

Integration of Autonomous UxS into USN Experiments

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Demand Signal

- SECDEF Guidance for the Development of the Force
 - Ensure **sea-based** mid-range **UAS** in two locations in **FY12**, including **sea-based** ISR for the National Mission Force
 - NLT FY15, conduct **CVN-based experiments** with **N-UCAS**
 - Assess the feasibility of accelerating IOC of **CVN-based unmanned** aircraft for **strike** and **ISR**
- SECNAV Priorities
 - Sailors, Marines, Families
 - Procurement & Industrial Base
 - **Unmanned Vehicles**
 - Energy
- CNO Direction
 - **Move Boldly:**
 - With fiscally achievable solutions
 - **From Platform-Centric to Information-Centric** structures and processes
 - Into **Unmanned**, machine **Autonomous** technologies
 - Creating a Fully-Integrated Intel, C2, Cyber & Networks Capability
 - Improve **sea-based** mid-range **unmanned** ISR capability



We must think differently about how we acquire and integrate UxS.

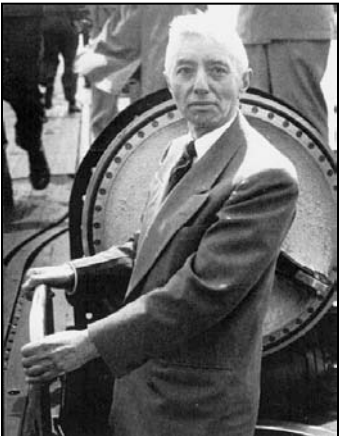


Naval Pioneers

- **“Air Admiral” RADM William A. Moffett** lobbied successfully for acceptance of aviation within the Navy, detailing the need for a central authority to coordinate affairs. In 1919, as a result of his certainty that aircraft carriers would be the best weapon system to have if the US had to go to war in the Pacific with Japan, catapults and planes were fitted to battleships and flying boats were added to ships, laying the foundations for the aviation-dominated Navy that would emerge and change the course of World War II.



- As director of the Naval Reactors Branch, **Admiral Hyman G. Rickover** developed the world's first nuclear powered submarine, USS Nautilus (SSN 571). In the years that followed, Admiral Rickover directed all aspects of building and operating the nuclear fleet that changed the world.



- **UxS effort requires similar approach to previous Naval Innovations and is expected to change the course of Naval Warfare**

Core Group required to shepherd this new & disruptive technology



Challenges of the Naval Mission

- Naval Unmanned Systems must operate in all four domains – Air, Ground, Sea-surface and Sub-surface
- Maritime environment presents different challenges
 - Months and weeks vs days and hours on station time
 - Stealthy and undetected
 - Vastness of the open ocean
 - High number of “white” contacts in choke points
 - Difficulties of sensor and C2 operations
- Naval UxS must work independently and teamed with other manned and unmanned platforms
 - Collaborative networks
 - Netted, meshed teams
- Higher levels of autonomy must be defined and supported by technology development
 - Manpower challenges
 - When does the UxS “call home”?
 - Experimentation will be a key component to building the trust needed for autonomous systems

Develop venues that bring together technology providers and warfighters to help develop new warfighting concepts, training standards, doctrine and TTPs.

