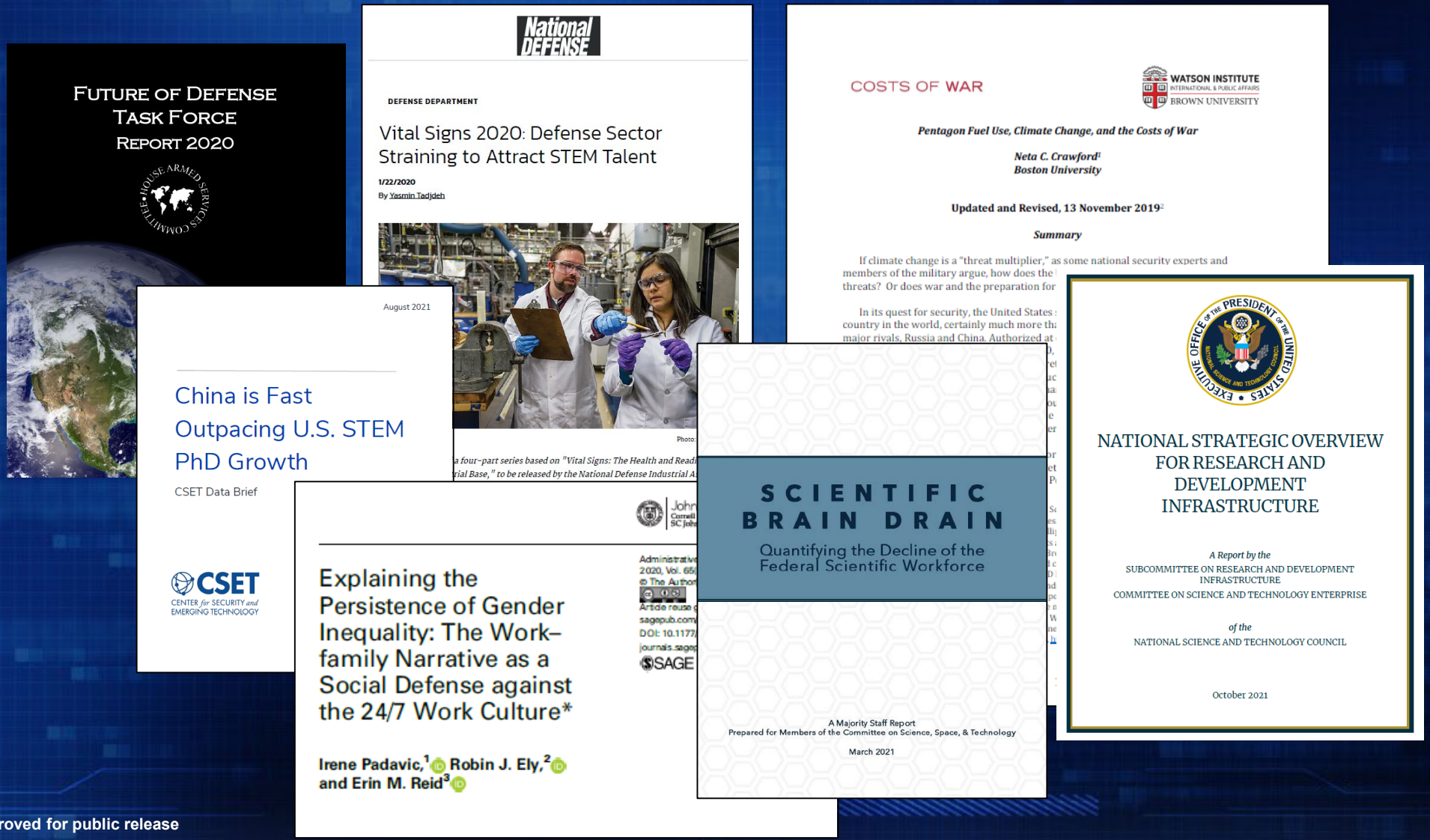






"Ensure the DOD can operate under changing climate conditions, preserving operational capability and enhancing the natural and man-made systems essential to the Department's success"

