



30 JUNE 2021

Memorandum for Systems Engineering Analysis Cohort 31 (SEA31)

Subj: FY2021-22 SEA31 Capstone Project: Tasking and Timelines

Enclosures:

Tab A: Mission Engineering for Hybris Force 2045

Tab B: NPS Warfare Innovation Continuum “Hybrid Force 2045”

1. This memorandum provides the FY2021-22 guidance for the conduct of the Systems Engineering Analysis (SEA) integrated project, which is required as partial fulfillment for the SEA degree. SEA students will deliver completed project reports and final briefing materials to faculty advisors in accordance with the following plan and milestones. SEA 31 will:
 - a. Develop project proposals and management plans during the Fall Quarter AY2022. These proposals and plans will serve to focus initial research and analysis. These plans will be reviewed and updated frequently as research progresses.
 - b. Conduct project reviews approximately every six weeks, finishing with a final brief to interested stakeholders on and off campus.
 - c. Assign a report lead. Work closely with faculty advisors to prepare the final reports for faculty advisor signature by six workweeks before graduation. The final reports are then due to the SEA chair one week later; and to the Operations Research and Systems Engineering department chairs two weeks before graduation.
 - d. Develop and deliver an annotated briefing and report to OPNAV N9I that considers performance, costs and design alternatives to better inform DoDs POM process.
2. SEA students will identify and integrate students and faculty from across the campus – and from outside NPS – to participate directly in the project or to provide source documents, technical knowledge and insights, and knowledge of evolving requirements, capabilities, and systems. This participation could include students who would join project groups like MSSE distant learning and MSA distant learning; students doing related individual thesis topics from TSSE, TDSI, OR, IS or SE; faculty inside or outside NPS who have expertise related to the project; and appropriately engaged government agencies and industry developers. It is the students’ responsibility to integrate the efforts of outside participants in the projects. Faculty advisors and the SEA Chair will significantly assist in these efforts.
3. Prior to commencing the formalized systems engineering and analysis process including stakeholder analysis, **the SEA team will consult with Chairman of the NPS Institutional Review Board and submit** a general description of the team’s systems and analytical approach to address the tasking and a list of candidate questions for stakeholders for review. The intent is to ensure questions are oriented about the “what” of the systems and not about the “who” of the stakeholder.

4. The analysis will employ the systems engineering and operations analysis methodologies presented in class work and from the project advisors. The role of the SEA students is that of the lead project systems engineering team, working closely with other members of the project engineering teams from TDSI and other campus curricula. SEA students will be expected to define the functions and performance of systems, develop alternative architectures to meet those functions, and evaluate the alternative architectures for performance and cost. In executing these tasks, students will be defining and understanding the overall project requirements, recognizing that the definition process is iterative and will evolve as the project progresses.
5. Grades are assigned to the participants in these projects. Although work is performed as part of a team, individual performance will be the basis for this evaluation. Successful completion and documentation of the project is a degree requirement.
6. The SEA 31 project will build on, possibly challenge, but not replicate, other DOD, Navy, Naval War College, FFRDC, MSSE and SEA projects. SEA 31 will coordinate their study efforts, participate and occupy leadership roles in other FY21/22 efforts at NPS aimed at contributing to developing the concepts and designs for preparing for war in the era of Great Power Competition and unmanned systems warfare. These activities, coordinated within the Warfare Innovation Continuum are described in Tab B.



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TAB A

SEA 31 Tasking Mission Engineering for Hybrid Force 2045

Reaping lessons learned from the all WIC activities, SEA 31 will focus on “Mission Engineering for Hybrid Force 2045”. The SEA team will analyze selected architectures for various missions, for instance: Full Spectrum ASW; Littoral Warfare (Strike); War at Sea Strike (Long Range Fires); Port/Base Security; Integrated Air and Missile Defense; Maritime Interdiction Operations (Grey Zone activities); Protection of Underwater Infrastructures.

Overarching concepts described in the CNO NAVPLAN, NWP-3, Unmanned Campaign Plan, and other guidance direct the basis of force development and deployment. SEA 31 may use the NSWC Mission Engineering approach to describe the functional requirements, networks, and platforms. SEA 31 also will use principles from systems engineering to identify future force requirements, capability gaps, and an architecture to meet those requirements. SEA 31 will then synthesize mission-by-mission approach into larger-scope fleet requirements.

SEA 31 should anticipate an evolving threat; therefore, it is reasonable to envision that China and Russia employ many more Unmanned Systems in 2045. The above-mentioned mission areas may fit under the general concept of “Swarm vs Swarm for Sea Control”, but SEA 31 should seek to identify areas of synergy across proposed mission-area solutions.

