CHIEF OF NAVAL OPERATIONS STRATEGIC STUDIES GROUP XXVIII

Way Ahead Plan

The Unmanned Opportunity

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Submitted on behalf of SSG XXVIII
by

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1. Introduction.

The Chief of Naval Operations (CNO) Strategic Studies Group (SSG) is chartered with generating revolutionary naval warfighting concepts. SSG XXVIII has been tasked to generate innovative concepts for the operational and tactical employment of unmanned systems, in all domains, as an integral part of the Naval Force for 2020 and beyond. From these innovative concepts, SSG XXVIII is also tasked to produce recommendations and actionable steps for implementation of unmanned systems integration into the Navy's force structure. This *Way Ahead Plan* provides a framework for SSG XXVIII's approach to address this task and challenge. It includes a summary of the SSG's preliminary thoughts on the value of unmanned systems, an initial overarching concept, and associated concept teams and areas of interest.

2. The Unmanned Opportunity?

Unmanned Capabilities are the Entering Argument. The increased use of unmanned vehicles appears to be a natural, desirable, and obvious progression of current trends. Capabilities of unmanned systems (such as increased dwell time, and performance of dull, dirty, and dangerous tasks) suggest greater utility in the future. These attributes of unmanned systems solve current operational problems with point solutions. Success in Iraq and Afghanistan portends increased unmanned systems use across the entire military. Increases in technology suggest commensurate increases of unmanned systems capabilities that will bring even greater benefits through their tactical and operational use. These trends extend into a basic argument: since unmanned systems have proven effective in combat and may bring increased capabilities against future challenges, the Navy should procure and employ more unmanned systems. While a start, this argument, if unguided by overarching concepts of unmanned integration, has serious flaws.

Holistic Approach Could Increase Effectiveness. Incremental projections of today's successes do not look sufficiently far into the future, may not scale effectively across the force, and may fail to realize the maximum benefits that a holistic implementation of unmanned systems could produce. Simply adding unmanned systems without examination of restructuring Navy forces may miss unseen opportunities of unmanned systems such as realization of a free form force and enhanced development of distributed, flexible, and agile forces employed in yet undiscovered operational ways and means.

Balancing Risks and Rewards. Uncertainty over both the exact capacities of future unmanned systems and the challenges of specific future threats complicates the integration of the former. A mismatch between future capabilities and challenges represents risk to both the Navy and the nation. Unmanned systems are one portion of the overall future capability of the Navy. Ad hoc procurement of more unmanned vehicles, devoid of an overall concept of their use in the context of the entire naval force and the uncertain threat environment, will increase that risk. A concept of unmanned systems usage must address a variety of possible futures in order to utilize unmanned assets in a way that maximizes rewards and best mitigates risk.

Man and Unmanned. A continued increase of unmanned systems without analysis of the relationships between manned and unmanned systems as integrated pieces of the whole Navy force may miss opportunities to achieve the "sweet spot" between manned and unmanned systems. Future force structure should not be based on predetermined numbers or ratios of

unmanned systems, rather the force should be built to maximize the capabilities of an integrated manned and unmanned force.

What do we want to "Unman?" Unmanned systems are often described as being more capable, cheaper, less risky, and less manpower intensive than manned systems. While these perceptions may be true, further study in a broader context is required to determine the validity of these points. Examination of unmanned attributes and their projected futures will provide better metrics to establish what roles are best unmanned. The SSG will analyze potential capabilities and benefits of unmanned systems contribution to total Navy capabilities across a *range* of alternate futures while seeking concepts that add the most value and reduce risk amidst uncertainty.

