Unmanned Maritime Systems for Naval Applications – Bringing Real Capability to the Fleet

Bob Nugent

Unmanned maritime systems (UMS) have lagged behind their aerial counterparts over the past two decades. This lag can be measured in technological development, operational capability, spending, or numbers of platforms fielded. The very visibility of the unmanned aerial vehicle (UAV) has helped it capture the attention of informed observers and the broader public thinking about the future of military drones and robots. As robotics continues to reshape the military art, UAVs remain thus far the "leading edge" in unmanned systems and operations development.

That this should be so is no surprise given recent history. Urgent calls to increase the variety, number and capability of unmanned vehicles to support "real world" operations in Iraq and Afghanistan speeded the advancement of UAVs over the past 15 years. Spending on UAVs over the same period increased sharply, further accelerating technological development.

Author

Bon Nugent is a Virginia-based Affiliate Consultant for AMI International in Bremerton, WA, USA.

Estimated military spending on UAVs worldwide reached \$6.5 billion in 2014, and is forecast to nearly double over the next ten years.[1]

Yet as UAVs look set to remain the lead unmanned military platform, new developments in the maritime domain are worth a closer look. Increasing globalisation in maritime interests is driving sustained growth in new naval platforms and systems.

And many countries are confronting the reality of high costs for new construction manned ships and submarines well beyond the budgets available for fleet expansion and modernisation. These countries will be especially interested in quicker and/or lower cost options to fill naval capability gaps as they pursue their own offset strategies against larger or more modern naval rivals. Here UMS could be a good fit for quickly and cheaply acquiring capability in lieu of more expensive manned platforms. This appears to be happening now in the Mine Countermeasure Vessel (MCMV) market.

At the same time, the increased cost and complexity of new naval systems are pushing legacy navies in the US and Europe with stagnant budgets to invest more actively in UMS.

Photo: Raytheon/PR Newswire/U.S. Navy

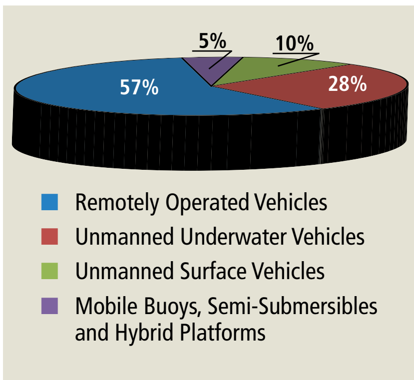
Raytheon's Remote Minehunting System and AN/AQS-20A Minehunting Sonar on USS INDEPENDENCE (LCS-2)

This article will review some recent developments in unmanned maritime systems – particularly in the US. These new programmes, new contracts, and new platforms combine to mark a "step change" in the sector. For the first time, significant programmes and spending are moving UMS from an "interesting" adjunct to manned platforms to a vital capability in their own right. As recently observed by the US Navy Chief of Naval Operations: "As the size of the submarine fleet decreases, opportunities and requirements for smarter, more reliable and more compact UUV's will increase".

Admiral Greenert's comments, and similar remarks from other naval leaders around the world suggest that – finally – navies and nations believe that unmanned maritime systems are ready to realise the operational and technological potentials of robotics so far seen mostly in the air.

Defining Unmanned Maritime Systems – Types and Markets

A quick topology of the UMS sector divides vehicles by domain and autonomy. As noted in the chart below, only a small percentage of the UMS currently in service – in both commercial and military settings – operate on the surface. These Unmanned Surface Vessels (USV) have tended to be adapted from existing manned hulls such as Rigid Hull Inflatable Boats (RHIBs) and tend to



Source: http://www.auvsi.org/HamptonRoads/blogs/chris-mailey/2013/08/08/umv-report-core-capabilities-and-market-background

Photo: U.S. Naval Institute

In the scope of the U.S. Navy's LCS programme AAI was awarded the contract for the Unmanned Influence Sweep System (UISS) in September 2014.