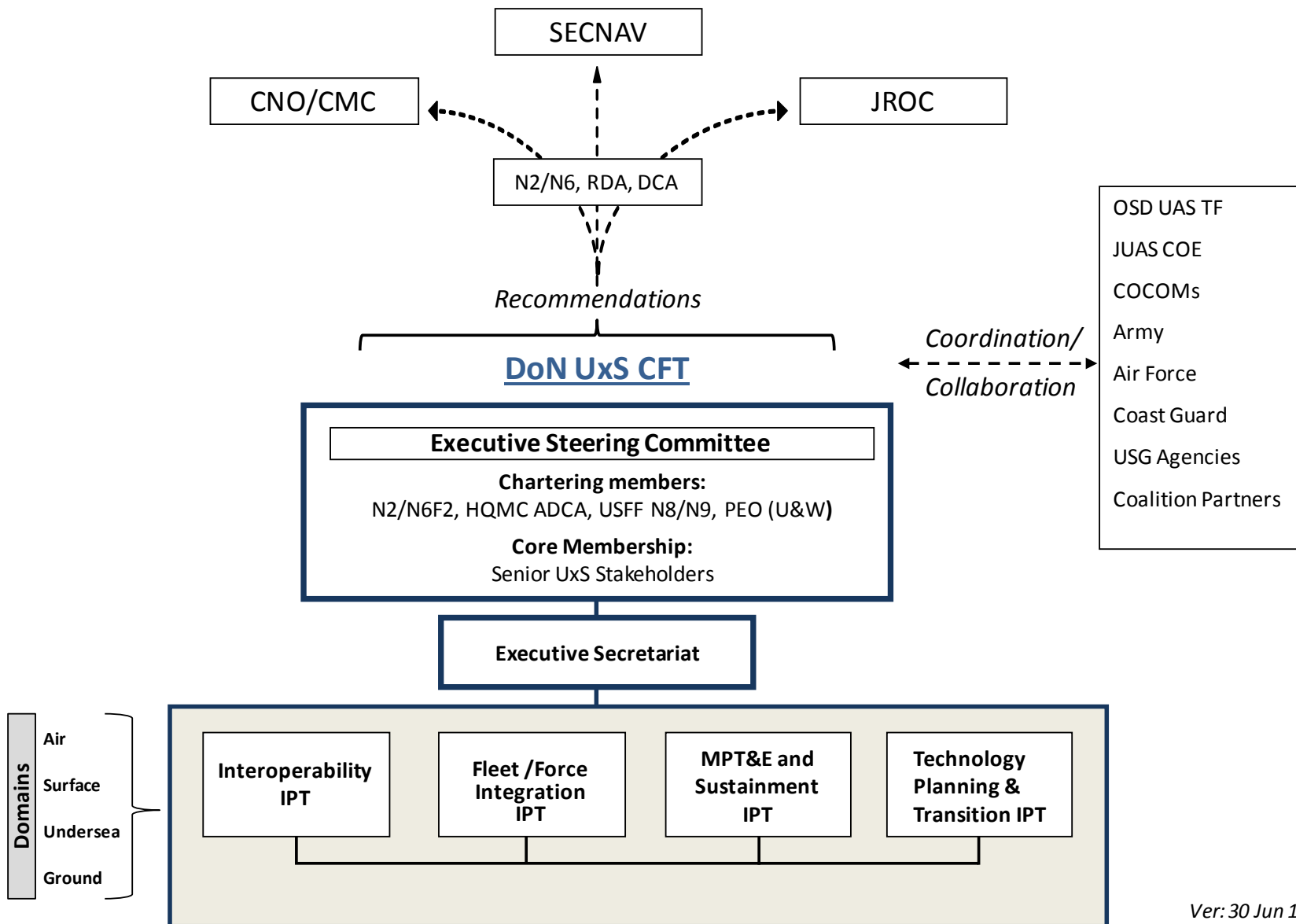


Unmanned Systems Cross Functional Team (UxS CFT)

- Naval Forces require a coordinated approach to UxS development for:
 - Requirement Priorities
 - Investment strategies
 - Interoperability
 - Fleet introduction
 - Manpower
 - Technology Transition
- Jul '09 – ASN RDA designates PEO(U&W) the “Unmanned Systems Focal Point”
 - Early vision of UxS CFT approach developed
- Apr '10 - “Naval UxS CFT” MOA signed –
 - OPNAV N2/N6, PEO(U&W) and USFF N8/N9 agreement to charter a Naval UxS CFT
 - HQMC ADCA included as Executive Steering Committee Member
- Nov '10 - Naval UxS CFT charter signed
- Utilize Mission Engineering as one of several CFT tools to provide context, rigor and repeatability in cross-domain Mission Thread Analysis and solutions development among the IPTs and WGs



The UxS CFT Organization



Ver: 30 Jun 11



CFT UxS CFT Mission Statement

- Assess barriers and issues associated with the development, integration and fielding of UxS capabilities in order to implement or facilitate effective solutions
- Guided by service vision and goals, the UxS CFT will coordinate resolution of identified barriers and issues across all stakeholder organizations
- Proactively drive and/or influence decisions to ensure the efficient fielding of unmanned systems with enhanced joint capability while optimizing resource efficiency

Through cooperative participation by contributing organizations and senior leadership support the CFT will effect the desired changes necessary to develop, field and integrate UxS capabilities



ME Across Domains

UxS Capability Contributions Roll up of CFT IPT Tasks

Capability n

- FFI IPT Efforts
 - Weaponized Fire Scout CONOPS
 - Sea Based Perimeter/HVA Defense NLW Experimentation
- Interoperability IPT
 - Full Motion Video from Fire Scout backhaul from LCS
 - Common Controller
 - TCPED Integration
- TP&T IPT
 - Autonomy - Automatic Target Recognition Capability Gap
 - Autonomy - Platform and Sensor Autonomy Capability Gap
- MPT&E IPT
 - Current Training Assessment
 - Training Commonality Investigation

... that provide options to developing Interoperable and Integrated capabilities across domains in multiple Naval Missions

CFT Stakeholders working ME and discreet DOTMLPF, P tasks that constitute important components of Naval Capabilities . . .

Multi - Mission Capabilities

Missions provide operational needs, requirements, and environment documented in doctrine, TTPs, SOPs, etc.