Unmanned integration recommendations are not new. Since 1995, several SSGs have included elements of unmanned systems in their reports. SSGs XXIV and XXV provided detailed information on what came to be called the "Free Form Force." Uniquely, this force was scalable, adaptable and relied heavily on unmanned vehicles of several types and sizes that operated on and under the sea, and in the air. SSG XIX introduced the concept of FORCEnet, an operational, netted architecture which provided the necessary battlespace in which the Free Form Force could most effectively operate. SSGs XXVI and XXVII focused on cyberspace and the Navy's role in that environment. SSG XXVIII believes that the work of these previous SSGs is highly germane to this year's topic, and that an operational concept for full integration of the work of these earlier SSGs may be furthered in our work this year.

3. SSG XXVIII Overarching Concept:

Our Overarching Concept—***The Unmanned Opportunity***— provides a preliminary operational framework for the year's work. It is not intended to be exhaustive, and will evolve with continuing research.

To provide a common frame of reference, SSG XXVIII's Overarching Concept is built upon specific terminology to clearly communicate our early thoughts providing an initial construct for us to begin our work. Specifically, we have chosen not to use the terms "systems" or "system of systems" when describing unmanned and manned entities. We have found that the more diverse the audience, the wider the range of definitions for these terms which leads to confusion. We have found, in common usage, that "systems" and "system of systems" can mean anything from small-scale to large-scale, varying across logistical support, training, hardware, networking, and specific sensors. Rather than using "systems" and "systems of systems," we have decided to use "entity" and "naval force package" in our initial Overarching Concept:

> - ***Entity*** - *The lowest divisible level/element of a taskable unmanned or manned unit (e.g. a vehicle, sensor, weapon, or cyber element). This definition assumes the support structure behind each entity exists when it is designed. An entity may operate individually or be grouped together with other similar or dissimilar entities to fulfill capability requirements.*
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> - ***Naval Force Package*** - *An operationally and logistically integrated combination of entity groupings (from one to many) containing the command and control for these*

groupings, the organic logistics and sustainment structure supporting the grouping, and the pool from which the entity groupings are constituted. The package generates operational effects through coordinated use of the entity groupings, and is provided to the Joint Commander to fulfill a mission or set of missions. The Naval Force Package is a sub-component of a larger Joint/Coalition/Interagency force.

***The Unmanned Opportunity*.** In order to position the Navy to best meet the dynamic range of challenges that will emerge over the next 12 to 20 years, SSG XXVIII proposes that manned and unmanned force structure merge in a cohesive and seamless fashion. The work of SSG XXVIII during the remainder of our year will test the eight hypotheses laid out in this Overarching Concept:

The Navy must adapt to evolving missions sets. Maximizing naval mission effectiveness will require the integration of manned and unmanned entities in all domains (land, sea, air, space, and cyberspace). This integration will also provide new opportunities for mission accomplishment that will revolutionize concepts of operations and related doctrine, and may render some current missions, systems and approaches obsolete.

Integrated and netted manned-unmanned force structure will be a force multiplier. A mission-tasked Naval Force Package, comprised of heterogeneous groups of manned and unmanned entities—fully deconflicted throughout the battlespace—will provide a more robust capability to the Joint Commander.

Realizing Free Form Operations. Integrated Naval Force Packages will be responsive and adaptable to changes in mission, tasking and environment. Manned and unmanned entities should be able to be tasked and employed with equal ease.

Resilience will be a centerpiece principle of the integrated force. Naval Force Packages will accomplish the mission or some portions of it despite losses, adversary action or uncertainty, through attributes including self-healing and graceful degradation.

Survivable networks and exchange of information will be vital to success. Networked together to increase strength, survivability, and reach, entities cannot be considered just in isolation, but also as part of an integrated Naval Force Package.

The challenges are not simple and organizational bias runs deep. Given that the Navy's current institutional structure has not yet truly integrated manned and unmanned entities into a coherent framework, true integration will likely involve cultural, doctrinal, personnel, and organizational revolutions.

Lead the technology race. Complete integration of unmanned entities into Naval Force Packages will present technological challenges. Integration implies the need for development of new innovative technologies, expeditious merging and collaborating of current and emerging technology, and the evaluation of associated technological risks.