S&T Issues/Concerns



The Naval Research & Development Establishment

The Naval Research Enterprise

2022 Commander's Intent for the Naval Research Enterprise

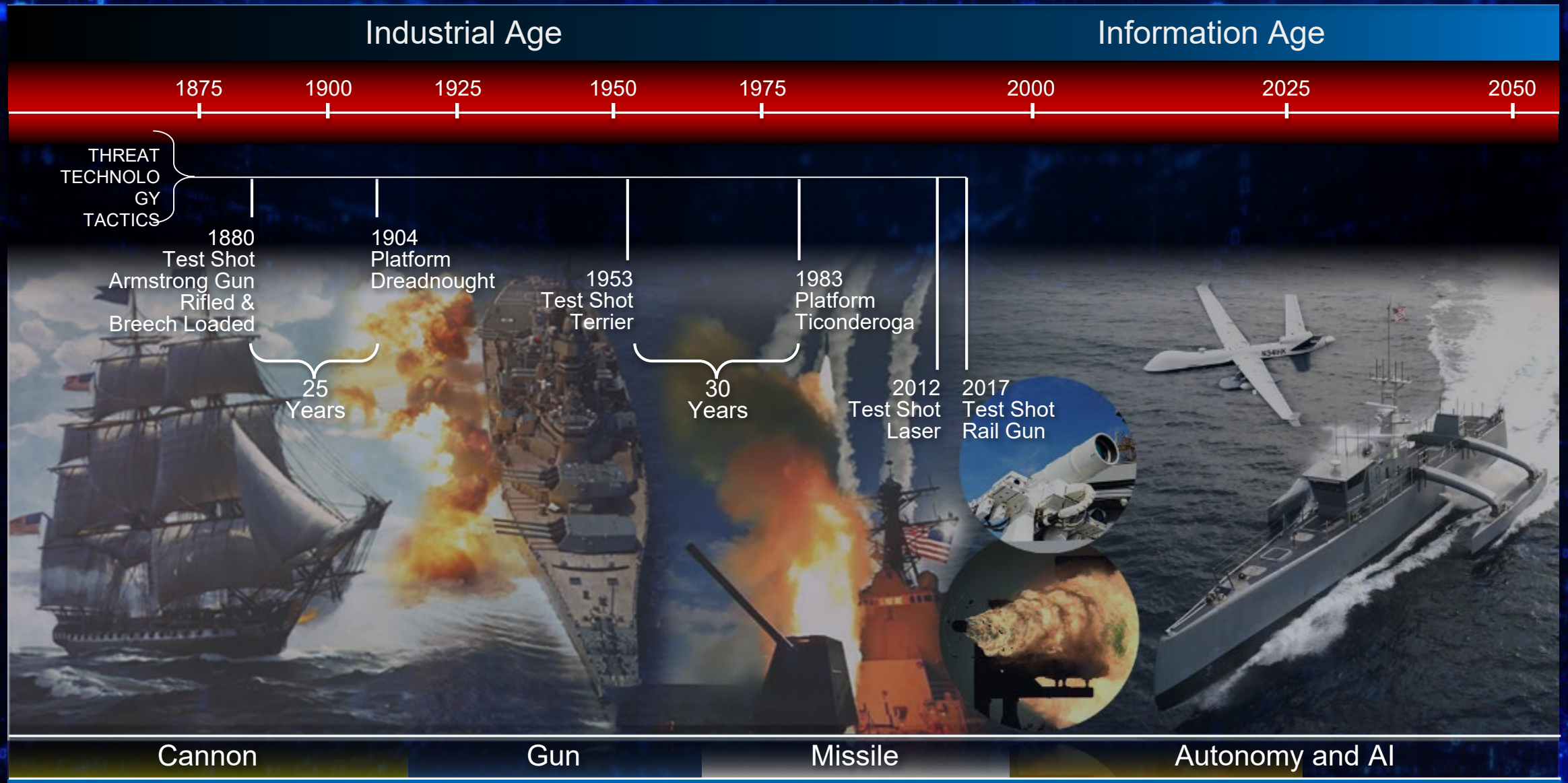
1. **Powerful Portfolio:** Build a vibrant, exceptional S&T portfolio and performer network, based on an unparalleled worldwide network that balances naval power.

