Executive Summary
Roles of Unmanned Vehicles

Over the past 20 years there has been a proliferation of unmanned vehicles (UV) research and development (R&D) efforts and programs. These generally uncoordinated efforts have resulted in a plethora of unmanned systems in all operating environments—unmanned aerial vehicles (UAVs), unmanned ground vehicles (UGVs), unmanned surface vehicles (USVs), and unmanned underwater vehicles (UUVs). Increasing demands upon operating forces in terms of tempo, increased threat capabilities, rules of engagement parameters, and risk management are leading Naval Forces, as well as other services, to the development of and reliance on such systems. These UVs are envisioned to perform a variety of missions in many environments.

Study Scope and Methodology

In view of this, the Naval Research Advisory Committee (NRAC) was tasked by the Assistant Secretary of the Navy (Research, Development, and Acquisition) (ASN(RDA)) to form a study panel to assess potential concepts of operations and employment across all naval missions with respect to UVs. The Panel was tasked to examine Fleet needs, requirements, and desired capabilities and recommend which concepts are considered to have the greatest potential to improve warfighting capabilities and effectiveness, and reduce manpower and operating costs.

Although the time allotted to the Panel to complete this study was relatively short, the Panel was aided in completing its tasking by two factors. The first was the makeup of the Panel itself As a whole, the Panel members represent almost 500 years of operational, technical, and managerial experience. Seven of the Panel are former Navy or Office of the Secretary of Defense (OSD) executives. Ten have had responsibility for major system development or acquisition. Five are former military who have had operational commands and decision making responsibility. Secondly, the Panel benefited from a robust fact finding and briefing schedule which included extensive briefings by both users (Navy, Marine Corps, Air Force, Army) and developers (Navy laboratories, warfare centers, Air Force and Army laboratories, Defense Advanced Research Program Agency (DARPA), industry) of UVs. Additionally, the Panel, in whole or in subgroups, visited seven commands directly involved in UV R&D.

The study methodology used in accomplishing the Panel's tasking was straightforward. The Panel was divided into subgroups by type of UV: UAV, UGV, USV, and UUV. Each subgroup then conducted a qualitative assessment (value and cost) to assess the contribution / applicability of their UV type for each of the Sea Power 21 Capability Areas (Persistent Intelligence, Surveillance, and Reconnaissance (TSR), Time Sensitive Strike, Information Operations, Expeditionary Maneuver Warfare, etc.). Based upon these assessments, specific findings and actions were proposed for each UV type.

Finally, based on the individual subgroup assessments, the Panel as a whole formed conclusions and made recommendations designed to facilitate improvement in the Department of the Navy (DON) approach to UV development and use.

Conclusions

The Panel came to the following conclusions with respect to UVs as a whole. Specific findings and actions for each UV type are included in the main body of the report.

- The combat potential for the use of UVs is virtually unlimited UV systems can play a significant role in Persistent TSR, as communications nodes in netcentric warfare, and in unique areas as an augment to current force structure. Substantial reductions in warfighter risk are expected for time sensitive strike missions and some elements of tactical reconnaissance.
- Quantitative analysis and metrics are lacking The Panel observed the lack of any formal quantitative analyses to justify the investments in unmanned systems. Similarly, the Panel found little in the way of metrics addressing the benefits of key aspects of unmanned systems. Both are considered essential to determine the most beneficial concept of operations (CONOPS) for initial and subsequent deployment of UVs.
- Naval programs are not coordinated or focused The Panel found numerous Naval UV initiatives in development, funded from various sources. There is no master plan for USVs. Master plans for UAVs, UGVs, and UTJVs exist in various levels of detail. All master plans appear deficient in planning life cycle total ownership costs and in sustainment of system capability on a forecasted, reliability-centered maintenance basis.
- Lessons learned are not institutionalized The Panel could not find a systematic and coordinated Navy and Marine Corps effort to take advantage of the experience gained from experiments and demonstrations, including Advanced Concept Technology Demonstrations (ACTDs), Fleet Battle Experiments (FBEs), Advanced Warfighting Experiments (AWEs), or actual combat experience.
- Cultural and policy obstacles exist Successful development of UVs faces cultural and policy issues. These include, for example, resistance to trusting a machine to perform tasks previously performed by humans, insecurity resulting from humans being displaced by machines, and development and application of a common Tactical Control Station.

Recommendations

The Panel proposes six recommendations to improve Naval development and use of UVs. Three are actionable at the Chief of Naval Operations (CNO) / Commandant of the Marine Corps (CMC) level and three are actionable at the Secretary of the Navy (SECNAV)/ ASN (RDA) level.

- Create an integrated UV Master Plan (CNO/CMC) Designed to focus investment and speed the attainment of operational capability. This effort should identify the

requirements for initial applications and develop plans for integration of these systems into the Naval Force.

- Conduct independent quantitative analysis (CNO/CMC) The UV Master Plan must be accompanied by independent, quantitative analyses of the alternatives to conducting specific concepts of operations with and without UVs.
- Institutionalize lessons learned (CNO/CMC) The Panel recommends that Commander Fleet Forces Command (CFFC) and the Marine Corps Combat Development Command (MCCDC) be made both the repositories for lessons learned and the action agents to ensure they are implemented in the UV Master Plan, future exercises, and in future systems.
- Create an integrated management structure to acquire UVs (ASN (RDA))
- Organizational alternatives should be explored and a structure implemented that will establish design principles and standards, create and maintain test beds, and enforce compliance.
- Establish a policy for open systems architecture, modular design approach, and common man/machine interfaces (SECNAV) - Ensures maximum possible benefit from interoperability.
- Focus on technology obstacles for next generation UV deployment (Deputy Assistant Secretary of the Navy (DASN)/Program Executive Officer (PEO)/Chief of Naval Research (CNR)) Focus science and technology (S&T) efforts on the following five highest priority technology enablers: cooperative adaptive autonomous controls, intelligent information management, secure robust communications, energy storage and propulsion for endurance, and launch and recovery systems.

Concluding Remarks

There is no question that the Fleet/Force of the future will be heavily dependent upon UVs. Many will be organic to surface and submarine combatants and many will be in a ready for issue role to fleet units, areas of responsibility and/or combat zones around the world. Development must be in compliance with an interoperable architecture and the networking necessary to integrate UVs into Sea Power 21's elements: Sea Shield, Sea Base, and Sea Strike. Implementation of this study's recommended actions will ensure that future naval forces have available to them an effective and affordable suite of UV systems that complement our manned capability and effectively respond to the ever changing threat and character of combat.