Objective measures will indicate success. A framework for evaluating accomplishment of Naval Service missions will result in fair and unbiased competition for the best manner to achieve the tasks through combinations of manned or unmanned entities, and will provide the basis for metrics to measure the progress toward force integration.

4. Approach

Overview. The SSG has been given the task to generate innovative concepts for the operational and tactical employment of unmanned entities, in all domains, as an integral part of the Naval Force. Our initial focus is on determining what can be accomplished by 2020. Additionally, we will evaluate concepts that could be relevant in the 2020-2028 timeframe mindful that manned platforms of today will support most of the unmanned entities fielded in that period.

In addition we will review decision methodologies for the transition to unmanned entities, assess the communications and networking requirements for integrating unmanned entities, address common vehicle control approaches, and review the strategy for development of autonomy in unmanned entities.

An important part of this *Way Ahead Plan* is to identify effective metrics for guiding further analysis and testing. Our work will cover the full range of unmanned entities in terms of size, capability, numbers, modularity and autonomy to provide mission effectiveness and flexibility. We will consider the impact of unmanned entities on force structure, manning and training. Our work will also consider and attempt to complement the work of the other Services.

The Group will report out to the CNO in July 2009.

Concept Teams. To test the hypotheses of ***The Unmanned Opportunity***, SSG XXVIII has divided into five Concept Teams. Each of the five CTs will undertake individual (yet, coordinated) research plans. In carrying out these plans, CTs will: review past SSG work; draw upon literature reviews; base-line present and near-future programs; integrate futures forecasting; analyze related trends and driving forces; challenge assumptions; outline methods to collect the best ideas from leaders in academia, industry, and government; and critique or "Red Team" their work.

The five Concept Teams as defined by their topical emphasis are:

Missions and Roles,

Innovative Capability and Technology,

Command, Knowledge, Networking and Control,

Culture, Organization and Process, and

Methodology, Metrics, Roadmaps, and Research Synthesis.

Each Concept Team is discussed in further detail in Section 5.

Coordination and Collaboration. The Concept Teams are not autonomous; we recognize that the concepts and capabilities that each CT develops will be deeply interwoven with the work of other Concept Teams. Therefore, collaboration among and integration across all CTs will be vital components of our efforts. Concepts will be individually and collectively challenged and critiqued within the SSG and by outside experts. Each Concept Team has identified topics for initial study referred to as "areas of interest." These areas of interest are by no means exhaustive, but rather a starting point for the efforts of each CT.

Since there are overlaps among the areas of interest initially addressed by the CTs, the Concept Teams plan to identify and utilize these common threads as opportunities to form combined teams to ensure a refined and holistic examination of common threads. Over the course of our work we expect to refine, perhaps define anew, these areas of interest as we proceed in directions we currently cannot foresee.

Approach Summary. SSG XXVIII is determined to tackle our tasking with an unconstrained view, by challenging all assumptions and striving to develop revolutionary operating concepts that help the Navy seize ***The Unmanned Opportunity***.

5. Concept Teams:

Missions and Roles Concept Team

Overview:

The U.S. Navy's future missions and roles will be defined by multiple driving factors. Emerging technologies, global trends, rising nation-states, and the increasing relevance of non-traditional actors and organizations will pose challenges and present opportunities for the Navy in the years to come. These dynamic factors will change the way the Navy thinks about naval, joint, allied, interagency, and international relationships and organizational constructs. Moreover, this changing landscape demands a review of the missions and roles of the U.S. Navy within the Joint/Combined Force.

Considering the Navy's missions and roles in a range of alternate futures, this CT will employ a multidisciplinary, open-minded review of potential naval missions and roles as part of the overall development of the future Navy force structure. Findings from this CT will establish a baseline for the work of other SSG XXVIII CTs.

