



Naval Science & Technology in the Asia-Pacific OpTech-EAST

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Office of Naval Research Global
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O F F I C E O F N A V A L R E S E A R C H



The Office of Naval Research

The S&T Provider for the Navy and Marine Corps



- 4,000+ People
- 23 Locations
- \$2.1B / year
- >1,000 Partners



Discover



Develop



Deliver



*Technological
Advantage*





ONR is part of the NR&DE, Providing Full-Spectrum RDT&E

RDT&E Budget (6.1-6.7)

S&T Budget (6.1-6.3)

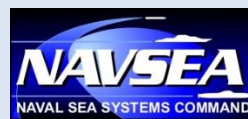
6.1 Basic Research	6.2 Applied Research	6.3 Advanced Technology Development	6.4 Adv. Comp. Development & Prototypes	6.5 System Development & Demonstration	6.6 RDT&E Management Support	6.7 Operational System Development
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Naval R&D Establishment

(ONR, SYSCOMs and their Warfare Centers, PEOs)

Office of Naval Research





ONR Global Mission

Discovering the Best Science

- Innovate fundamental research
- Help shape future U.S. Naval investments and strategies
- Engage global S&T talent through cooperation
- Support publication of S&T research

Enabling Global Technical Awareness

- Prevent technological surprise
- Fundamental research is universal
- Continued contributions to global technology awareness

Science & Technology Collaborations

- Advance mutually beneficial science
- Embed in Navy and Marine Corps staffs to connect the warfighter and the Naval Research Enterprise
- Develop and maintaining US Navy military to military research relationships





ONR Global Presence

Washington, D.C. Region
 Executive Officer
 Director, NSTCP
 Director, Science Advisors
 CFCC/C10F ★★ ★★
 CNO N9 ★★ ★★
 CNO N81 ★★ ★★

ONRG London
 Commanding Officer
 Technical Director
 Regional Director
 Associate Directors

Newport
 CNO SSG ★★ ★★

ONRG Prague
 Associate Directors

ONRG Tokyo
 Regional Director
 Associate Directors

San Diego
 C3F ★★ ★★
 SURFOR ★★ ★★
 I MEF ★★ ★★
 NSMWDC ★★ ★★
 UWDC ★★ ★★

Dahlgren
 NAMDC ★★ ★★

Norfolk
 FLTFOR ★★ ★★ ★★
 AIRFOR ★★ ★★ ★★
 SUBFOR ★★ ★★ ★★
 MARFORCOM ★★ ★★ ★★
 NECC ★★ ★★
 NWDC ★★ ★★

Naples
 C6F ★★ ★★

Bahrain
 C5F ★★ ★★

Yokosuka
 C7F ★★ ★★

Hawaii
 USPACOM ★★ ★★ ★★
 PACFLT ★★ ★★ ★★
 MARFORPAC ★★ ★★ ★★

Mayport
 C4F ★★ ★★

Camp LeJeune
 II MEF ★★ ★★

Okinawa
 III MEF ★★ ★★

ONRG Santiago
 Associate Directors

ONRG São Paulo
 Associate Director

ONRG Singapore
 Associate Directors

CAPT Clark Troyer
 Commanding Officer

Dr. Patricia Gruber
 Technical Director

CAPT Kevin Quarderer
 Executive Officer



- ★ Joint Command
- ★ Naval Command
- ★ Marine Corps Command

ONRG co-located with other DoD S&T components

- London (USA/USAF)
- Tokyo (USA/USAF)
- Santiago (USA/USAF)
- Singapore (USA only)