2. **Diverse Workforce:** Fuel a driven, empowered and diverse workforce, rooted firmly in a deep commitment to the mission.

3. **No Business as Usual:** Understand needed business outcomes, and use performance and data-driven analysis and feedback.

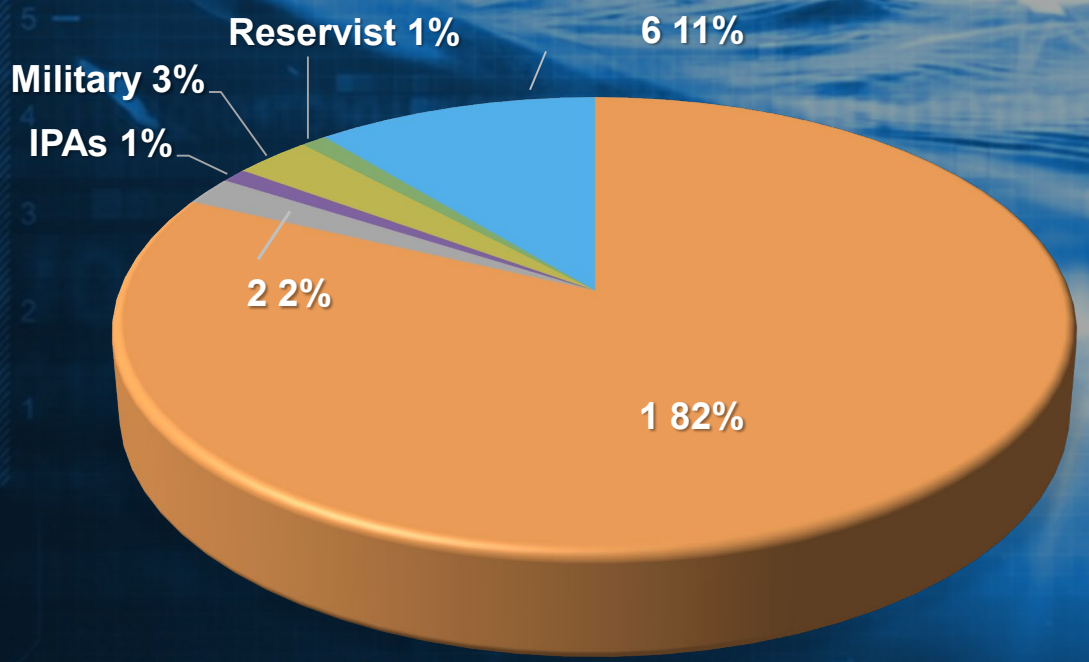
4. **Infrastructure Essentials:** Enable cutting-edge research and work efficiency through world-class S&T laboratories and equipment.

