SPECIALReports

Manned and Unmanned Teaming: Shaping Future Capabilities

This report looks at the emergence of manned-unmanned teaming as an evolving capability for the integrated distributed force.

In this report, we look at some aspects of shaping a new manned-unmanned teaming approach which the U.S. and allied forces are pursuing.

These are early days but certainly the capabilities of shaping, evolving, and working manned-unmanned teaming to enhance both security and defense operations will be enhanced over time.

And significant effort is being directed along these lines.

Published January 31, 2020

DEFENSE.info

Manned-Unmanned Teaming: Shaping Future Capabilities

Defense.Info

Table of Figures

INTRODUCTION

As the liberal democracies shift from the land wars to engaging in conflict scenarios in which they will need to operate in a contested air and sea space, new concepts of operations and systems have been and are being introduced. The term anti-access and area denial has been coined to describe how certain competitors, notably Russia and China, are shaping their defense structures to try to ensure combat dominance in times of direct conflict, but also, a core capability to underwrite other forms of combat operations, such as "gray zone" operations or hybrid-war concepts of operations.

The core challenge is how to operate effectively in a contested and air and sea environment, to ensure that the liberal democracies can protect their interests and not allow the 21st century authoritarian power overturn the rules-based order as they seek to rewrite the rules of the game.

A number of new platforms and capabilities have already been introduced by the United States and core allies and partners to reshape approaches and training for new concepts of operations. New maritime patrol capabilities, new surface and sub-surface platforms, new missile defense and strike missile systems, new combat aircraft are coming into the forces, and along with those new capabilities, new multi-domain training approaches are being introduced as well.

A key element of the reshaping dynamic is the expanding role of artificial intelligence and unmanned air systems and maritime remotes and autonomous systems. This clearly is a work in progress and will leverage the experience of AI and "unmanned" systems such as the Triton system already introduced into the US Navy.

In this report, we are going to look at some aspects of shaping a new manned-unmanned teaming approach which the U.S. and allied forces are pursuing. These are early days but certainly the capabilities of shaping, evolving, and working manned-unmanned teaming to enhance both security and defense operations will be enhanced over time. And significant effort is being directed along these lines.

An example of this effort is the work ongoing in Australia. For several years, I have worked with the Williams Foundation based in Canberra, Australia, and during that time, the Foundation has held two seminars a year with the Australian Defence Force, the Australian government, defense industry, as well as with allied force representatives to discuss the way ahead with regard to shaping what they call a "fifth generation" combat force. What the Australians are focused upon is how to shape an effectively integrated force driven forward by advanced capabilities, to deliver a relevant effect in the combat or security space.

This Spring, the Williams Foundation will address the question of where manned and unmanned teams fits into the evolution of the Australian defense and security forces. On March 26, 2020, a seminar will be held in Canberra which focuses on "next generation autonomous systems."

The Foundation describes the upcoming seminar as follows:

Building upon the existing foundations of Australian Defence Force capability, the aim of the March seminar is to explore the force multiplying capability and increasingly complex requirements associated with unmanned systems. From its origins at the platform level, the opportunities and potential of increased autonomy across the enterprise are now expected to fundamentally transform Joint and Coalition operations.

The concept of the Unmanned Air System (UAS), or Unmanned Aerial Vehicles (UAV), is nothing new nor is their use in missions which traditionally challenge human performance, fragility, and endurance. Often described as the dull, dirty, and dangerous missions, unmanned systems have now provided the commander with a far broader range of options for the application of force against even the most challenging target sets. However, ongoing

operational experience confirms unmanned systems on their own are not the panacea and trusted autonomy in manned and unmanned teaming arrangements in each environmental domain is emerging as the game changer.

The narrative is now forming across defence which has progressed the argument for greater numbers of unmanned systems in a far more mature and balanced way than hitherto. The manned-unmanned narrative is now sensibly shifting towards 'and', rather than 'or'. Manned and unmanned teaming leverages the strengths and mitigates the weakness of each platform and concentrates the mind on the important operational aspects, such as imaginative new roles, and the challenges of integration to generate the desired overwhelming firepower.

This capability will require a complex web of advanced data links and communication systems to make it operate as a combat system. Designing and building the 'kill web' so that it can enable the delivery of manned-unmanned firepower across domains will be a huge challenge not least due to the laws of physics. However, the ability to train, test, evaluate and validate tactics and procedures will add a whole new level of complexity to generate the 'trusted autonomy' required for warfighting.

The aim of the March 2020 seminar, therefore, will be to promote discussion about the near and far future implications of autonomous systems, and to build an understanding of the potential and the issues which must be considered in the context of the next Defence White Paper and Force Structure Review. It will investigate potential roles for autonomous systems set within the context of each environmental domain, providing Service Chiefs with an opportunity to present their personal perspective on the effect it will have on their Service.

The seminar will also explore the operational aspects of autonomous systems, including command and control and the legal and social implications that affect their employment. And finally the seminar will examine the current research agenda and allow industry an opportunity to provide their perspective on recent developments in unmanned air, land, surface and sub-surface combatants. Each of which are opening new ways of warfighting and creating opportunities to reconceptualise Joint operations and move away from the platform-on-platform engagements which have traditionally characterised the battlespace.

In report, we address some aspects of the changes highlighted by the upcoming seminar. We start with an interview with a senior US Navy Admiral who is working manned-unmanned teaming as part of his overall responsibilities for delivering air-operated reconnaissance capabilities to the fleet.

Next we address the coming of "remotes" as part of a manned-unmanned teaming system in the air. The first time I discussed this approach was with then Secretary Michael Wynne who envisaged the coming of what he referred to as the Wolfpack to the air combat force.

After presenting the Wynne interview which presaged much of the current work, we turn to how Airbus Defence and Space views manned-unmanned teaming as part of the Future Combat Systems program.

Next we highlight how at the recent International Fighter Conference held in Berlin in November 2019, the Royal Air Force highlighted how they saw the coming of manned-unmanned teaming within their combat air innovation project called Team Tempest.

Then we turn to the question of the introduction of manned and unmanned teaming in the maritime force. I will start by looking at how the lead within the Royal Australian Navy (RAN) looks at the way ahead with regard to maritime remotes. I will then examine how a former member of the RAN who now works with L3Harris in Australia considers the way ahead with regard to maritime remotes.

Next we interviewed a senior L3Harris expert on maritime remotes at the Seapower conference held in Sydney this past October with regard to how to conceptualize the nature of the challenges and possible ways

ahead. And in that discussion two very different dynamics, one the airpower manned-unmanned teaming approach and the maritime remotes manned-unmanned teaming approach.

THE TRANSFORMATION OF THE MARITIME PATROL "AIRCRAFT" ENTERPRISE

By Robbin Laird

(2019)

Recently, I had the opportunity to visit with Rear Admiral Pete Garvin in his office in Norfolk Virginia to discuss the way ahead with the US Navy's Patrol and Reconnaissance Force (MPRF).

Commander Patrol and Reconnaissance Group / Commander Patrol and Reconnaissance Group Pacific (CPRG/CPRG-PAC) provides oversight to more than 7,000 men and women on both coasts operating the U.S. Navy's maritime patrol aircraft including the P-8A "Poseidon", P-3C "Orion", EP-3 "Aries II" and MQ-4C "Triton" unmanned aircraft system.

The MPRF is organized into two Patrol and Reconnaissance Wings at NAS Jacksonville, Florida, and NAS Whidbey Island, Washington including 14 Patrol and Reconnaissance squadrons, one Fleet Replacement Squadron (FRS) and over 45 subordinate commands. The MPRF is the Navy's premier provider for airborne Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASuW), and maritime Intelligence, Surveillance, and Reconnaissance (ISR) operations.

We discussed the force transformation currently underway as the foundation for further innovation moving into the future for the maritime force in its global operations. The P-8A and MQ-4C are not simply replacement platforms for the P-3 and EP-3. The change is as dramatic as the Marines going from the CH-46 to an Osprey which could only be described as a process of transformation rather than a transition from older to newer platforms.

