HSRP Comments on OCS Automation and Autonomous System Strategy
September 2017

The HSRP thanks OCS for requesting comments on the Autonomous Strategy and also appreciates the briefing on the Strategy CAPT E.J. Van Den Ameele presented at the Technology Working Group meeting August 3, 2017.

We reviewed the following documents:

- Executive Summary and OCS Autonomous Systems Roadmap
- Autonomous strategy 1-pager, and
- 20170731_UxS_OCS_Strategy - HSRP Tech WG.pptx

The following comments have been grouped by item and do not follow the order of any of the NOAA documents.

Document proof reading/editing

General items related to proof reading:

- The presentation provided more information than the paper and the one-pager, and it is suggested all be reviewed for consistency.
- OMAO is not spelled out in full in its first use in the executive summary and paper.
- Inconsistency in using abbreviations UAV, UAS, USV, etc. Some in full, but not first use in paper and others in definition section only.
- Size references to the Hydroid REMUS-600 AUV are not consistent. In some places, it is referred to as a “mid-sized AUV” and in other places it is referred to as a “large AUV”. This should be standardized and consistent throughout.
- Maybe should differentiate between unmanned surface vessels and autonomous surface vessels, and progression to autonomy.

Strategy versus Plan

Currently the document is more a plan than a strategy, and some of the strategy behind the plan was more clearly presented at the Tech WG meeting. It would be helpful to clarify the intent and scope of the plan/strategy/roadmap. In doing so, the final title (plan/strategy/roadmap) should emerge.

There is some uncertainty about the use and benefits of autonomous systems and it seems likely they will not provide immediate cost benefits. The paper should outline how it is intended that the investment in assessing the issues and solutions as technology and operations develop will benefit NOAA OCS.
It is suggested the document can include:

- Some of the reasons behind items in the plan,
- where autonomy can potentially address OCS focus areas,
- type of strategy e.g. “crawl, walk, run” strategy; monitor technology, gain experience and build knowledge to then leverage when technology and operations more mature, and

- research priorities that address different aspects of the autonomy level matrix in the presentation.

The plan notes that it leverages the existing experience and infrastructure of the organization and not one that completely re-works OCS approach to surveying. It uses a variety of approaches; prototype, test, learn and then scales for a transformative new approach. Examples of areas where the document could be expanded to outline why these are proposed could include:

- The strategy is to progress to autonomous systems and addressing some specific OCS Focus Areas,
- priority areas for research to meet most likely areas for development, and
- standing up the operational team to build best practice, assess personnel and training requirements.

The Autonomy Levels diagram/matrix in the presentation is also a good link between what OCS has done and the strategy. This should be included in the paper and expanded to include:

- current status in levels for each of vehicle type/size noting it is not the same for all,
- what will be addressed for each section (vessel, mission, sensor) to meet goals with each type of vehicles, and
- area of specific collaboration with academic and industry (systems and operation)

It is important to clarify that unmanned systems do not currently reduce staffing requirements or reduce the need for surface support ships, but have the potential to reduce requirements in the future. Once the artificial intelligence and command/control systems improve, it is highly possible that one operator can control multiple vehicles, thereby reducing staffing requirements. Its potential as a “force multiplier” is one of its greatest potential benefits.

Cost benefit

The HSRP generally supports any activities or developments that improve the cost effectiveness and quality of NOAA OCS operations. This should be developed further in the strategy:

- Innovation should not just be for the sake of innovation, but outline why this is an important part of OCS strategy, and
- highlight cost benefit of technology and operational transfer benefits back to normal survey operations. The automation of a launch so that it could be partially manned or unmanned is an important next step and is potentially more cost effective than new totally unmanned vessels.
- Highlight the safety benefit of removing personnel from vessels (the benefit of “unmanned” in reducing risk).
- Highlight how the additional data collected would benefit the end user

OCS Focus Area

The OCS Focus Areas were included in the presentation but the paper did not directly address how the strategy might be applied to these areas. It is suggested that this be included in the paper and some examples include:

- Remote area access and operations in the Arctic require progress in all OCS Focus Areas, and autonomy may assist in economically making substantial progress of hydrography/charting tasks.
- Many chart discrepancies may not be easily progressed in traditional surveys and plan to investigate if smaller and portable autonomous systems could be leverage for this task.

There are a couple of different ways to include these (and others identified by NOAA) depending on how the intent and scope of this effort are further defined. One option, should the interest be in keeping this a broader plan/strategy/ roadmap, would be to include OCS-specific focus areas in a separate appendix.