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TAB B

NPS Warfare Innovation Continuum A Coordinated Naval Postgraduate School Cross-Campus Project FY 21-22 “Hybrid Force 2045”

Purpose: This paper’s purpose is to the FY21-FY22 NPS NWSI Warfare Innovation Continuum (WIC) theme to be “Hybrid Force 2045” to align with the CNO’s NAVPLAN, the Tri-Service Maritime Strategy “Advantage at Sea”, and the Navy’s Analytic Master Plan.

Background: For the past 13 years the NPS has adopted a major theme of naval interest to align over 300 faculty and students’ classroom, research, and capstone project work with emerging technologies, naval concepts and operational issues. The Warfare Innovation Continuum (WIC) is a series of independent, but coordinated cross-campus educational and research activities to provide insight into the opportunities for warfighting in the complex and electromagnetically contested environment at sea and in the littorals. Products from these efforts often precede and contribute to warfare development centers’ concept development campaigns.¹ In this sense, NPS fulfills its mission to provide a graduate education experience to prepare our officers for uncertain conflict environments as technological leaders.

Discussion: Emerging technologies in unmanned systems; directed energy; autonomy; missile systems; undersea systems; long-range, netted, quantum and multi-domain sensors; additive manufacturing; artificial intelligence, and networks create a new environment for operations in the littorals, on, under and over the sea. This changing technology environment both challenges traditional fleet operations and provides opportunities for new fleet design; innovative tactics, techniques, and procedures to achieve maritime domain objectives in sea control, power projection and distributed maritime operations. Unmanned systems technologies; joint, combined and coalition forces contributions; and multi-domain C2 provide opportunities to support integrated offensive operations, and further develop a hybrid naval force to operate in the range from competition to conflict. As a graduate education and research center committed to gaining technological advantage, NPS is a fertile ground for exploring opportunities to advance force design.

Proposal: Designate “Hybrid Force Design 2045” as the NPS WIC theme for FY21-FY22. The WIC efforts can contribute, and be informed by, the Navy’s AMP events and studies as it progresses. For example, issues from NWC wargaming on the Future Force Design 2045 may shape the WIC while in progress.

The larger research questions for this continuum are: “**How might emerging technologies, new operational concepts, and alternative fleet designs contribute to a more effective naval force across the spectrum from competition to conflict? How do the alternative fleet designs enhance the effectiveness and resilience of joint, combined and coalition forces across all domains?**”

In alignment with the Tri-Service Maritime Strategy and CNO’s NAVOPLAN and to support the Navy’s Analytical Master Plan and Marine Corp’s Force Design, the following WIC activities are proposed:

- NWSI research group Task Force Overmatch supports NAVWAR's efforts on Naval Operational Architecture Development
- Faculty submitting IREPs to the NPS Naval Research Program align their proposals to the CNOG's key operational problems (with no reference) and/or hybrid force development
- Capstone Courses like the Wargaming, Joint Campaign Analysis, Joint C4I, Tactical Oceanography, Naval Tactical Analysis, and others adopt a common unclassified world-wide conflict scenario and address topics related to a "Hybrid Fleet," and those emerging technologies which may enable it. Specific technical or tactical/operational topics maybe subjects for sponsored wargames.
- The NPS NWSI September Warfare Innovation Continuum Workshop brings together naval systems commands and navy lab engineers; fleet representatives; warfare center and warfare development center representatives; warfare development squadrons, NEE faculty and students; and industry engineers to consider emerging technology opportunities on hybrid fleet design
- Incoming students within the Master of Science in Strategy program will be directed to focus their applied research thesis towards topics related to a "Hybrid Fleet" and those emerging technologies may enable it.
- The NPS Total Ship Systems Engineering design some portion of an unmanned-manned platform system in a three course engineering design sequence.
- The three-quarter NPS Systems Engineering Analysis interdisciplinary cross campus capstone project adopt "Hybrid Force 2045" to explore force architecture design alternatives.
- CRUSER, CISER, JIFX, and the various research centers on campus are made aware of the broad WIC topic and contribute to the final executive report

ⁱ 2013-2014 WIC theme is "Distributing Air and Future Naval Forces" In January 2015 Surface Force proposes "Distributed Lethality" which USFF modifies in 2016 as the concept "Distributed Maritime Operations" Capstone projects (TSSE, JCA, and J4CI classes) and theses produced preceding these concepts and later in support of developing these concepts.

2014-2015 WIC theme is "Littoral Warfare in the Contested Environments" In 2015 the concept of "Littoral Operations in the Contested Environments" is proposed by NWDC and MWCL. NPS work fed directly into that proposal

2019-2020 WIC theme is "Logistics in Contested Environments", now a major study project by OPNAV N4, NWDC, and MCWL. NPS work includes analysis starting in FY18, the TSSE group design for a robust logistics carrier, and the SEA group interdisciplinary project with the same title. All provided to OPNAV N4, NWDC, and MCWL