It is not simply that these are different platforms, but the question of how to title the article suggests the dynamics of change. These are not merely maritime patrol aircraft but rather a synergistic 'Family of Systems' empowering global maritime domain awareness and the joint strike enterprise.

Most importantly, while the P-8A is a capable engagement platform in its own right, the information generated by the P-8A/MQ-4C dyad empowers and enhances the organic ASW strike capability on the P-8.

Moreover, the entirety of Department of Defenses' strike capability is enhanced against adversarial multi-domain forces.

We hear a lot about the coming of Artificial Intelligence and new sensors to the combat force, but the P-8A and MQ-4C are bringing these capabilities to the force today. With pre-mission planning and post-mission product dissemination supported by a dedicated "TacMobile" ground element, these platforms comprise a solid foundation for the new MDA enterprise. Working together, the weapon systems will deliver decisive information to the right place at the right time to empower the multi-domain combat force. These systems are designed to be quickly software upgradeable and evolve over time as combat performance, and contact with the adversary, provide significant real-world feedback.

Although these are US Naval platforms, they are designed to connect with the larger C2/ISR infrastructure, changing the capabilities and operations of the entire U.S. and allied combat forces.

With core allies buying P-8 and MQ-4C, this force is truly global.

My visits to Norway, the United Kingdom, and Australia have provided significant opportunities to discuss with those nations, how they are engaged with the United States in recrafting the MDA and strike enterprise.

These platforms provide significant situational awareness for a task force, and can operate in effect as combat clouds for a tailored task force operating across the spectrum of conflict.

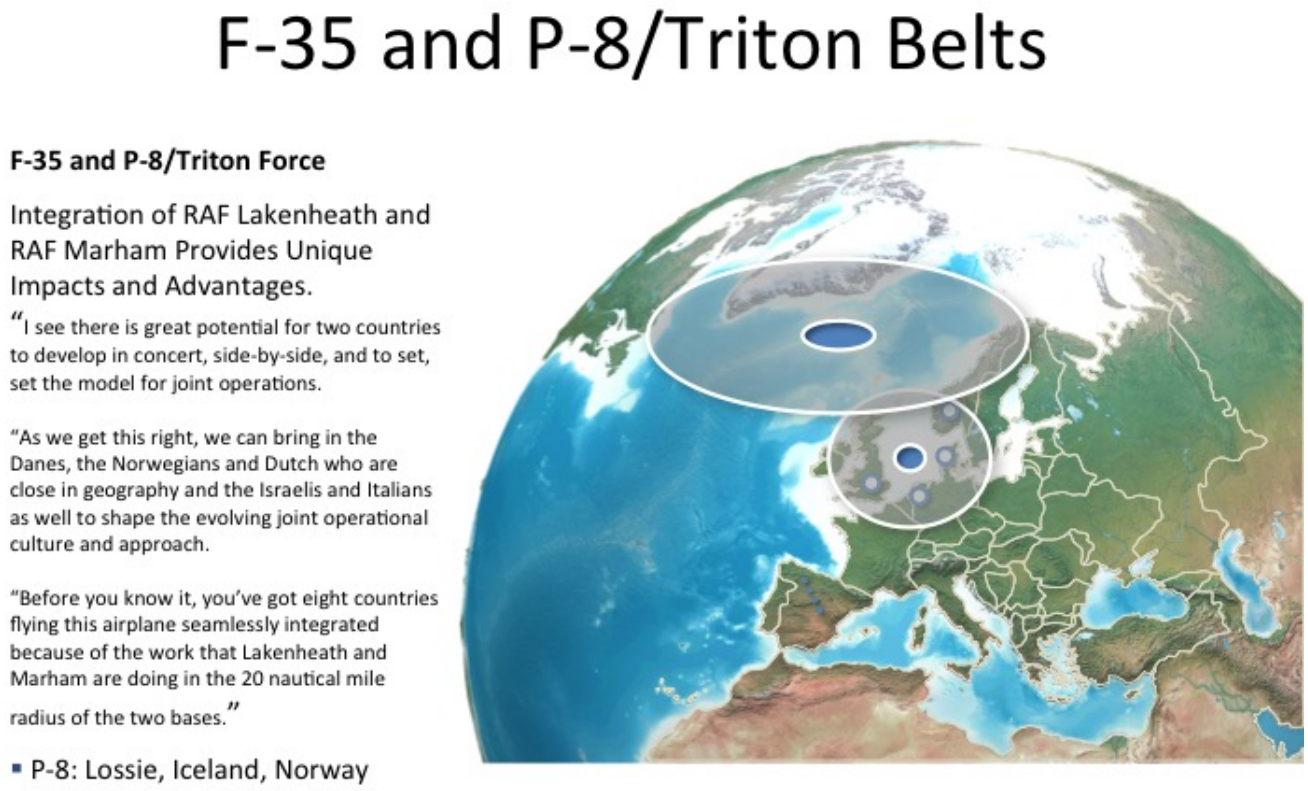

FIGURE 1 IMPACT OF F-35 AND P-8/TRITON DEPLOYMENTS ON NORTHERN EUROEPAN AND NORTH ATLATNIC DEFENSE CAPBILITIES CREDIT: SECOND LINE OF DEFENSE

At the recent International Fighter Conference 2019, there was significant discussion of the coming of manned and unmanned teaming. There were no naval aviators at the conference but if they had been present, they would have told the conference that the U.S. Navy is already working and improving manned/unmanned teaming concepts and doctrine.

With the coming of Triton, a completely new approach is being shaped on how to operate, and leverage the data and systems onboard the manned and unmanned air systems joined at the hip, namely, the P-8 and the Triton.

There is an obvious return to the anti-submarine mission by the U.S. and allied navies with the growing capabilities of the 21st century authoritarian powers.

Defense.Info

However, as adversary submarines evolve, and their impact on warfare becomes even more pronounced, ASW can no longer be considered as a narrow warfighting specialty.

This is reflected in Rear Admiral Garvin's virtuous circle with regard to what he expects from his command, namely, professionalism, agility and lethality.

The professionalism which defines and underpins the force is, in part, about driving the force in new innovative directions. To think and operate differently in the face of an evolving threat. Operational and tactical agility is critical to ensure that the force can deliver the significant combat effect expected from a 21st century maritime reconnaissance and strike force. Finally, it is necessary but insufficient to be able to find and fix an adversary.

FIGURE 2 OAK HARBOR, WASH. (OCT. 17, 2019) REAR ADM. PETER GARVIN, COMMANDER, PATROL RECONNAISSANCE GROUP, POSES FOR A PICTURE WITH SAILORS OF THE PATROL SQUADRON (VP) 46 ADMINISTRATION DEPARTMENT DURING A TOUR OF THE SQUADRON'S SPACES. VP-46 HAS RECENTLY FROM DEPLOYMENT IN THE U.S. 5TH FLEET AND U.S. 7TH FLEET AREAS OF OPERATIONS AND IS MAKING PREPARATIONS TO TRANSITION FROM THE P-3C PLATFORM TO THE P-8A POSEIDON. (U.S. NAVY PHOTO BY NAVAL AIRCREWMAN (OPERATOR) 3RD CLASS VICTORIA RUZZO /RELEASED)

The ability to finish must be realized lest we resign ourselves to be mere observers of a problem.

The Australians consider the P-8/Triton force to be part of their fifth-generation transition in that the information being processed and worked by the machines in the dyad and the analysts onboard or ashore is

informing assets across the enterprise with regard to threats and resolutions required by the entire combat force.

It is not simply about organic capabilities.

The P-3 flew alone and unafraid; the dyad is flying as part of a wider networked enterprise, and one which can be tailored to a threat, or an area of interest, and can operate as a combat cloud empowering a tailored force designed to achieve the desired combat effects.

The information generated by the 'Family of Systems' can be used with the gray zone forces such as the USCG cutters or the new Australian Offshore Patrol Vessels. The P-8/Triton dyad is a key enabler of full spectrum crisis management operations, which require the kind of force transformation which the P-8/Triton is a key part of delivering the U.S. and core allies.

A key consideration is the growing importance of what one might call "proactive ISR."