Evolution of Naval Warfare



Who We Are

Workforce Demographics



Degrees

PhD
32%

Masters
20%

College
25%

Average Length of Service

14

Male
70%

Female
30%

Average Age

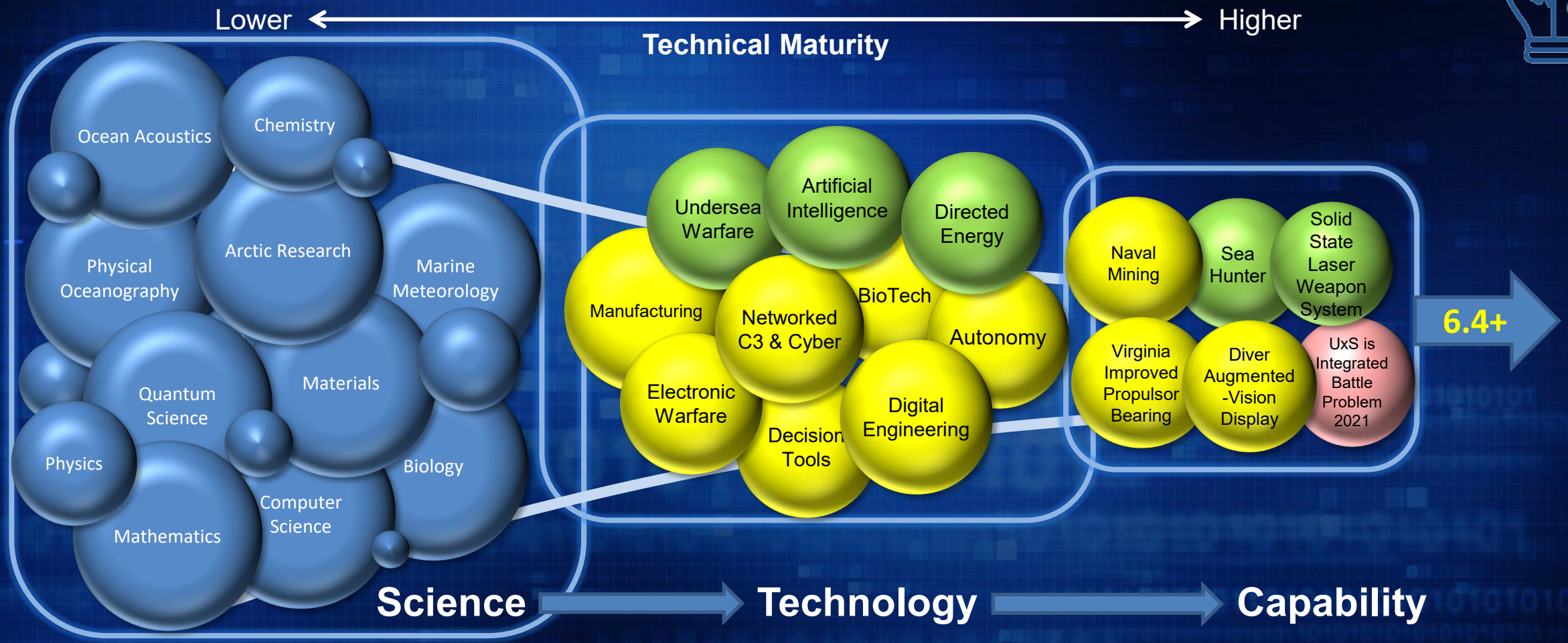
46

ONR Portfolio Management

The underlying Portfolio Management Strategy is Balance

- Science and Engineering (Understand and Create)
- Long-Term and Near-Term and (BAR, INP, TC, FNC)
- Deliverables (Knowledge, Technology, and People)
- We mitigate risk by ensuring balance
- Leverage others
  - Their investments (NSF, ARL, AFOSR, DoE, NOAA , industry, . . .)
  - To harvest the results of our investments (SCO, DARPA, DIU, other services, other agencies, and industry)

NRE – Portfolio



- Basic and early Applied Research (BAR - 47%)
- Disruptive Technology (Innovative Naval Prototypes - 11%)
- Enabling Capabilities (Tech Candidates - 7%, Future Naval Capabilities - 11%, Tech Maturation - 19%; Total - 37%)
- Quick Reaction (Advanced Prototyping & Experimentation - 5%)

*Percentage of PB23

New Naval STEM Initiatives

Spurred by ongoing global and national events

1. ***Virtual STEM Initiatives*** targeted education and outreach to 5,000+ students (K-12, undergraduate) via virtual internships, virtual field trips, university challenge competitions
2. ***Naval Horizons*** launched a STEM essay contest to increase high school and college student awareness of STEM careers and naval science and technology challenges via video interviews with 30+ scientists and engineers *(~21,000 views and 1,000+ prizes awarded to date)*
3. ***NREIP Fall Engagement*** implemented a short-term (40 hour) virtual internship program for college students. Highly successful from student and naval scientist and engineer mentor perspective *(~390 internships to date)*
4. ***STEM Diversity Initiatives***, piloted an eight week Flight Academy with Commander Naval Air Forces Diversity, Equity and Inclusion Director which resulted in 4 high school students graduating with a private pilot's certificate. Other initiatives under development, to increase to increase diversity in STEM in a meaningful, scalable, and statistically significant way.

Reimagining Naval STEM

Diversity-focused, Hybrid, Scalable, Sustainable

Navy and Marine Corps JROTC Flight Academy

Three graduates with CAPT Victor Glover, Naval aviator/NASA astronaut

Developing a Diverse STEM Workforce

Blue Integrated Partnerships (BIP)

One single entity cannot solve the inequality gap and lack of diversity in STEM fields, alone - we must forge key strategic partnerships at multiple levels. We propose a system of systems approach to change the culture at each local institution within the ecosystem but that can also be replicated.