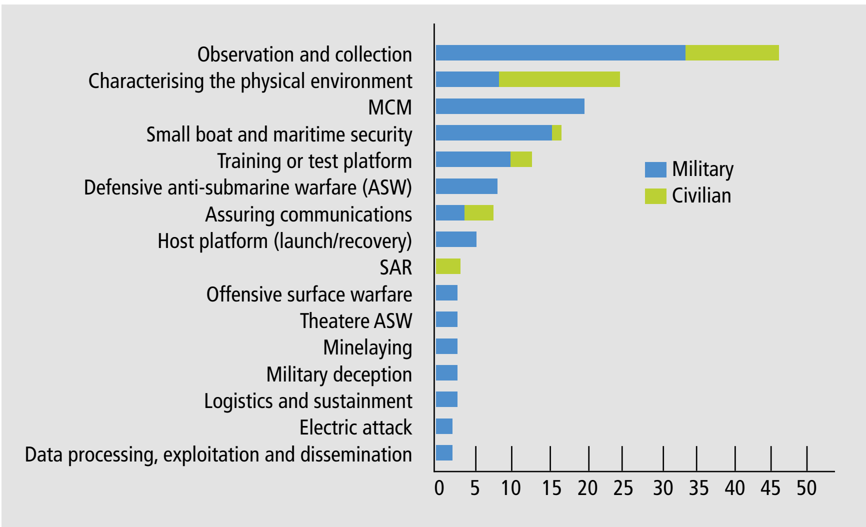
be small – from 3-10 metres in length. And the great majority of existing USVs are controlled remotely (wireless communication). Many have autonomous control systems that enable operation at greater distances from launch points without continual active control from a manned control station.
The majority of UMS operate in the subsurface domain as submersible or semi-submersible vehicles. Remotely Operated Vehicle (ROV) describe usually very small (man portable) systems continuously powered and controlled through surface tethers such as cables to the host platform. The great majority of ROV designs now in service are in the commercial sector used in ship repair, port and harbour survey, offshore oil and gas, and related applications. A subset of the submersible UMS is the Unmanned Underwater Vehicle (UUV). In contrast to ROVs, UUVs are designed for autonomous operation, without the constant power and control provided by ROV tethers. Many UUVs are built with autonomous control capabilities that enable them to conduct sustained independent missions such as ocean bottom surveys, mine countermeasures and intelligence, surveillance and reconnaissance. Most existing UUV designs are in service with navies and related sea services.
As remarked above, the UMS market has tended to grow at a slower pace than the UAV market over the past decade. This has proved especially true of the military UMS sector, in which predictions of rapid growth from a variety of observers has consistently overestimated future demand.
This is explained by the absence of a motive force such as active military operations that drive demand for more and better vehicles. Another factor at work in the slow development of the UMS market has been the arguably more complex maritime environment of the UMS. Designing unmanned platforms and systems to be effective at and under the sea – with the additional complexities of water and near-water environmental factors – challenges technological development in UMS platforms, propulsion, sensors and control.
So, looking back at the past decade, the naval UMS market could accurately be described as "niche" segment heavily reliant on adapted manned platforms and systems. A closer look at the USV market in particular shows how adaptation of existing manned hull forms tended to shape the distribution of USV designs – with the majority being in the 7-11 metre segment for RHIBs and adaptations of conventional small patrol boat designs 10-25 metres in length.

Unmanned Maritime Systems – Roles and Missions

Continuing customer concerns with UMS safety, C^2 and collision avoidance have also worked to constrain UMS growth, and concentrate UMS development in specific mission areas such as mine countermeasures, hydrographic survey and intelligence collection. These missions tend to be characterised by high risk to manned platforms and/or are carried out in isolated maritime areas with lower levels of maritime traffic. These missions maximise the strengths of the UMS while minimising the risks of collision, compromise or damage from inadequate autonomous control systems.
A look at the chart below on USV designs and missions (RAND) reinforces this point. In the case of civilian and military UMS, missions and applications concentrate on survey (sensing and measuring oceanographic data) and mine warfare. Another mission area where USVs (and to a lesser extent UUVs) provide unique value is in maritime patrol and early warning. Training and testing - and especially the use of USVs as target drones for naval live fire weapons - is another mission segment where UMS are uniquely suitable. All of these missions reflect the current focus on applying UMS to missions that are "dull, dirty and dangerous" and traditionally pose very high risks to highly trained naval specialists involved. Explosive Ordnance Disposal for example is a one area that has seen extensive use of UMS to reduce risk to personnel.
As UMS platforms grow larger, improve endurance and power available, and address communications and autonomy limitations, one would expect to see growth in UMS mission areas now exclusively the province of manned platforms. Among those now being looked at for future UUV designs are anti-submarine warfare, offensive mining and offensive electronic warfare.

UMS Programmes and Investments

Amidst a globalising naval market, the US is expected to continue to spend most on UMS over the next 10 years. As will be detailed below, the sizable growth in U.S. Navy investments in UMS has been led by the Littoral Combat Ship (LCS) programme. Specifically, the LCS Mission Packages (MP) are designed to rely heavily on unmanned platforms to enable capability despite the smaller size and reduced numbers of crew compared to conventional naval ships of similar size and mission (frigate, MCMV).