Surface Warfare (FAC/FIAC)

SoF Land Based Attack (Maritime)

Mine Warfare

Weaponized UxS

Common Controls

TCPED Integration

Capability

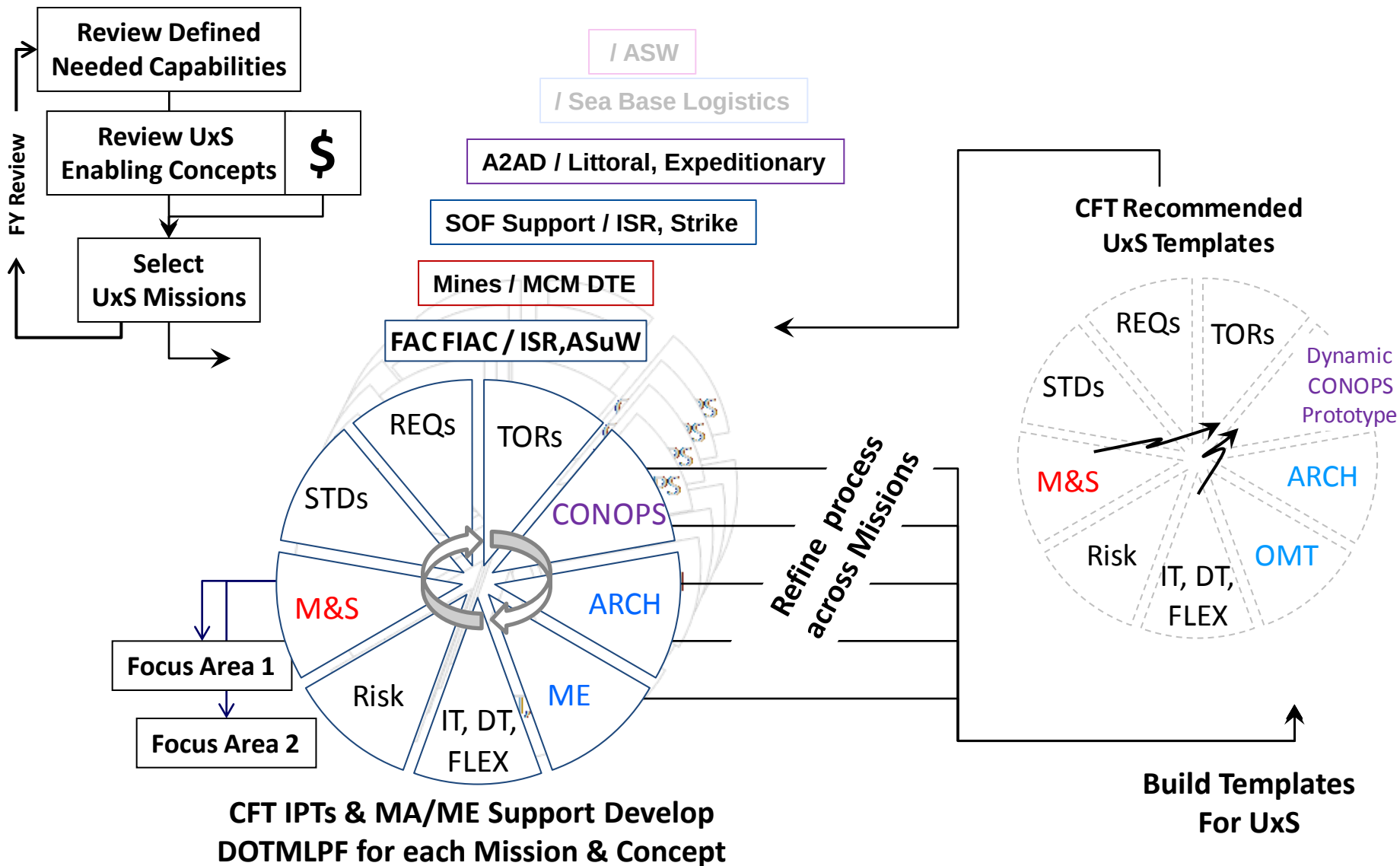
- System-of-Systems solution
- Satisfies requirements in one or more mission areas

- Focusing on Capabilities makes workload achievable, specific to UxS
- We will tie into existing USN missions as needed to help define efforts

Operational, Requirements/Resources, S&T, Warfare Centers and Acquisition Stakeholders Rigorous Collaboration