VISION: ***TO ATTRACT, MENTOR & SUPPORT THE UNTAPPED INCLUSIVE TALENT OF THE 21ST CENTURY WORKFORCE, READY TO SOLVE THE BIG CHALLENGES OF TOMORROW AND BUILD A TRANSFORMATIONAL ECOSYSTEM OF NATIONAL SECURITY.***

CLIMATE ACTION 2030

Department of the Navy

Climate-Ready Force

To remain the world's dominant maritime force, the Department of the Navy must adapt to climate change. ***A force that is resilient to climate impacts is more capable, agile and lethal.*** We will enhance our operational capability, resilience, and reduce our climate impacts by aligning our climate actions to ***strengthen maritime dominance, empower our people, and strengthen strategic partnerships.***

Performance Goals

Build Climate Resilience

Ensure that our forces, systems, and facilities can continue to operate effectively and achieve the mission in the face of changing climate conditions, and worsening climate impacts.

Reduce Climate Threat

We must reduce our greenhouse gas emissions and draw greenhouse gases out of the atmosphere, stabilize ecosystems, and achieve, as an enterprise, the nation's commitment to net-zero emissions by 2050.

Ambitious Targets

To achieve net-zero emissions economy-wide by 2050, the Navy and Marine Corps commit to:

- 65% reduction in greenhouse gas emissions department-wide by 2030
- 100% carbon pollution-free electricity by 2030
- 100% zero-emission light-duty vehicle acquisitions by 2027
- 50% reduction in emissions from buildings by 2032
- 50% annual diversion of non-hazardous solid waste from landfills by 2025
- 1 million cars' worth of CO_2e drawn down by 2027 through nature-based solutions

Lines of Effort

Our strategy is organized around five lines of effort that are consistent with those laid out in the Department of Defense's (DoD) Climate Adaptation Plan.

1. Climate-informed decision making
2. Train and equip for climate resilience
3. Resilient built and natural infrastructure
4. Supply chain resilience and innovation
5. Enhanced mitigation and adaptation through collaboration

Focus on Resilience

Nature-Based Resilience: Mitigate shoreline erosion, protect mission-critical assets, and improve natural assets that are key to achieving resilient infrastructure and operations.

Energy Resilience: Install cyber-secure microgrids or comparable resilience technology that leverage carbon free power generation and long-duration battery storage.

Climate Change: Three Pillars

- **Mitigation:** Measures to reduce the amount and speed of future climate change by reducing emissions of greenhouse gases or removing carbon dioxide from the atmosphere.
- **Resilience:** The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.
- **Adaptation:** Adjustment in response to a changing environment in order to reduces negative effects.

-DODD 4715.21, Climate Change Adaptation and Resilience.

DON Strategy Lines of Effort:

LOE1. Climate Informed Decision Making
LOE2. Train & Equip for Climate Resilience
LOE3. Resilient Built and Natural Infrastructure
LOE4. Supply Chain Resilience and Innovation
LOE5. Enhanced Mitigation and Adaptation Through Collaboration

ONR Research Vessels

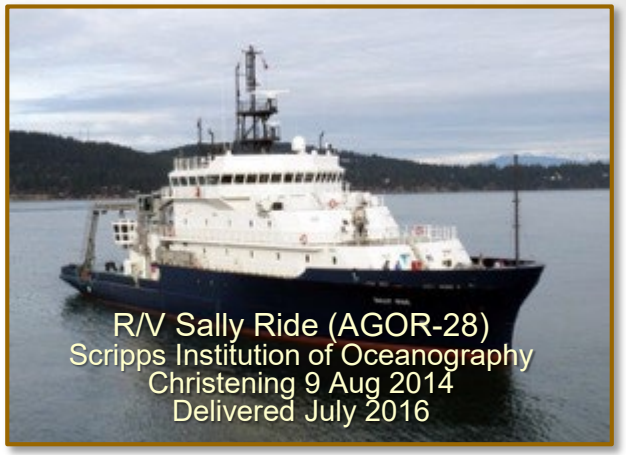

R/V Neil Armstrong (AGOR-27)
Woods Hole Oceanographic Institution
Christening 29 Mar 2014
Delivered September 2015