Distribution of USV applications in the current marketplace

The LCS Mine Countermeasures Mission Package is the centre of the U.S. Navy's current UMS investment. An especially noteworthy milestone in the development in the LCS MCM package was the September 2014 award of a $34 million contract to Textron Systems' business unit AAI for the "Unmanned Influence Sweep System" (UISS). The UISS award – which could total up to $118 million in total, will see development and series production of the "Common Unmanned Surface Vessel" a 34 metre USV with a reconfigurable payload space. Series production of the UISS could see 50 or more CUSVs built over the next five years and provide the U.S. Navy with its first experience in integrating and operating USVs into fleet operations on a large scale.

Similarly, Lockheed Martin's Remote Minehunting System (RMS) programme is another key element in the LCS MCM mission package. The entire RMS programme represents some $1.5 billion in spending. RMS is centred on an unmanned and semi-autonomous "Remote Multi Mission Vehicle" (RMMV), with total production of 54 RMMV planned if the programme is fully executed.


Photo: U.S. Naval Institute

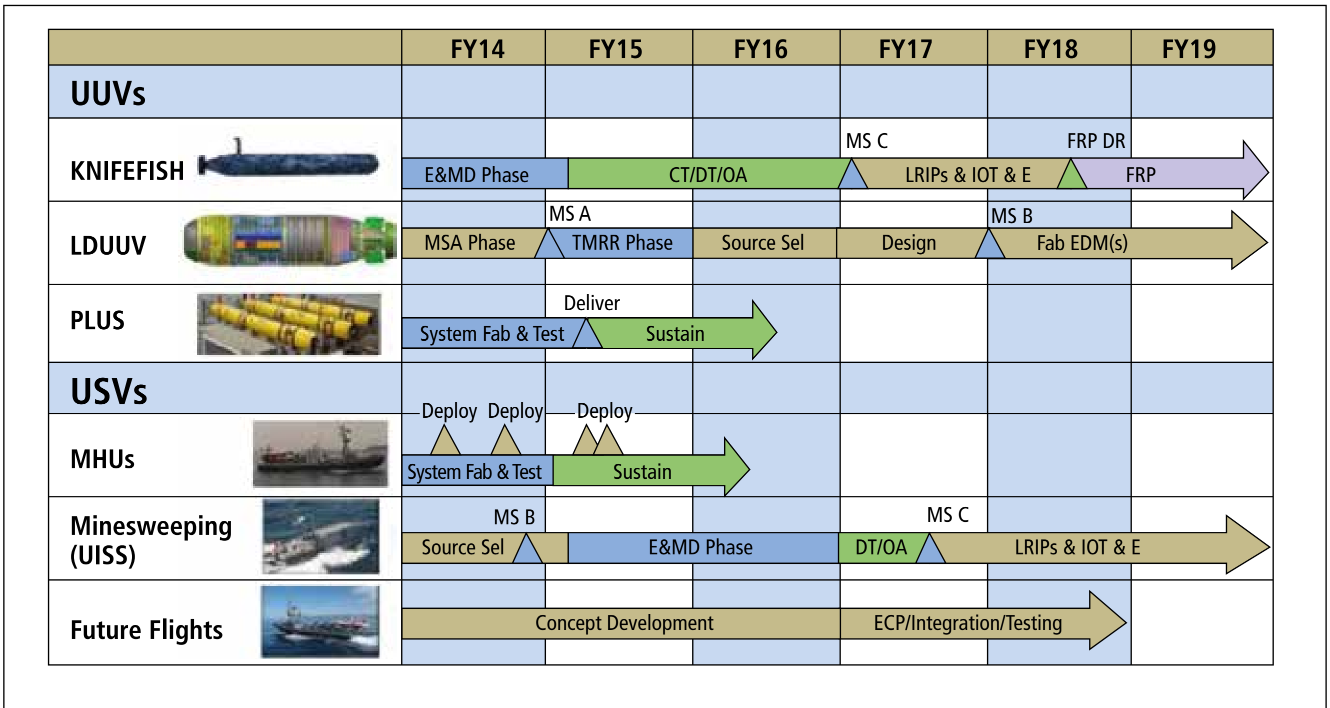
Lockheed Martin's Remote Multi-Mission Vehicle in 2010

Beyond the LCS, the U.S. Navy has requested $25 million in the current defence budget for the Large Displacement UUV (LDUUV). The LDUUV is especially noteworthy as a UMS intended to be more "ship like" than current generation UUVs dependent on host platform like LCS for launch, operation, recovery and maintenance.