It is crucial to study the operational environment and to map anomalies; this provides a powerful baseline from which to prepare future operations, which require force packages that can deliver the desired kinetic or non-kinetic effect.

Moreover, an unambiguous understanding of the environment, including pattern of life and timely recognition of changes in those patterns, serves to inform decision makers earlier and perhaps seek solutions short of kinetic.

This is not about collecting more data for the intelligence community back in the United States; it is about generating operational domain knowledge that can be leveraged rapidly in a crisis and to shape the kind of C2 capabilities which are required in combat at the speed of light.

Historically, a presence force is about what is organically included within that presence force; today we are looking at combat reach or scalability of force.

Faced with limited resources, it is necessary for planners to exercise economy of force by tailoring distributed forces to a specific area of interest for as long as required. The presence force however small needs to be integrated not just in terms of itself but also in its ability to operate via common C2 or ISR connectors with both allied and U.S. forces. This enhanced capability needs to be forward deployed in order to provide enhanced MDA, lethality and effectiveness appropriate to achieve the desired political/military outcome.

Success rests on a significant rework of C2 networks to allow a distributed force the flexibility to operate not just within a limited geographical area, but reach beyond the geographical boundaries of what the organic presence force is capable of doing by itself.

This is about shaping force domain knowledge well in advance of and in anticipation of events.

This is not classic deterrence – it is pre-crisis and crisis engagement.

This new approach can be expressed in terms of a kill web, that is a U.S. and allied force so scalable and responsive that if an ally executes a presence mission and is threatened by a ramp up of force from a Russia or China, that that presence force can reach back to relevant allies as well as their own force structure in a timely and effective manner.

For this approach to work, there is a clear need for a different kind of C2 and ISR infrastructure to enable the shift in concepts of operations. Indeed, when describing C2 and ISR or various mutations like C4ISR, the early

notions of C2 and ISR seen in both air-land battle and in joint support to the land wars, tend to be extended into the discussions of the C2 and ISR infrastructure for the kill web or for force building of the integrated distributed force.

The P-8/Triton dyad lays a solid foundation for the wide range of innovations we can expect as the integrated distributed force evolves: expanded use of artificial intelligence, acceleration of the speed for software upgradeability, achieving transient combat advantage from more rapid rewriting of software code, an enhanced ability to leverage the weapons enterprise operating from a wide variety of air, ground, and naval platforms (off-boarding), and an ability to expand the capabilities of manned-unmanned teaming as autonomous maritime systems become key elements of the maritime force in the years to come.

In short, the Maritime Patrol and Reconnaissance Force is not simply transitioning, it is transforming.

It is delivering significant new capabilities now, and laying a solid foundation for the future. It is empowering what the Aussies would call a fifth-generation multi-domain combat force.

You can either live in the past and lose ground; or you can lean forward and build out the foundation for the integrated distributed force.

SECRETARY WYNNE ON THE WOLFPACK

(2012)

In a 2012 article, Secretary Wynne, as always, was looking ahead, and in this case to manned-unmanned teaming, driven by the capabilities of the F-35 as a flying combat system. In this interview, he linked his characterized the new capabilities as shaping a wolfpack concept of operations for the air combat force.[1] Part of the article is excerpted below.

Shaping an Offensive and Defensive Enterprise for the 21st Century

To really consider this; we need to break apart operations into the Offensive Enterprise; and the Defensive Enterprise. These two are different, and assets can be deployed in different ways.

For example, the United States relies on geographic distance for its major coastal defense; but employing Remotely Piloted Vehicles could dramatically enhance the integration of available defenses; even providing early warning relatively inexpensively, Air to Air Missiles; and some Air to surface missiles are an additional enhancement to even low speed platforms.

These are being flown currently by National Guard and Reserve Squadrons; and allowing their integration into the off shore airspace adds enormously to detecting and deterring threats.

In a very similar way; around some of the distant states and possessions of the United States that serve as staging areas or forward operating bases, a squadron of Remotely Piloted Vehicles equipped with SONAR and RADAR together with limited means of response to threat would provide great training and be a part of a layered defensive system.

Examining the Offensive Enterprise requires a similar exploitation construct as any Military Force, but adds the third dimension to the mix. This would have the fifth-generation platforms as the scouts and observers; and the

[1] https://sldinfo.com/2012/09/shaping-the-wolfpack-leveraging-the-5th-generation-revolution/

fourth-generation platforms as shooters to be thrown towards enemy defenses to force their response and identification as well as be the swarm to deter any further penetration.

This aspect requires rethinking the use of fourth generation platforms and introduces the concept of using fourth generation assets as Remotely Piloted Vehicles.

They would, as they can now, receive targets from the fifth-generation platforms; be able to verify and validate the received target; and engage either enemy air or enemy integrated air defenses to smooth the way for further operations.

This concept is 'The Wolfpack'; employing two fifth generation platforms with four fourth generation remotely piloted vehicles. The fifth-generation platforms; as scouts would be admonished to not shoot lest they give away their position; but rather to expend all the weaponry from the fourth generation platforms; or from any available shooter that could reasonably engage the designated target. If they are required to engage owing to the fact they have been detected; then shoot and scoot is the motto. This concept would seek to preserve the quantity of fifth generation assets well into the second and third day of warfare.

Realizing that you go to war with the weaponry you have, not the weaponry you want, our Air Forces, whether Naval Aviators or Marine Aviators or Air Force Aviators need to think about force multiplication and affordability.

Apparently, our leaders are relating in as loudly as they can that our Nation will no longer 'darken the skies' with the quantity of Air Assets made available to our forces.

As a nation we are reaching out to coalition partners and other friendly nations to adapt our capabilities so there is a symbolic and real reserve force worldwide to thwart any determined competitor. The United States capability must be interoperable with these forces and within our own forces to leverage what we can using situation awareness, the ability to share this situation awareness; and overwhelm competitors needs training and early employment.

Concepts for exploiting the best of fourth generation assets and available fifth generation assets; in combination with what we have learned in the first decade of Remotely Piloted Vehicles will be crucial to deterrence in the face of increasing attention to economics.

The 'Wolfpack' can be more than casual thought; properly employed by well-trained pilots, it can change the outcome in surprising ways. Crafting the 'Wolfpack' can provide a strategic advantage and a best value-leveraging proposition.

THE ROLE OF REMOTES IN THE FUTURE COMBAT AIR SYSTEM PROGRAM

By Robbin Laird

(2019)

A key element of building the connected force is clearly the question of the nature and capabilities of remote carriers to work with manned systems in the air. Remote carriers will become part of the evolving combat force in the near to mid-term.

This has become a key dynamic associated with the changes in C2 revolving around enhanced artificial intelligence built into the force, but a clear need to both evolve data linked weapons – which after all are the first round of manned-unmanned teaming already in the sky.

Defense.Info

Remote carriers are coming with the various loyal wingman approaches as well within which current fighters work with evolving remote capabilities to deliver a combat effect from the teaming capability.

It is clear that remote carriers will become key force multipliers and shape new concepts of operations going forward as they are added to air combat fleets. During the recent International Fighter Conference held in Berlin in November 2019, conference, I had a chance to continue my conversation began last year on this topic with Bruno Fichefeux, Head of FCAS for Airbus Defence and Space.

From my perspective, Airbus has already delivered two key 21st century air platforms – the MRTT tanker and the A400M airlifter – which should provide useful launch points for the redo of air combat along the lines envisaged by the FCAS. And doing so makes business interest for Airbus, and not just for those air forces flying Rafale or Eurofighter.

To highlight the opportunities, in an interview I did last year at Amberley Airbase in Australia, the Wing Commander charged with operating the KC-30A or the A330MRTT, a la Australian, focused on how he saw the future of that tanker.

According to Group Captain Steve Pesce, Officer Commanding 86 Wing, comprising the RAAF's C-17, KC-30A, B300, CL604 and B737 fleets, in a conflict against a "near-peer" adversary the RAAF and allied forces may not have the luxury of secure tanking in uncontested airspace.