Challenges

There are currently several hurdles to overcome in reaching the higher/highest levels of automation. We recommend highlighting these in general, understanding that as technology advances some of these challenges will be overcome by events:

- *Labor-intensive intensive logistics support (e.g., personnel needs for unmanned systems)* Launch and Recovery Systems are a good example. Getting a large unmanned vehicle back on board safely in rough seas is very challenging and is often done by deploying a manned small boat. As noted in the plan this is viewed as a high area of risk and potential modifications that may limit cost effectiveness.
- *Regulations and policy*
- *Managing big data*

Not everything has to be solved in this document; however, indicating any current NOS/OCS strategies for overcoming/addressing this hurdles would certainly be welcomed.

Industry and other collaboration, regulations and standards

In the one-pager and presentation it notes one of the reasons for innovation is to pioneer and be the nation's experts. There are many other government, industry and academic organizations that have substantial autonomous experience and research. It is not clear if collaboration with industry relates just to system and vessel manufacturers or includes survey operators. There is significant industry autonomous operational experience, and how does OCS intend to collaborate with industry to support their strategy?

Is a better role for NOAA to lead the establishment of a government, industry, academic consortium for progressing guidelines and standards for operations and regulations? Autonomous vessels, including survey vessels, come with legal and policy implications that are currently undeveloped in nature. Part of the

mandate of the OCS team and public-private consortium could be to work with existing transportation researchers and policymakers to help build safe, reasonable, and achievable regulatory and policy frameworks for the future. Developing a regulatory framework for ASVs is essential and industry is already involved in similar efforts worldwide (NZ, Norway, Canada, EU and UK).

As an example, Fugro is active (primarily in the UK) in helping develop standards, codes of practice and codes of conduct. Emerging standards and advocacy groups include:

- AUVSI Maritime sub-committee
- US Coast Guard and USA Navigation Safety Advisory Council (NAVSAC
- SARUMS –EU workgroup; Safety And Regulations For Unmanned Maritime Systems
- UK Marine Industries Alliance - the maritime autonomous systems (surface) code of practice; in draft but actively being worked on with expectation of first distribution in 2017

There is no mention of the Naval Oceanographic Office (NAVO) and its experience with AUVs/ASVs. NAVO has already operated the survey systems on their launches remotely (for at least a couple of years) and has an automated quality control software suite to determine multibeam data quality. NOAA personnel may gain benefit from riding a NAVO ship during testing and/or operations. Does the location of the proposed operational group at Stennis Space Center, aim to collaborate with NAVO?

Does OCS have a process to support transfer of R&D to industry (technology and operations), and encourage extended use of autonomy by industry to support OCS Focus Areas? An example could be the support of small business survey company use of autonomous systems in their area with NRTs for disaster response and to progress removing chart discrepancies?

Personnel, operational and training issues

The documents note that there will be personnel implications and general industry experience has been that operation of autonomous platforms requires a different and more technical set of skills than traditional hydrographic survey operations, requiring a team with programming, electronics, communications and networking skills in addition to knowledge of hydrography and boat operations. Given that such personnel are hard to find and retain, how realistic will it be to routinely conduct multiple field operations with these devices? The document should outline a strategy for identifying, developing, and/or recruiting personnel with the necessary skills for autonomous operations.

The strategy might include:

- Autonomous operations may initially increase personnel requirements.
- Plan for additional or different training and knowledge of users.

- Is standing up the operations group part of strategy in developing personnel requirements?

Other Questions and Comments

Large AUV's – testing and lessons learned were valuable, but does NOS/OCS need to continue to be involved in operation of the large REMUS AUV? Why not turn the REMUS over to other NOAA offices as with a previous AUV, and have the NOS/OCS team concentrate on the ASVs that better serve the program's hydrographic needs, also noting the personnel required to operate a large AUV?

HSRP recognizes that OCS has a mission requirement for UAVs, though this likely falls under NGS. Examples include:

- Orthorectified photogrammetry is a good tool for shoreline verification and UAVs may be safer than sending a vessel or surface vehicle to find the position of awash rocks, wrecks, and obstructions. A UAV can be launched from a mother vessel or vehicle, rapidly get pictures, and come back. Also useful for getting close-up pictures of prominent landmarks for the Coast Pilot or Light List.
- For disaster recovery, a UAV with camera, even just a downward-looking GoPro with time-tagged images so that time-tags can be matched to vehicle position, would be useful for reconnaissance.
- An NRT tasked with surveying after a hurricane can detect visible/floating/awash hazards before the boat even leaves the dock; visible oil slicks, bubbles, or discolored water can point to broken pipes; obvious shoaling or erosion can be marked, etc.

If UAVs are not covered in the scope of this particular document, a separate roadmap/strategy for UAVs may be useful for NOAA as you move forward with unmanned systems.

The "Vision" for the operational unmanned systems team does not include a focus for Unmanned Surface Vehicles. Is this intentional or an omission?