In contrast, the LDUUV is described as having the size, range, endurance and autonomy to operate without support for days and weeks at a time. It will be launched from a variety of platforms - including surface ships – as well as deploying independently from shore bases.

And the LDUUV mission set also highlights the flexibility and endurance that are hallmarks of traditional sea power exerted by manned naval platforms. The modular design of the LDUUV will enable it to carry payloads and operate with the stealth of crewed submarines. This makes it especially suitable for intelligence and surveillance missions as well as mine countermeasures (including detection and neutralisation). Large enough to transport and launch weapons, the LDUUV could be also be tasked for anti-submarine and anti-surface missions.

Published information on the LDUUV indicates the U.S. Navy plans to acquire up to 40 of the LDUUV platforms. This force would represent a significant 'force multiplier" for a U.S. submarine fleet set to decrease to 40 attack submarines (from the current 55) by 2028. Further, a large autonomous UMS like LDUUV would of-



Multiple unmanned maritim systems spanning across every phase of the acquisition life cycle

Other significant U.S. Navy RMS spending in the most recent defence budget includes $17.4 million for the KNIFEFISH Surface Mine Countermeasure (SMCM) UUV programme. SMCM is another component of the LCS MCM mission package Unmanned Undersea Vehicle and is specifically intended for "clandestine mine detection capability against volume and bottom mines."

fer more flexibility in operating in denied or geographically constrained waters compared to manned hulls.
Significant UMS investments are also underway in Europe. Under the European Defence Agency, the EU Unmanned Maritime System Programme has looked at applying UMS to mine countermeasure missions among European navies.
The United Kingdom and France are also executing mine warfare programmes that will include significant investment in UMS. The UK's current Sweep Capability Project (previously the Fast Agile Sweeping Technology – "FAST") is evaluating several USVs for minesweeping missions. France's "SLAMF" mine warfare improvement programme has seen building and testing of a large (17 metres, 25 tonnes) USV STERENN DU as a host platform for MCM UUVs. Similar in concept to the US CUSV, the STERENN DU would combine the range and mission payload of a larger USV with the specialised task ability of small UUVs.

On the Horizon: The Future of UMS Sector 2015-2035

As shown above, spending on UMS has seen significant increases in the past two years, especially in the US. At the same time, total investment in naval UMS worldwide still represents a very small percentage of total expenditures on new naval platforms and systems.
For example, AMI's current market forecast for the MCMV segment projects US$13.8 billion to be spent on 131 new hulls globally over the next 20 years – a rough average of about $100 million per new ship built. If even a small portion of that planned investment in MCMV – say 5% - was redirected at UMS investment, that would represent a substantial increase in naval UMS spending in just one mission area. The expansion in anti-surface and anti-submarine capable platforms like the LDUUV would see the UMS market become substantially larger.

A key question is whether the current round of new naval UMS spending represents a new stage of sustainable demand. The technology obstacles to a fully implementing UMS potential for naval work remain considerable, and past predictions of UMS market opportunity have not come true.
Still, new spending on the US' LCS-related MCM and the large UUV programmes appear to mark a turning point in development of viable and sustainable UMS capability for several reasons.

Unmanned Maritime Systems (UMS)
2009 start, 11 participating nations: Belgium, Finland, France, Germany, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden; €53 million
Goal: improve UMS capabilities based on system construct for interoperability, modularity, & inter-changeability of modules/standardisation.
Projects focus mainly on MCM • Influence minesweeping • Drifting mines detection • Buried mines detection and neutralisation
Study also addresses • Harbour protection • Anti-Submarine Warfare (ASW)

First, programmes like UISS and RMS are programmes of record tied to a long-term plan for the LCS and follow-on classes of ships. While the money being spent is still categorised as research and development, acquisition strategies clearly anticipate funding future large-scale production.
Secondly, that series production will bring UMS into naval operation service in significant numbers for the first time. This will make the UMS a real part of the fleets, not just oddities. And one lesson for the new UMS can be taken from the recent expansion in military UAV fleets. That is, when new platforms and technologies join the force in numbers, they become part of the system of training, maintenance, repair and operations. In other words, they come to stay.
So in sum, it would appear the latest round of new programmes and awards for naval UMS do signal a significant change in the role and stature of UMS within naval forces. And this change represents an opportunity for new growth in global naval market over the coming two decades.

(Endnotes)
1 http://www.tealgroup.com/index.php/about-teal-group-corporation/press-releases/118-2014-uav-press-release


Photo: defenseindustrydaily.com

Model of the SMCM KNIFEFISH UUV


Photo: Michel Floch/flickr.com

The STERENN DU USV has been built and tested as a host platform for MCM UUV in the scope of France's SLAMF programme.