Areas of Interest:

- Review missions and roles of the U.S. Navy and the Joint Force based on current documentation.
- Examine alternate futures, associated reports, and the methodologies used for developing them.
- Explore the impact on the Joint Force of these alternate futures with regard to technologies, threats, and challenges, and the likely set of future missions and roles of the U.S. Navy.
- Through collaboration with the other CTs, develop a potential operational framework for the employment of integrated manned and unmanned entities.
- Examine ethical and legal implications, in a broad sense, as they apply to Naval Force Packages.
- Generate potential metrics for evaluation of the best use of entities and integrated Naval Force Packages.
- Incorporate red teaming into evaluation of potential roles and missions.

Innovative Capability and Technology Concept Team

Overview:

Developing revolutionary war fighting concepts involving unmanned entities, and integrating them with manned entities, requires a thorough understanding of current, emerging, and potential technologies. This CT will explore science and technology developments underpinning unmanned entities—in use, in development, and envisioned. This CT will identify opportunities for both "technology push" and "capability pull" to enable revolutionary war fighting concepts. Its research will also delve into vulnerabilities and potential mitigation strategies. This CT will identify the technological nexus between unmanned entities, and air, sea, land, and cyberspace environments.

While not all-inclusive or constraining, this CT will endeavor to decouple traditional platform functions and mission functions in an effort to discover new concepts. Specifically, it will consider separating payloads from platforms; separating operational and mission functions from hotel, housekeeping, and administrative functions; and separating sensors, effectors, and deciders. This approach will allow the CT to facilitate identification of concepts related to modularity, commonality, scalability, and standardization.

Areas of Interest:

Power Generation, Supply, and Storage

Employment

- Logistics.
- Entity launch, delivery and recovery.

Sensors

Effectors

- Directed energy and advanced warheads.
- Jammers and decoys.

Deciders

- Autonomy and cognition modeling.
- Advanced programming interfaces and operations systems.
- Entity control methodologies.

Materials

Communications

- Bandwidth optimization through complexity reduction and discriminate analysis.
- Mesh networking.
- Animal behavior.

Command, Knowledge, Networking and Control Concept Team

Overview:

A broader incorporation of unmanned entities into the Naval Force of the future creates challenges previously not encountered by commanders, decision makers, and legacy structures (processes, tools, equipment, design, relationships) designed for command and control of humans and groups of humans. Command and control (C2) and networking comprise more than just boxes, beams, and bandwidth. The manner in which knowledge is extracted, organized, communicated, and employed will be central to how a future commander conducts operations. This CT will explore future agile C2 and networking structures that will allow the force to manage risk and maximize opportunity in all domains.

The future netted force will have emergent strengths, vulnerabilities, and opportunities. This CT will examine "network effects" that can increase the strength, adaptability, survivability, and reach of the overall force. Further, it will look at information security while exploring concepts for robust, reconfigurable, and agile networks that are resilient against the next generation of network intrusion or disruption mechanisms. By developing a deeper understanding of future strengths and vulnerabilities, opportunities to exploit adversaries' networks may emerge.

Areas of Interests:

C2

- Evolution of the basic notions of command and control.
- Fundamental execution of C2 including ownership, tasking, deconfliction, span of control, battlespace boundaries, degree of autonomy, and rules of engagement.
- Gaining advantage through low-tech opportunities.
- Explore non-hierarchical organizational structures both in friendly and adversary forces.
- Examination of the relationship among trust, accountability, responsibility, authority, shared awareness, and command and control.

Knowledge

- The challenges of human systems integration in dealing with future data overload.
    - Combining C2, unmanned entities, and human systems integration to best support decision makers.
    - Explore automation, data overload, information quality, and the extraction of information as complex, interconnected problems for the future decision maker.
- Translating situational understanding into actionable information and knowledge.

Networking

- What can the network architecture of the force be in 2020.
- Examination of how information and knowledge are shared, prioritized, and allocated among entities in the force, and how they are shared with systems outside of the Navy.
- How "network effects" can be brought to bear with unmanned and manned entities.
- Designing agile networks for resilience, survivability, bandwidth, and network loss.