Air forces will gain transient advantage rather than total control of the air and will support surface assets that will be more dispersed across a larger Area of Operation (AO). Demand for AAR (and air mobility in general) will increase as the survivability of a large tanker is reduced.

Distributed operations in contested airspace will become a norm, and that means in his view the end of the classic larger tanker operations. The manned tanker will operate further away in the battlespace and become the mother ship for tanking remotes operating as refueling nodes to expendable assets deployed forward.

"My view of the future battlespace is that sensors and shooters will be more proliferated, integrated and reach further and with greater precision.

"There will be a natural move towards dispersion to improve survivability and delivery of fuel will be critical.

"The future of a large tanker will be to support more distributed and dispersed operations and we will be looking at small tactical refuelers providing fuel to tactical air combat assets – these tactical assets will likely be cheaper, unmanned and more expendable.

"That is where A3R comes in.

"I see an advantage in the automatic boom because it reduces the workload on the operator who in the future may be managing or controlling formations of UAV during AAR.

"As we learn to use this technology, it will be part of shaping the skill sets to transition to the next phase, of a large tanker replenishing smaller, automated tactical refuelers…."

As Airbus Defence and Space is a global business, it would make sense as the FCAS program generates manned-unmanned teaming capabilities that such capabilities would be made available to its global customers in the tanker program, for which there are many, and for the A400M program which there are fewer but certainly more than the core participants into the FCAS program itself

Bruno Fichefeux confirmed that this proposition is being studied within Airbus Defence and Space. He argued that there were two ways in which Airbus Defence and Space was addressing the opportunities within and eternal to the FCAS program.

First, for each of its key platforms such as tanker and A400M, they were shaping road maps for the development of the platforms which highlighted ways to enhance their capabilities within an integrated and connected battlespace.

Second, they are shaping technology streams which are designed to deal with the different challenges within manned-unmanned teaming.

Those technology streams can be drawn upon to shape developmental opportunities for the existing or new platforms envisaged in FCAS.

With regard to the first, the focus of what has been called the smart tanker program is precisely designed to shape ways ahead to use the space within the tanker for enhanced contributions to the integrated battlespace.

It must be remembered that the fuel carried by the A330MRTT is carried in the wings, which leaves the large cabin free to do other missions, which now are largely devoted to movement of warfighters and support staff or to carrying cargo.

According to Fichefeux: “Smart MRTT is focused on how to make use of all the internal space and to leverage it for the other platforms in the combat system and to increase their situational awareness and to handle data transfers.”

Another example is the A400M and its potential role as a remote carrier. According to Fichefeux: “We have initiated a series of design studies looking at how we can operate the A400M as a launcher and recovery platform for remotes, and operating as a mother ship so to speak.

“In this sense, the A400M becomes the wingman for the fighter fleet, but by functioning as a mother ship to launch and recover remotes which can go deeper into the battlespace to provide broad support for the tip of the spear of the air combat force.”

FIGURE 3 AIRBUS GRAPHIC CONCEPTUALIZING THE ROLE OF REMOTES WITHIN THE FUTURE COMBAT AIR SYSTEM PROGRAM.

In addition to working to study capabilities of its two core new air combat assets, namely the tanker and the A400M, Airbus Defence and Space has launched a series of "technology streams" examining how to develop a manned-unmanned teaming capability." According to Fichefeux: "We have launched generic technology streams, where we are looking to mature technologies around swarming, around level of autonomy, around the teaming intelligence, around how do we display this teaming for future fighter cockpit. How does the fighter pilot and the drones work together?

"We are running these technology streams concurrently with developmental streams and are targeting the introduction of remote carriers on the Eurofighter platforms to extend the range of its capabilities and to fill the combat gaps."

And to my earlier point that in many ways data linked weapons are the precursor of the manned-unmanned teaming envisaged with regard to UAVS, fighters, lifters and tankers working together, he underscored the working relationship between Airbus and MBDA.

Fichefeux underscored that they were working on the spectrum of unmanned platforms with various size and operational characteristics to think through a technology and development tree to introduce such capabilities into the combat force.

For example, with regard to the smaller remotes, they have teamed with MBDA to leverage MBDA's experience in operating data link weapons. "In the design of remote vehicles of a smaller size category, Airbus and MBDA are working together which allows us to leverage their experience and gives them access to our thinking and developments with regard to remote carriers which will carry evolving sets of weapons in the future".

And, of course, the overall technology developments are clearly affecting thinking about new platforms. In no case is this clearer than the European MALE RPAS program. When Airbus Defence and Space presented their focus on European MALE RPAS few years ago at an earlier Airbus Defence and Media Day, clearly the European MALE RPAS one saw glimmers of such thoughts. But with the FCAS launch these glimmers are becoming solidified in a programmatic sense.

In short, Bruno Fichefeux laid out the incremental approach of Airbus Defence and Space in the crucial area of manned-unmanned teaming and the importance of integrating new remote platforms within the concepts of operations of air combat fleets. While the strategic objective of FCAS is clearly to deliver a new combat fighter, the focus is very much on delivering key building blocks along the way.

And new remote platforms are such a building block. Airbus Defence and Space are looking to add new remote platforms which can work with existing air combat platforms, including fighters as well as other air combat assets, such as air lifters and airborne tankers.

In short, they are looking to deliver a System-of-Systems, connecting platforms, operating across domains, and being fully interoperable with allied forces instead of "only" targeting a new combat fighter qua a new platform.

ROYAL AIR FORCE PERSPECTIVES ON THE WAY AHEAD ON AIRPOWER AND THE ROLE OF MANNED-UNMANNED TEAMING

By Robbin Laird

(2019)

There is very little question that the impact of the F-35 global enterprise is a significant one.

Those Air Forces flying F-35 have grasped the fundamental point that its impact is strategic in character, and are changing how they redraft their air combat forces, notably with the objective of shaping new multi-domain integrated force capabilities.

It is also not the end of history with regard to air combat development. And one impact of the F-35 is the telescoping of generations of combat aircraft to sort through what a blended but integrated fleet will look like in the mid-term, and how that force blend will set in motion the "next generation" airpower capability.

In other words, rather than speaking of sixth generation fighter aircraft, it is more accurate to talk about next generation air combat capability which will be driven by the dynamics of change generated by the impact of fifth generation aircraft on the legacy fleet.

At the International Fighter Conference 2019, such a perspective was clearly highlighted by the presentations by senior RAF officers. When I was in the United Kingdom this past May, I had several meetings with senior RAF officers who precisely focused on this transition which in many ways is how they interpreted Project Tempest.

While much focus has been upon the ultimate fighter which might come out of the Project Tempest effort, it is clear that for the senior RAF officers I interviewed, they had in mind the telescoping of generations, and working through the blend to reshape almost cultural revolution like the evolution of combat airpower and at some point consider what a new fighter platform might look like.

Defense.Info

In other words, a reversal is underway. What is being considered is the nature of the C2/ISR infrastructure being crafted to empower the blended air forces, and then to consider what platforms might look like that will embody the "next generation" of the C2/ISR infrastructure.

In my summary of the findings from the May visit regarding Team Tempest, I reached the following set of conclusions:

The problem posed by having at the vortex of this launch a new combat aircraft is that really the main thrust of the way ahead for the decade ahead is not really about that – it is about evolving new capabilities which flow from the Typhoon-F-35 integration effort and from the work with global F-35 partners on weapons and remotes.

At some point, I am sure a new combat platform will emerge from this, but the focus here is clearly quite different from the Franco-German announcement which focused clearly on the need to launch a new fighter and to use that launch point as the iron magnet to draw together the strands of airpower modernization.

In meetings last Fall and this Spring in London, it became apparent that the British approach to FCAS is very clear – leverage the Eurofighter/F-35 dyad to figure out what to do next in the air combat development area. it is clearly about leveraging the dyad of Typhoon and F-35 to shape a decade or two of innovation and to leverage that UK, allied and partner development process to deliver what is to come next.

It was pointed out in private meetings that the UK was following what they saw as the USAF lead whereby the USAF was not committing itself to a sixth gen aircraft but to leveraging fifth gen with unmanned with the legacy fleet and weapons modernization to sort out what comes next.