Strategic Guidance is the Foundation for our Naval S&T

National & Naval Strategy/Direction



Warfare Enterprise's S&T Objectives

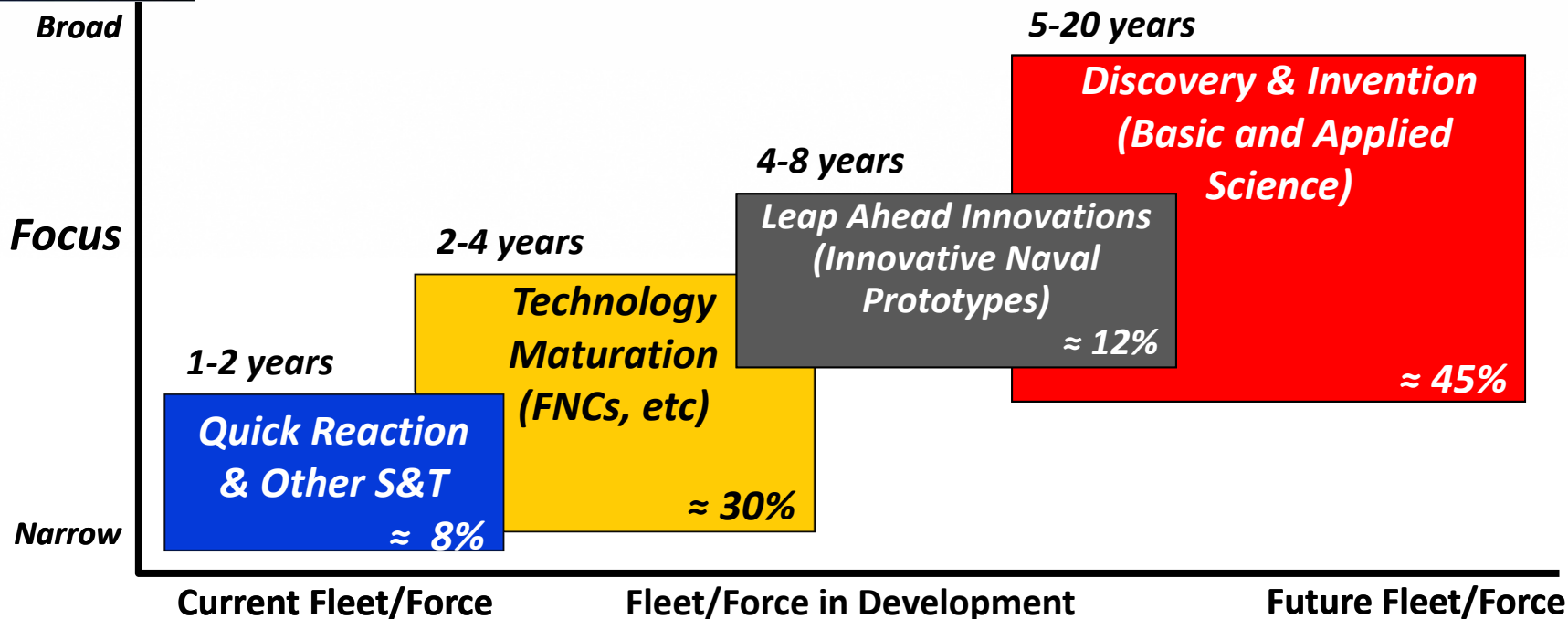




Warfighting Capabilities Enabled by S&T Investments



- *Assure Access to Maritime Battlespace*
- *Autonomy & Unmanned Systems*
- *Electromagnetic Maneuver Warfare*
- *Expeditionary & Irregular Warfare*
- *Information Dominance/Cyber*
- *Platform Design & Survivability*
- *Power & Energy*
- *Strike & Integrated Defense*
- *Warfighter Performance*



Portfolio is balanced across near, mid, and long term S&T investments



Naval S&T Knowledge, Technology, Capability

1-2 years
Quick Reaction
& Other S&T ≈ 8%

2-4 years
Technology Maturation
(FNCs, etc.) ≈ 30%

4-8 years
Leap Ahead Innovations
(Innovative Naval Prototypes) ≈ 12%

5-20 years
Discovery & Invention
(Basic & Applied Science) ≈ 45%



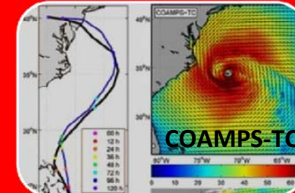
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GBAD OTM



Integrated Topside
(InTop)



COAMPS-TC



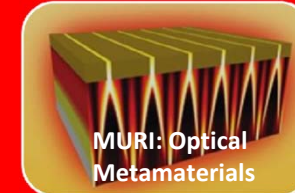
Transportable
Electronic Warfare
Module (TEWM)
Upgrade



Data Triage



FEDECO



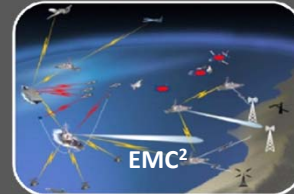
MURI: Optical
Metamaterials



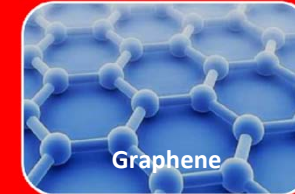
USSV Autonomous
Operations



SLQ-32



EMC²



Graphene



XFC UAV



Mk18 Family
of UUVs



LDUUV INP



ZRay Glider



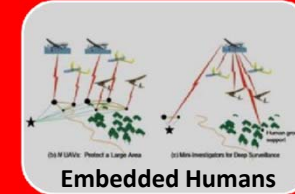
Advance Aircraft
Topcoats



Next Generation
Countermeasures
Technologies for
Ship Missile Defense



Electromagnetic
Railgun (EMRG)