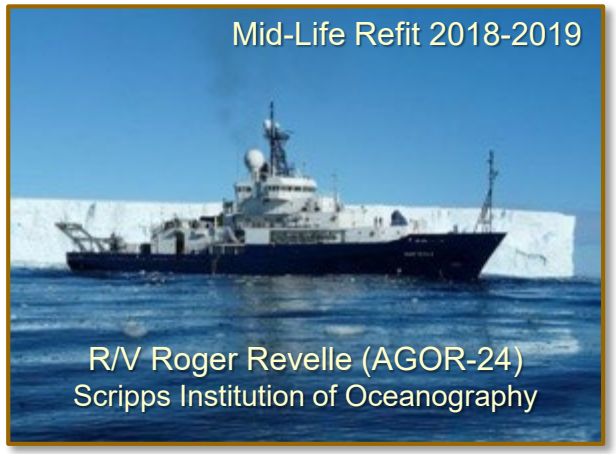

R/V Atlantis (AGOR-25) & Alvin
Woods Hole Oceanographic Institution


Mid-Life Refit 2017-2018
R/V Thomas G Thompson (AGOR-23)
University of Washington

- Navy research ships have global reach - regular two year expeditions
- Science teams rotate to ship for 18-25 day projects
- Navy owned ships have been scheduled via UNOLS since 1972
- Navy ships in UNOLS average 280 days/yr operations
- Daily operations costs are recovered via a "day rate" charged to agency research
- NSF is the major user, then Navy, NOAA, USGS, DOE
- Crews are university employees and professional mariners

40-50 at-sea field experiments and demonstrations each year


R/V Sally Ride (AGOR-28)
Scripps Institution of Oceanography
Christening 9 Aug 2014
Delivered July 2016


Mid-Life Refit 2018-2019
R/V Roger Revelle (AGOR-24)
Scripps Institution of Oceanography


Propulsion Automation Upgrade 2016
R/V Kilo Moana (AGOR-26)
University of Hawaii

Zero-Emission Vessels

Proposed conceptual rendering of the new California coastal research vessel. Credit: Glosten

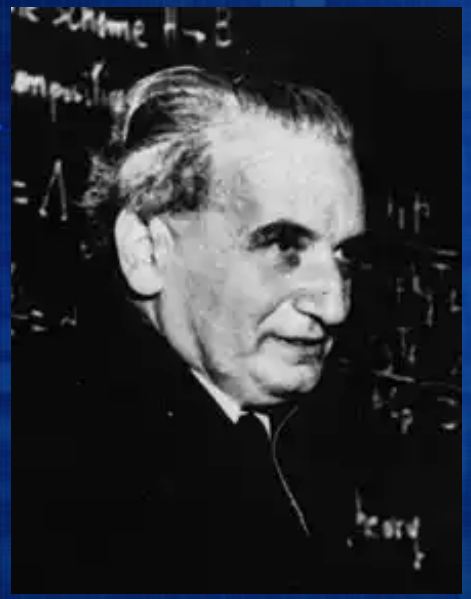
Aug 02, 2022

NAVAL ARCHITECT SELECTED FOR UC SAN DIEGO'S NEW CALIFORNIA COASTAL HYBRID-HYDROGEN RESEARCH VESSEL

Vessel with zero-emission capabilities will now move to design phase

Office of Naval Research

Our mission is to further the understanding of science and engineering and discover, develop and deliver new technologies and future capabilities in recognition of their paramount importance to future naval power and the preservation of national security.



Von Kármán at the Caltech Jet Propulsion Laboratory in 1950

"Scientists study the world as it is, engineers create the world that never has been."

Theodore von Kármán*

In von Kármán's seminal paper on supersonics, he noted that aeronautical engineers were ***"pounding hard on the closed door leading into the field of supersonic motion."***

ONR is pounding hard on many closed doors.

*An engineer who received the first National Medal of Science in 1962