The Brits with whom I met underscored that Team Tempest was not necessarily targeting a new build combat air frame, but really trying to leverage the innovations of the next decade to position UK industry to build, shape and craft the capabilities needed in the 2030s and 2040s.

Rather than having a clear commitment to a future combat fighter, it was a commitment to building out air combat capabilities to the point where new platform decisions could be taken.

But these decisions would be taken as the only Tier One partner in the F-35 with a 15% stake in the global program. This is a very different approach being proposed by France and Germany and allows Britain as well to work with the very significant F-35 global community, which might well join in a broader leveraging strategy with the RAF.

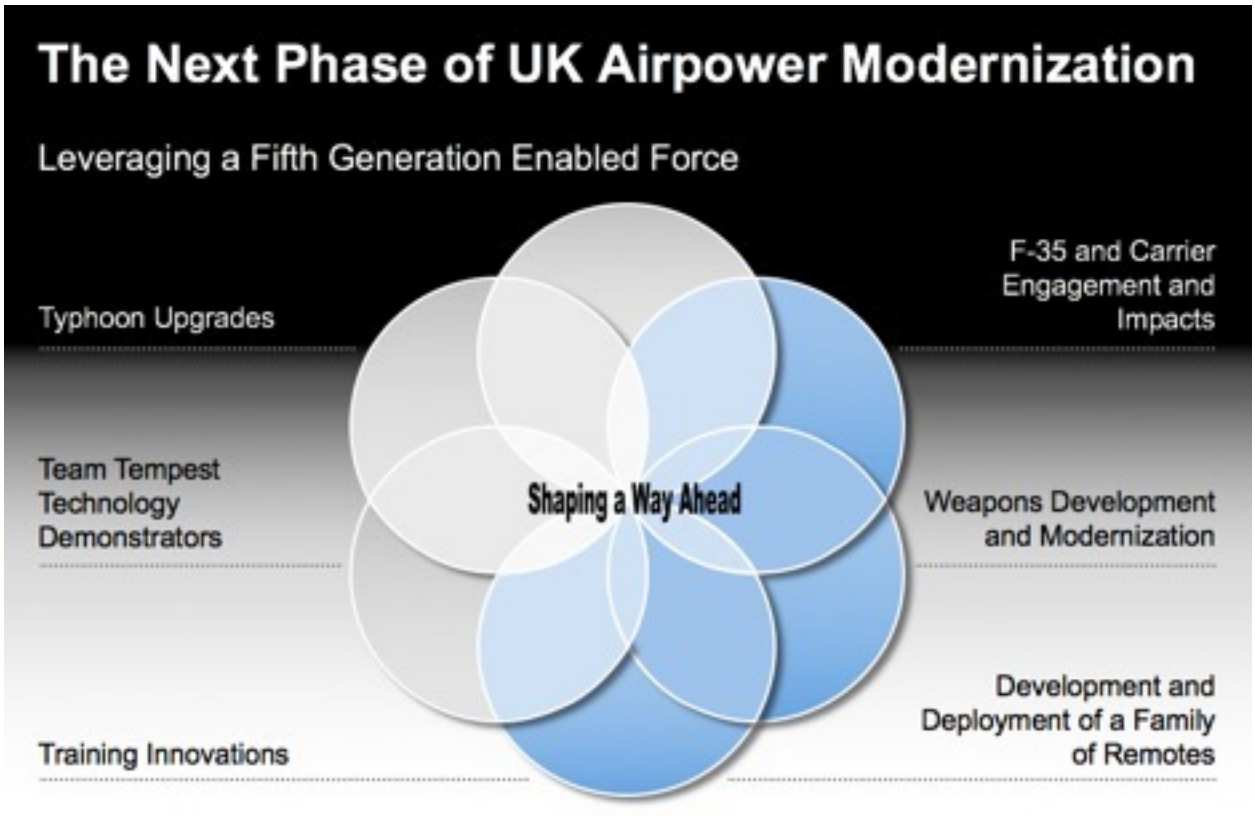

FIGURE 4 RAF APPROACH TO AIRPOWER MODERNIZATION. CREDIT GRAPHIC: SECOND LINE OF DEFENSE

At the IFC 19, one senior RAF officer underscored that the F-35/Typhoon integration was being undertaken while "in direct contact with the adversary." Put bluntly, it was not about shaping a set of briefing charts about the next generation aircraft, but shaping a blended capability driven by the introduction of the F-35. And as we anticipate manned-unmanned teaming it is clear that such integration is a foundational element for moving forward.

At the IFC 19, Air Commodore Dan Storr, Head of Combat Air Acquisition Programme made the very reasonable projection that what he called "additive capabilities" would come clearly in advance of any new fighter and he highlighted the key role of remotes as an "additive capability" to be added to the manned combat air fleet, and with a core competence on manned-unmanned teaming.

In a slide from his briefing where he discussed the question of platforms and additive capabilities, it is clear that the conjunction of weapons development and loyal wingman develops are crucial in the mid-term horizon.

Defense.Info

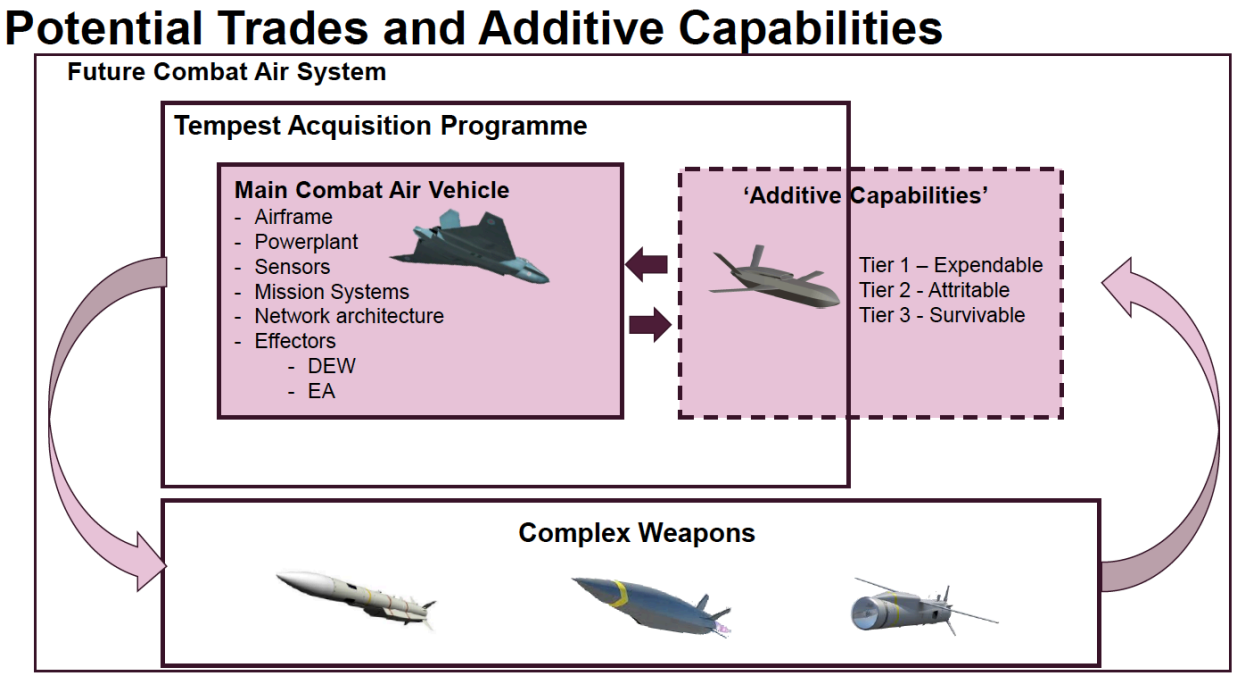

FIGURE 5 SLIDE FROM AIR COMMODORE STORR PRESENTAITION AT THE INTERNATIONAL FIGHTER CONFERENCE 2019

One aspect is clearly highlighted by the work in the complex weapons program, where SPEAR 3 is maturing as a new capability which can provide more data connectivity plus autonomy, in many ways in migration to the new generation of remote carriers envisaged in the UK, European, Australian and U.S. approaches.