Culture, Organization and Process Concept Team

Overview:

The culture, organization, and processes in today's Navy were developed during a period of limited unmanned entity use and may present barriers to pursuit of manned-unmanned integration. Although the transition toward unmanned entities may cause the role of the individual to change, these forces will not eliminate the "person" from the force. How and to what extent the role of the individual evolves is a critically important question and is the central focus of this CT.

Areas of Interest:

Culture

- **Biases and Barriers**: Explore cultural biases and consider how they may delay or derail efforts to field a force.
- **External Factors**: Consider the effects that external factors play on an unmanned entity's design, funding, and fielding.
- **Strategy and Policy**: Consider the impact of current policy and strategy on the Navy's ability to influence culture and vice versa.
- **Ethics and Law**: Learn how legal and ethical considerations may hinder integration of unmanned entities and develop an understanding of what changes may be needed.
- **Recruiting**: Explore what changes may be necessary to ensure recruiting is relevant.

Organization

- **Organizational Behavior**: Learn about the interaction of formal and informal relationships within organizations.
- **Barriers**: Study the causes of resistance to organizational change and learn techniques to reduce human and institutional barriers to change.
- **Structure**: Explore the current organizational structure for staffing and hierarchical changes that will be required to make the most of unmanned capabilities.

Processes

- **Doctrine**: Explore the effect that current doctrine has on application of unmanned entities.
- **Training**: Explore the formal training process, including indoctrination, and find ways to better meet the needs of tomorrow's service member.
- **R&D**: Learn about current research and development practices and explore ways to use existing technology to reduce the cost and delay associated with research and development.
- **Acquisition**: Examine acquisition processes and understand how it affects the deployment of new technology.
- **Operations and Maintenance**: Explore the current operations and maintenance of unmanned entities and consider opportunities for improvement.
- **Support Applications**: Research current processes used to support war fighting readiness. Evaluate the ability of current processes to implement new technologies.

Methodology, Metrics, Roadmaps, and Research Synthesis Concept Team

Overview:

There are currently multiple approaches for making decisions regarding the resourcing and integration of unmanned entities. This CT will examine the common threads and the key elements within these decision methodologies in order to allow concentrating resources and efforts toward the ultimate goal of an integrated manned - unmanned force structure. Overall integration of unmanned entities is essential to a coherent force structure and, if the integration of these unmanned entities is not addressed at the foundational level, critical capability shortfalls may emerge in the future.

Similarly, there are many roadmaps to the future for unmanned entities, as well as for the key systems that will be required to fully integrate manned and unmanned entities. For example, the FORCEnet Roadmap describes the creation of a fully-netted force and will likely be crucial to developing an understanding of the level to which, and the speed with which, unmanned entities can be integrated into the naval force structure. Joint Force and other government agency efforts will also be examined to determine if there exist key roadmap elements that are inconsistent with Navy decision methodologies and roadmap structures.

Finally, this CT will work to identify metrics within research areas across all CTs, and will provide research synthesis and alignment in order to smooth the integration of concepts emerging from the work of all CTs.

Areas of Interest:

Methodologies

- Evaluate current methodologies for determining whether entities should be manned or unmanned, find common elements for the formulation of unmanned decision criteria.
- Explore systems dynamics modeling for use in decisions regarding integrating unmanned entities.

Roadmaps

- Determine common requirements among Navy, DOD and USG unmanned entities.
- Determine common requirements between Navy, DOD and USG for systems such as FORCEnet and other common communication architectures.

Metrics

- Look for common metrics within each of the research areas, as well as across Joint and other government agencies.
- Determine which metrics are common and which are Navy unique.

Research Synthesis

- Ensure cross-CT integration is maintained throughout the overall research process.

7. CNO Strategic Studies Group XXVIII Directory

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