FLEX CFT Campaign Plan Process





Autonomy and Automation

- CFT's approach:
 - Develop methodologies for analyzing & prioritizing automation opportunities
 - Explore opportunities for near-term automation gains
 - Identify trends that span multiple operating domain
- UxS Experimentation will be used to produce “CONOPS-like” documents for automated and autonomous systems
- Manpower Requirements
 - Vehicle Operators – 1 with many
 - Sensor operators – 1 with many, of various types, fused info
 - Analysts – be “On the Loop” vs “In the Loop” for decision making
 - Maintenance – self-monitoring and self-healing
- Training Requirements
 - Trust in the performance of the vehicle must be learned by the human
 - Human must be the decision maker and understand the information and recommendations presented
 - Can systems learn and adapt and can that behavior be integrated into the TCPED?
- Current “Levels of Autonomy” definitions lack the fidelity needed to assess a robot's autonomy/automation in the maritime environment



FLEX Autonomy Goals

- Priorities for technology development
 - Autonomous vehicle operations / Common Control System
 - Remote sensing
 - Vehicle power
 - C2 requirements (meshed networks)
- Develop warfighters confidence in the abilities of the system.
- Determine what is affordable and how costs can be measured relative to other systems.
- Address some key issues:
 - Can a machine (computer) make better decisions than a human?
 - Who is accountable for these actions?
 - What are the moral and ethical implications?
- Identify the implications of autonomous UxS technology to the rules of engagement.

Exploring opportunities for modeling and simulation to provide more rapid and cost-effective CONOPS development



Conclusions

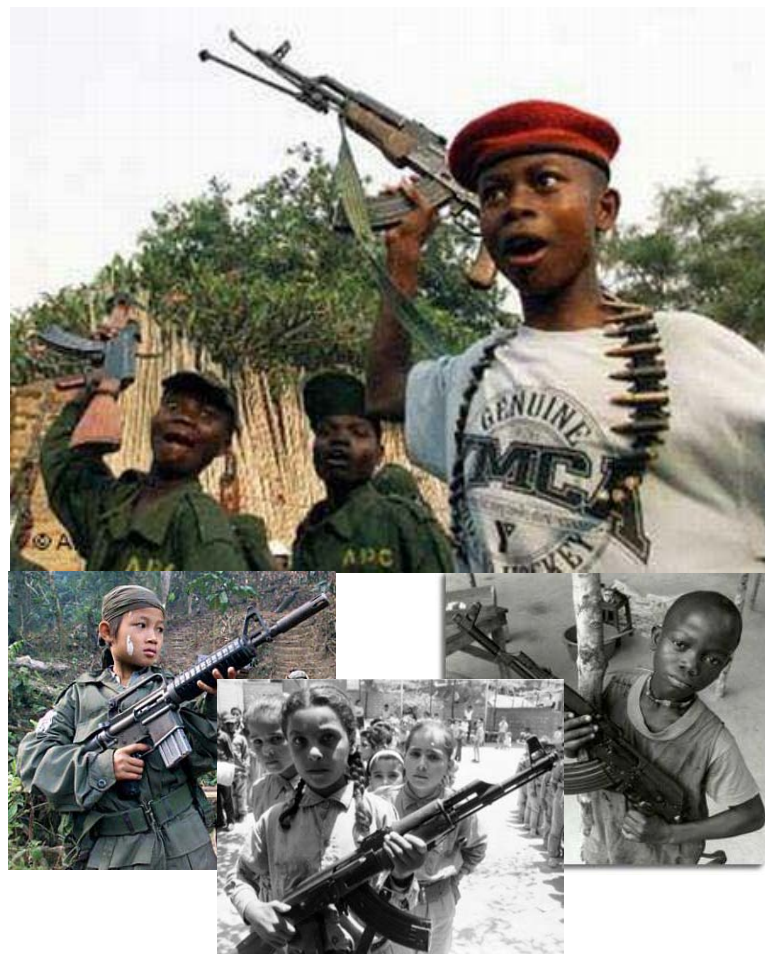
- Naval Maritime Missions present unique challenges – addressing these challenges requires a robust and integrated experimentation venue.
- The Naval UxS CFT was established to focus on delivering products that will address unmanned challenges, barriers, issues, opportunities, etc.
- Mission Engineering is one of several CFT tools to provide context, rigor and repeatability in cross-domain Mission Thread Analysis and solutions development.
- Increased autonomous capabilities for UxS include more complex tasks and operations with associated growth in mission capabilities, operational flexibility and adaptability.
 - Each of these characteristics may have a significant impact on related human workload.
 - Future missions will demand much greater levels of autonomous behaviors as part of an integrated manned - unmanned team.
 - Continuous human intervention is fundamentally inconsistent with the basic objective required for persistent operations across the operational areas for naval forces.
- Defined Levels of Autonomy will ensure mission threads across the maritime environment can be adequately addressed through experimentation and exercises in a consistent manner.

Final Thought on Autonomy

Our Standard



Other Standards



What are the autonomy analogs to grammar school, middle school, high school and basic training?

Questions



NAVAL UNMANNED SYSTEMS CROSS FUNCTIONAL TEAM