In addition, the UK has launched the LANCIA project earlier this year, which is the functional equivalent of the Australian Loyal Wingman program.

According to the MoD project release:

The Ministry of Defence (MoD) is undertaking pre-sourcing activity for a potential future requirement for the preliminary system design and assessment of cost-capability trade-offs for a low-cost Unmanned Combat Air System (UCAS) demonstrator.

This UCAS would see a significant reduction in its cost and development time compared to traditional combat air systems, and a potential future requirement would include the development and manufacture of the proposed design, and the conduct of a limited flight test programme.

THE LOYAL WINGMAN CONCEPT IN THE RAF AND THE RAAF

By Robbin Laird

(2019)

The Australians have launched its Loyal Wingman program to complement its manned combat air platforms. The loyal wingman program was part of the Australian effort as well to ramp up their indigenous development and manufacturing capabilities. Part of the defense rethinking going on in Australia involves finding ways to enhance a sustainable fifth generation force. Building out a lethal and effective offensive-

defensive force, which can expand the perimeter for the defense of Australia and provide for allied extended deterrence, is a core focus of ADF modernization.

To do so in a crisis management situation needs a serious look at how long Australian operations could be sustained if a determined adversary sought to disrupt imports into Australia to support a modern society and a modern combat force. The sustainment issue could be solved in part by enhanced domestic manufacturing capabilities and sustainment approaches, such as the projected shipbuilding effort or the F-35 regional support hub.

But clearly, there is an opportunity as well to build out manufacturing in Australia and with the ranges and potential workforce augmentations, missiles and unmanned air vehicles would be a clear area of interest, not just for Australia but for its partners as well. As a member of the F-35 global enterprise, there is a clear global partnering opportunity whereby the Australians could do "a Konigsberg" and build missiles or related capabilities for themselves but in a way that makes them a natural partner with other key F-35 partners.

The recently announced "loyal wingman" program could be a case in point. To be clear, the amount of money being discussed at the program launch at Avalon makes it, in the words, of a senior Australian strategist "a PR stunt." What he was focusing on was a key reality – the money being proposed could hardly achieve a program of record. But one way to look at it might be to see an Australian effort to leverage their position geographically and in terms of training ranges to provide a foundation for several partners to come and to build out an Australian-based test, development and manufacturing capability.

It is clear that already fifth generation led training in the United States is extending the range of training – quite literally – and it will be virtually impossible for European and Asian F-35 partners to do such training without the geographical scope that Australia provides.

If we take a look at the proposed Australian loyal wingman program, a key element is affordability and the expectation that these are assets which can be consumed in a combat scenario, more like weapons than airplanes. And to get a low cost, it is clear that the wingman will not be an organic festival of advanced sensors, C2 or other features.

But some of the analyses surrounding the proposed program suggests that this will be an asset which can provide the tip of the spear into contested airspace or fly with legacy aircraft in a way whereby the legacy combat asset somehow has thinking capabilities which they simply do not have.

The demonstrator is being developed under the Loyal Wingman Advanced Development Program, which is being supported by A$40 million ($28.5 million) over four years in Australian government funding and by Boeing as part of its A$62 million investment in research and development in Australia in 2018.

Dr. Alan Stephens, the noted Australian military historian and a research Fellow at the Williams Foundation, in his discussion of a Plan B approach to Australian defense policy going forward, underscored the importance of the Australian loyal wingman program for shaping a way ahead for the next round of airpower modernization, leveraging the foundation which is being currently put in place.

"Channeling their inner Sir Richard Williams, the Air Force's senior leadership appears to have redefined Australian air power through the agency of Project Jericho. Described as a "marriage of minds and machines", Jericho implies a transformed organization based on artificial intelligence, robotics, machine learning, manned-unmanned teaming, networks, and innate intellectual flexibility.

"Concurrently, and channeling their inner L.J. Wackett, the Air Force, the Defence Science and Technology Group and the Boeing Company have announced the cooperative development of a stealthy unmanned Defense.Info

combat air vehicle under the rubric of "Loyal Wingman". This is the most exciting initiative undertaken by the Australian aerospace community since World War II. If the project succeeds, the implications are profound."

And with regard to the UK, as MoD focuses on future airpower developments, a key opportunity rests with regard to how the carrier could work with their version of loyal wingman. With the capabilities built in to the F-35 to manage the battlespace, a loyal wingman with significant range could add the strategic bomber function to the fifth generation enabled carrier. The reach of the carrier is significantly enhanced as data flows into the carrier-based F-35s to provide targeting solutions at longer range which can then be passed onto a loyal wingman as a targeting solution.

Recently, I discussed with a well-placed UK defense analyst, the potential UK approach with regard to remotes going forward. In this discussion, he argued that at the heart of an effective remote development and deployment strategy was leveraging the F-35. The F-35s fusion engine and ability to do C2 at the tactical edge provided significant opportunities to expand the effectors. And with a loyal wingman approach one could build a relatively simple and relatively cheap wingman for the F-35 led force.

But the concept of a wingman was greatly expanded and different with a fifth-generation fighter. One saw this as the F-22s started to sort out the distances and which they flew to support one another and with the F-35 and its fusion engine and low observable data transfer system, the notion of the wingman is migrating to other platforms, other assets and a much broader diversity of ways to provide a targeting solution.

With a longer-range loyal wingman – a modular remote with a data link and an ability to be directed by the F-35 and its interactive networks – can operate from a variety of air launch points which provides for the kind of airbase mobility and flexibility necessary to deal with an adversary which is prioritizing strike on fixed bases and targets.

The UK analyst argued this was a way to give the RAF back a capability for de facto strategic bombing as well as providing for much more flexible employment of the existing force. And with modularity, one could envisage a wide range of potential payloads, which could evolve with technology and with the evolving weapons mix required for diverse missions in a crisis environment.

Such an approach could open the window significantly for partnering for the UK forces and industry, which this analyst felt was crucial to a post-Brexit environment. This could tap into a much broader F-35 enabled market place, much like the weapons manufacturers are doing as well as provide entry points as well into working with initiatives like FCAS. And obviously, there is a natural point here for collaboration with the Australians.

And by both the UK and Australia focused on a loyal wingman program, clearly there are opportunities for collaboration The British can bring relevant industrial capacity to the challenge along with Boeing Australia capabilities which can then leverage Australian test and development areas to shape a range of loyal wingman, some designed to fly with the F-35 and its fusion sensor enabled C2 capability and some designed to work with differently configured manned systems.

THE CASE OF MARITIME REMOTES: AN AUSTRALIAN PERSPECTIVE

By Robbin Laird

(2019)

Recently, I attended the Chief of the Royal Australian Navy's Seapower conference being held in Sydney from October 8th through the 10th, 2019. One of the sessions which I attended was a presentation by Cmdr.

Paul Hornsby, Royal Australian Navy lead on autonomous warfare systems. The presentation provided an overview on how the Australian Navy is addressing the development and evolution of remote systems within the fleet.

During my visits over the past five years in Australia and my time with The Williams Foundation, I have been impressed with the ADF and its efforts to build a transformed force. The transformation process has been identified as building a fifth-generation force. And within that effort, the significant modernization envisaged for the Australian Navy is focused on shaping a transformed maritime force as well.

As former Chief of Navy, Vice Admiral (Retired) Barrett put it in our interview earlier this year: "We are not building an interoperable navy; we are building an integrated force for the Australian Defence Force." The kill web approach was clearly what he is working from when he discusses force modernization for the Navy.

In this process of force transformation, the ADF is committed to a wide range of innovative roll outs to experiment in the evolution of its fifth generation con-ops.

This is why for a much larger force like the United States possesses, the Australians in their approach represent not just innovation for themselves but for the U.S. and other Australian allies.