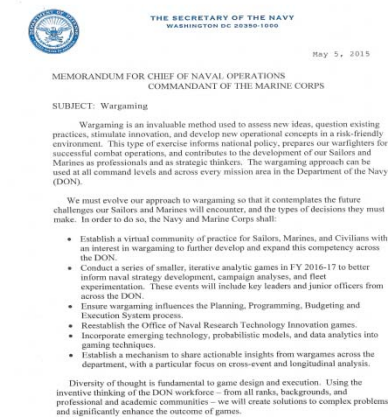
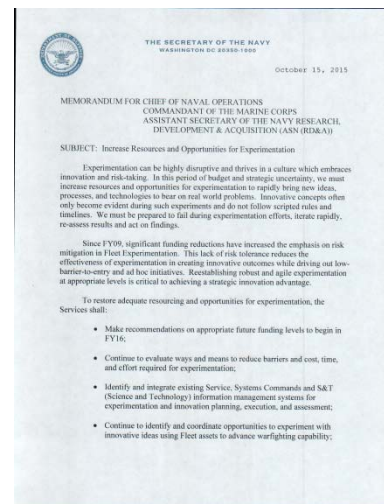


Embedded Humans



S&T in the Asia-Pacific

- Challenging Aspects for S&T
 - Physical Environment
 - Distance
 - Crowded
 - Policy/Governance
- Emphasis areas for S&T
 - Dual-use technologies
 - ISR
 - Logistics
 - Full range of engagement
 - Experimentation, Demonstration, and Exercises
 - Technology Innovation Game (TIG)





Sample S&T Projects: Basic Research

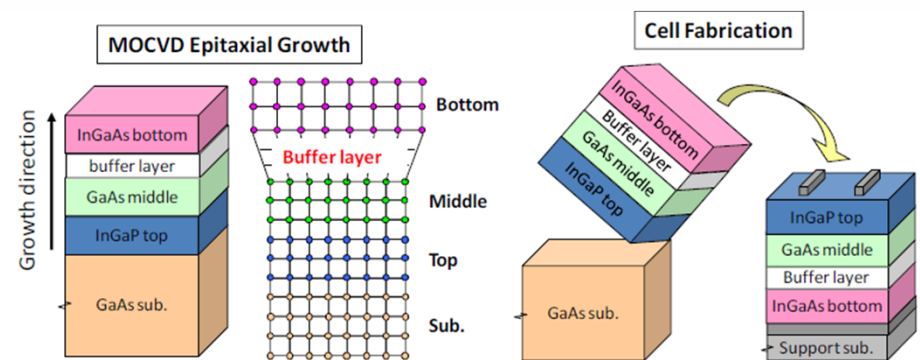
S&T Research Goals

- Develop lightweight, flexible and high-efficiency solar cells and modules which can be used for a terrestrial mobile power source by combining:
 - Flexible solar modules currently developed for satellite power, based on triple-junction solar cells using the inverted metamorphic (IMM) technology
 - Lightweight mobile solar panel for terrestrial use
- Specifically, develop and optimize the cell fabrication methods, including the selection and preparation of appropriate substrate materials

High-efficiency flexible solar cells and modules for terrestrial use

NICOP (S&T Grant)

New Start Oct 2015- Japanese Industry

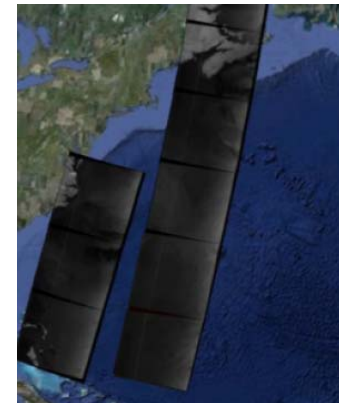
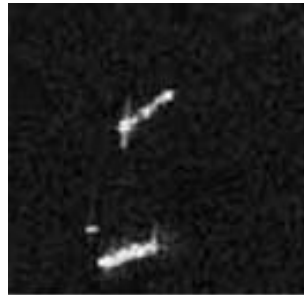


The lattice mismatch problem is solved by the buffer layer (left). When the Metalorganic Chemical Vapor Deposition (MOCVD) epitaxial growth is complete, the substrate is removed and replaced by a support substrate of desired mechanical properties.