Nowhere is this more evident than in the domain of unmanned maritime systems. As Hornsby put it in his presentation: "We have no choice but to be leaders in this area." He underscored that the significant operational area which Australian forces need to patrol coupled with limited numbers of maritime platforms and manpower limits meant that the building, operating and integration of maritime remote systems in the fleet was an operational necessity for the Royal Australian Navy.

"We could not get enough help from remote systems and artificial intelligence."

He argued that there was a cross-societal engagement with remote systems in Australia which the Navy could leverage as well. He noted that Australia has been involved in allied exercises across the board in the remote systems area.

He laid out through the various exercises in the UK, Australia and elsewhere that his team has been fully engaged in cross learning with allies, and to do so in order to harvest the best and leave the rest. He made a case for why Australia is a very important area for allies to work with the Aussies on remote innovations. The conditions in Australia are challenging and paraphrasing Frank Sinatra: "If you can make it here, you can make it anywhere."

FIGURE 6 CMDR. HORNSBY SPEAKING AT THE SEAPOWER CONFERENCE IN SYDNEY, OCTOBER 2019. CREDIT PHOTO: SECOND LINE OF DEFENSE

Cmdr. Hornsby underscored a number of key contributions of AI to the build out of a remote system distributed force.

First, AI was essential to provide enhanced context awareness: "appreciation of the emerging situation through available data and reacting appropriately to execute mission intent."

Second, AI was crucial for on-board payload analysis: "data analysis on the platform, reducing to relevant and executable information."

Third, AI was a key part of generating network independence: "distributed decision making, resilient in degraded combat environments."

And, finally, AI was crucial in shaping trusted autonomy: "facilitating a progression from human-in-the-loop to human-on-the-loop to many loops to orchestration of autonomous systems" and "to provide for automounts decisions within the boundaries of delegated authority and rules of engagement."

We are reaching a stage where the remotes can work with one another, underwater and above water, to provide SA to the battle commander; and to shape ways for the distributed system to assist and make decisions in something which really as way beyond the classic OODA loop.

When the machines are working OO (Orient and Observe) and notably with AI then the focus is upon how to DA (Decide and Act).

And even more to the point, humans and machines need to work the decision-making loop together and this requires significant learning on the human side for sure.

As he concluded his presentation, he framed a number of key questions which he argued needed to be addressed and ways ahead found to answer them. It is often the case, that change is really about changing the nature of the questions which need to be answered, rather than finding new answers to older questions.

"How does a vast continent like Australia enhance (not replace_ its defenses with Remote Autonomous Systems plus AI (that is, to cover areas that it never had to before the advent of RAS + AI)?

"How do we ensure RAS+AI is a core part of our ships coming on-line, not just be an add-on?

"How do we ensure RAS+AI is a core part of how our people see warfare – doctrinally and strategically (i.e., to know its limits and its strengths and its rules?)

"How do we teach them to fighter in partnership with machines and AI in an operational tactical environment that will be at a speed and multiplicity well beyond human capabilities?"

This means that new platforms moving forward need to have data processing capabilities, personnel able to operate SA systems, an ability to include relevant remote platforms onboard as well as a range of platform payloads, and technicians onboard able to deliver sustainment to systems operating at a distance and over relatively long operational times.

In short, for Cmdr. Hornsby the future is now. And I would add my own judgement – it is crucial to get some of these systems at sea in the operational force for these platforms and payloads will be transformed over time by operational input even more than R and D done by researchers alone.

MARITIME REMOTES, AUTONOMOUS SYSTEMS AND THE INTEGRATED DISTRIBUTED FORCE: THE PERSPECTIVE OF ROBERT SLAVEN, L3HARRIS TECHNOLOGIES

By Robbin Laird

(2019)

During my most recent visit to Australia in October 2019, I have had the chance to visit the Chief of Navy's Seapower Conference and to attend the latest Williams Foundation seminar.

And along the way have held roundtables at the Australian National University, the RAAF's Airpower Development Centre and ASPI.

Of course, I have had the opportunity as well to discuss with various Australian strategists, policy makers, military leaders and members of the Australian defense industry as well. I have been particularly interested in engaging in discussions on the way ahead for what I call the integrated distributed force, the role of C2 and ISR in that evolution as well as the reshaping of the sustainment infrastructure for the ADF and the partners of the ADF.

One of those discussions was with Robert Slaven of L3Harris Technologies, a former member of the Royal Australian Navy, and our discussion focused on the C5/ISR infrastructure for the integrated distributed force. For Slaven, the shift toward an integrated distributed force marks a significant change from his earlier training as a member of the RAN.

Traditional thinking, such as that developed by Admiral Mahan, has now been supplanted by the necessity to recognize that a step change has taken place and to embrace the fact that emergent technologies have dramatically reshaped the face of maritime warfare.

Previously the main doctrinal focus has been on counter-force operations conducted by Major Fleet units with supporting fleet and air elements. According to Slaven, "The evolution of the technology over the past thirty years has transformed the way navies will fight going forward.

"So when you refer to the new C5/ISR infrastructure, a key point to keep in mind is that it morphs dependent on the operations you are trying to do and the operations you are engaged in."

Frankly, the notion of a morphing C5/ISR infrastructure makes a lot of sense when you consider that platforms are shifting from largely dedicated mission designed hulls to becoming multi-mission platforms that can change

and flex on a mission by mission/task by task basis, and therein allow integrated Task Forces to be shaped with inherently flexible and resilient C5/ISR infrastructures.

The way Slaven put it was as follows: "every platform is a node within that infrastructure. Their role and importance within that infrastructure changes in accordance with the tasks you are trying to accomplish and how the enemy behaves and reacts as well."

He underscored that as maritime autonomous systems mature, they can play an important role as C5 nodes and ISR platforms in the morphing infrastructure as well. "The remotes can be distributed throughout the area of interest and be there significantly in advance of when we have to create a kinetic effect. In fact, they could be operating months or years in advance of shaping the decision of what kind of kinetic effect we would need in a crisis situation.

"We need to learn how to work the machines to shape our understanding of the battlespace and to shape the kind of C5 which could direct the kind of kinetic or non-kinetic effect we are trying to achieve."

He added a very useful insight with regard to the evolving tool sets associated with the non-kinetic domain. He highlighted that the Bismarck entered the kill zone because of the disabling of its rudder. This was done with a British torpedo, but what if that same effect could be achieved by non-kinetic actions?

Slaven highlighted the importance of coming maritime autonomous systems to the presence mission. "What we want to do is actually take the mechanics behind what one might call morphing infrastructure to build a persistent capability within the theater. With autonomous systems, we are not working to force an entry or establish an enduring presence into the area of interest, we are already there.

"What we're doing by bringing unmanned systems into the AO, is out manoeuvring Gray Zone competitors.

"We're building a persistent ISR presence in a pre-kinetic mode of operation, with an infrastructure consisting of UAVs, UUVs, USVs, surface and subsurface relay nodes, all of which are already pre-deployed and available for manned units to join the network.

"In addition, we have autonomous patrol assets which can provide an enduring environment assessment to ensure we have full situational awareness.

"This persistent forward deployed presence can be leveraged for kinetic operations within a crisis engagement setting as needed."

In effect, the situational awareness piece is a prelude and enabler to the kind of full spectrum dominance one would need in a kinetic effort, allowing Commanders to leverage unmanned capabilities and keep humans at a safe distance.

It is clear that this way ahead, which is central to being able to shape, operate and command, an integrated distributed force is building on the legacy platforms we have now, but is also a prologue to any new platforms to be built in the future.

A case in point is the Australian Arafura Class Offshore Patrol Vessel, which is being built with the ability to leverage off-boarded systems as a designed in feature of its own operational capabilities In this sense, the coming of the OPV plays a forcing function role within the ADF as its shapes what they call a fifth-generation force.

FIGURE 7 NEW AUSTRALIAN OPV. CREDIT: LUERSSEN

"The OPV will have a crew of around 40 and be tasked with the normal Patrol and Constabulary tasks the Armidales currently do for the Navy and the Border Command.

"But because of the inbuilt flexibility of the C5/ISR infrastructure onboard, the OPV will become part of the much larger distributed force, with reachback and force-multiplication capabilities way beyond its reach as a single ship.