Sample S&T Projects: PACFLT JCTD

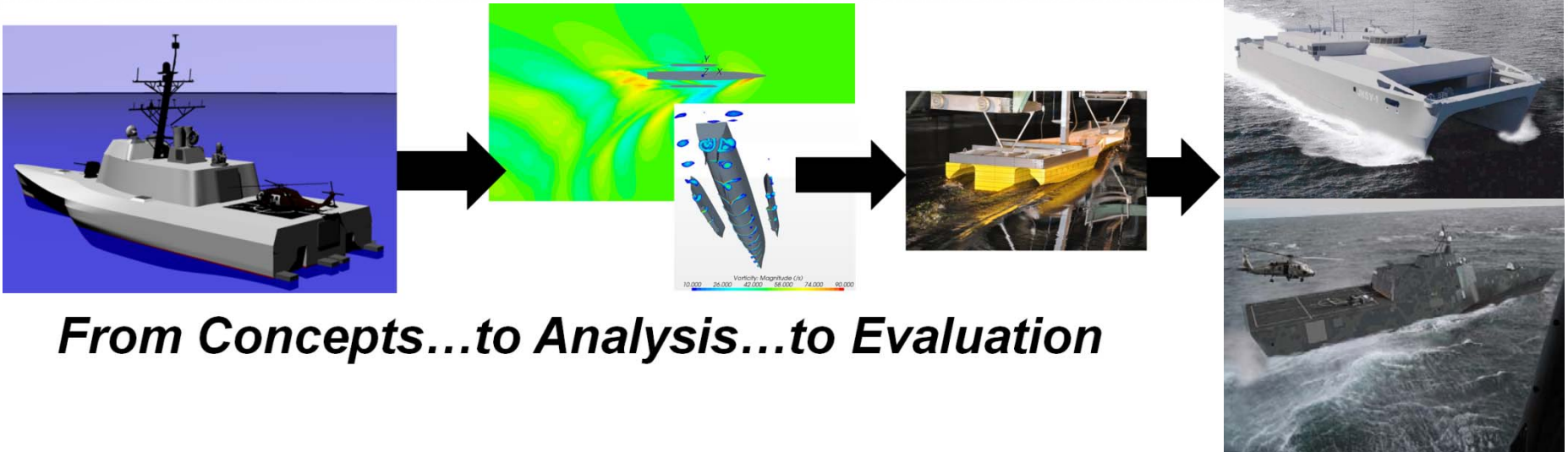
- Maritime Domain Awareness Using Commercial Satellites: *Coalition Tactical Awareness and Response (CTAR)*
 - Provide rapid access to task and receive ad-hoc, unclassified, shareable, wide area, space based, routine Geospatial Intelligence (GEOINT) data to augment ISR needs in maritime domain.
 - Introduce new RADAR business model: save ~80% current costs
 - Unclassified and Shareable to support coalition operations and partnerships
 - Simultaneously augments and compliments National means





Sample S&T Projects: Mil-Mil Research

- **Multi-Hull Naval Ship Design with Japan**
 - Improve USN and Japan MoD capabilities for design and performance assessment of multi-hull naval ships.
 - Improve the knowledge, design tools, and processes to support performance evaluation of current multi-hull ships, as well as development of future multi-hull ship concepts.



From Concepts...to Analysis...to Evaluation



Naval Science & Technology

Discover, Develop, and Deliver

- Continue to push boundaries of science and technology
- ONR Global's unique structure and mission enable continued and enhanced collaboration across the Asia-Pacific region
- The development, testing, and transition of technologies to address unique challenges of the Asia-Pacific region continues to be a major focus



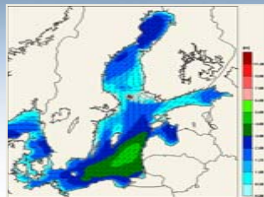
Questions?



Back Up Slides



Naval S&T Focus Areas



Assure Access to the Maritime Battlespace

- Ocean/Atmospheric Sciences
- Underwater Acoustics
- Ocean Sensing



Autonomy and Unmanned Systems

- Robotics
- Machine Learning
- Perception
- Human Machine Interface



Expeditionary and Irregular Warfare

- Situational Awareness
- Decision Making
- Mobility / Logistics
- Soldier Protection



Information Dominance / Cyber

- Communications / Information Technology
- Computer Science
- Mathematics /Data Analytics



Power Projection and Integrated Defense

- Directed Energy
- Energetic Materials



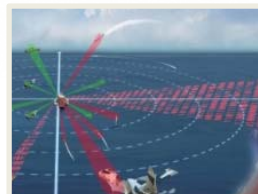
Platform Design and Survivability

- Air/Surface/Subsurface Vehicles
- Materials
- Corrosion /Biofouling
- Manufacturing Technologies



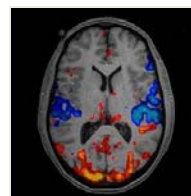
Power and Energy

- Renewable Energy
- Propulsion
- Power Control
- Thermal Management



Electromagnetic Maneuver Warfare

- EM Propagation & Waveforms
- Sensors and Electronics
- Optical Systems



Warfighter Performance

- Biomedical / Bioengineering
- Cognitive / Neural Sciences
- Training Technologies
- Health Protection