"It could operate as the mothership for a wide range of autonomous systems; and it can push that information into the wider battlespace."

In other words, the OPV is being designed from the ground up with off-board systems and the new C5/ISR morphing infrastructure as key building blocks. And given the modular flexibility associated with the ship and with the autonomous system payloads, the OPV could be an advance force element of an amphibious task force, provide support to a destroyer task force, be a key command element for a gray zone operation, and so on.

Because it is designed to be able to contribute to and to leverage unmanned systems from the outset, it can be task organized beyond its core mission.

From that sense, the future is now.

Defense.Info

EVOLVING REMOTE MARITIME CAPABILITIES: THE PERSPECTIVE OF DARYL SLOCUM OF L3HARRIS TECHNOLOGIES

By Robbin Laird

(2019)

In today's world, full spectrum crisis management is not simply about escalation ladders; it is about the capability to operate tailored task forces within a crisis setting to dominate and prevail within that crisis. If that stops the level of escalation that is one way of looking at it. But in today's world, it is not just about that but it is about the ability to operate and prevail within a diversity of crises which might not be located on what one might consider an escalation ladder.

They are very likely to be diffuse within which the authoritarian powers are using surrogates and we and our allies are trying to prevail in a more open setting which we are required to do as liberal democracies.

This means that a core legacy from the land wars and COIN efforts needs to be jettisoned if we are to succeed – namely, the OODLA loop. This is how the OODA loop has worked in the land wars, with the lawyers in the loop, and hence the OODLA loop. The OODA loop is changing with the new technologies which allow distributed operators to become empowered to decide in the tactical decision-making situation.

But the legalistic approach to hierarchical approval to distributed decisions simply will take away the advantages of the new distributed approach and give the advantage to our authoritarian adversaries. What we are seeing is a blending of technological change, with con-ops changes and which in turn affect the use and definition of relevant military geography.

In other words, the modernization of conventional forces also has an effect on geography.

As Joshua Tallis argued in his book on maritime security, the notion of what is a littoral region has undergone change over time in part due to the evolution of military technologies.

"Broadly speaking, the littoral region is the 'area of land susceptible to military influence from the sea, and the sea area susceptible to influence from the land.'

"In military terms, 'a littoral zone is the portion of land space that can be engaged using sea-based weapon systems, plus the adjacent sea space (surface and subsurface0 that can be engaged using land-based weapon system, and the surrounding airspace and cyberspace.'

"The littoral is therefore defined by the technological capability of a military, and as a result, the littoral is not like other geographic terms."[2]

What is changing is that the force we are shaping to operate in the littorals has expansive reach beyond the presence force in the littorals themselves. If you are not present; you are not present. We have to start by having enough platforms to be able to operate in areas of interest.

But what changes with the integrated distribute ops approach is what a presence force can now mean. Historically, what a presence force is about what organically included within that presence force; now

[2] Joshua Tallis, ***The War for Muddy Waters*** (USNI Press, 2019, p. 2).

we are looking at reach or scalability of force. We are looking at economy of force whereby what is operating directly in the area of interest is part of distributed force. The presence force however small needs to be well integrated but not just in terms of itself but its ability to operate via C2 or ISR connectors to an enhanced capability.

But that enhanced capability needs to be deployed in order to be tailorable to the presence force and to provide enhanced lethality and effectiveness appropriate to the political action needed to be taken. This rests really on a significant rework of C2 in order for a distributed force to have the flexibility to operate not just within a limited geographical area but to expand its ability to operate by reaching beyond the geographical boundaries of what the organic presence force is capable of doing by itself.

This requires multi-domain SA – this is not about the intelligence community running its precious space- based assets and hoarding material. This is about looking for the coming confrontation which could trigger a crisis and the SA capabilities airborne, at sea and on the ground would provide the most usable SA monitoring. This is not "actionable intelligence."

This is about shaping force domain knowledge about anticipation of events. This requires tailored force packaging and takes advantage of what the new military technologies and platforms can provide in terms of multi-domain delivery by a small force rather than a large air-sea enterprise which can only fully function if unleashed in sequential waves.

In the maritime domain, an evolving capability which will operate in concert with capital ships are unmanned maritime systems or remotes. Such systems come in two forms: underwater unmanned systems and surface unmanned systems, which when the con-ops matures will work interactively with one another to extend the reach of the manned surface fleet to provide for perimeter defense via a flexible picket fence so to speak, and to provide a significant impact to the reworking of C2 highlighted above≥

In many ways, the F-35 force package is directly forcing a significant revision of where D takes place in the OODA loop. Tactical decision making at the edge needs to be worked as the F-35 pushes decision making capability to the edge.

As that is worked through, the next phase will entail how remotes can provide not just SA and remote targeting capabilities, but share in the decision making with the humans in the loop. For the Air Forces, this will be about sorting through how loyal wingman can work with manned combat air assets; for maritime forces it will be about how above and below sea remotes can be woven into the extended reach of a capital ship and become part of a force package, and, in turn, changing the nature of what a combat fleet looks like.

In other words, there are waves of learning how to work with remotes and to incorporate them into an integrated distributed force. Over the next five years, we will see a significant presence of maritime remotes and as operational experience is gained, the next wave of learning will go from treating these as platforms adding to the capability of the fleet, to becoming core parts of an integrated distributed force with significant changes in the concepts of operations of the combat fleets as well.

During my visit to the Chief of the Royal Australian Navy's Seapower conference which was held in Sydney from October 8th through the 10th, 2019, I had a chance to discuss with officers of the Royal Australian Navy as well as defense industry leaders the evolving maritime remote capabilities currently available and on the horizon. One of those industry leaders I met with was Daryl Slocum of L3HarrisTechnologies. He has been involved with maritime remote systems since his graduate student days and as head of the OceanServer program, is based in Massachusetts at the L3Harris facility located there. He was at the conference engaging

with various Navies attending the conference to discuss the capabilities which L3Harris has in the maritime remotes area.

I took advantage of his presence to discuss more generally how one might understand how maritime remotes are developing and might develop in the future, and their role and contribution to the maritime combat force.

Slocum views maritime remotes as force multipliers. As the durability of the systems evolves and they can operate at greater range and operate with greater loiter times, the core question is what the fleet commanders want these systems to do. This means that the focus is clearly upon payloads, and how to take the information on these remotes generated by the various payloads and to get that information in a timely manner to the users in the combat fleet.

Right now, unmanned underwater systems can operate with a variety of payloads, the most significant of which can provide remote mapping and situational awareness. As the capabilities to do onboard processing on the remotes ramps up, information can be processed on the platform and with the aid of evolving artificial intelligence can determine provide for information parsimony.

This means that the systems onboard the platforms as their capabilities evolve will be able to send core information to users highlighting threats and opportunities for the combat fleet.

And as the ability of the remotes to work with one another evolves, surface and subsurface remotes will be able to work together so that the communication limits imposed by underwater coms can be mitigated by surface remotes working as transmitters.

We discussed the impact of these projected capabilities on capital ship design.

It is clear that new capital ships need to have onboard processing capabilities and decision tools to be able to leverage what a deployed system of remotes might be able to deliver to that capital ship.

This means as well that maritime warriors will need to learn to work with thinking machines as decision making at sea will evolve as well. Slocum highlighted that the Iver family of L3Harris underwater remotes were platform agnostic, which meant that they can work with a wide variety of users worldwide. This means as well that they can focus on building a platform which is battery agnostic as well to incorporate changes in the evolution of battery capabilities, which are of course, crucial to durability, speed and range of the remotes.

We both agreed that is important to get these systems out of the labs and into the fleet to get the kind of operational experience necessary to drive innovation moving forward with essentially a software upgradeable platform.

Slocum indicated that they had this kind of relationship with the US Navy in San Diego as the US Navy gets read to tap into remotes as a key part of the counter mine mission. As he described the goal of a remote platform which is payload agnostic: “Today, I want to do a side scan mission; tomorrow, I might want to do an ISR mission; and the day after tomorrow, I might want to do a SiGINT mission.”

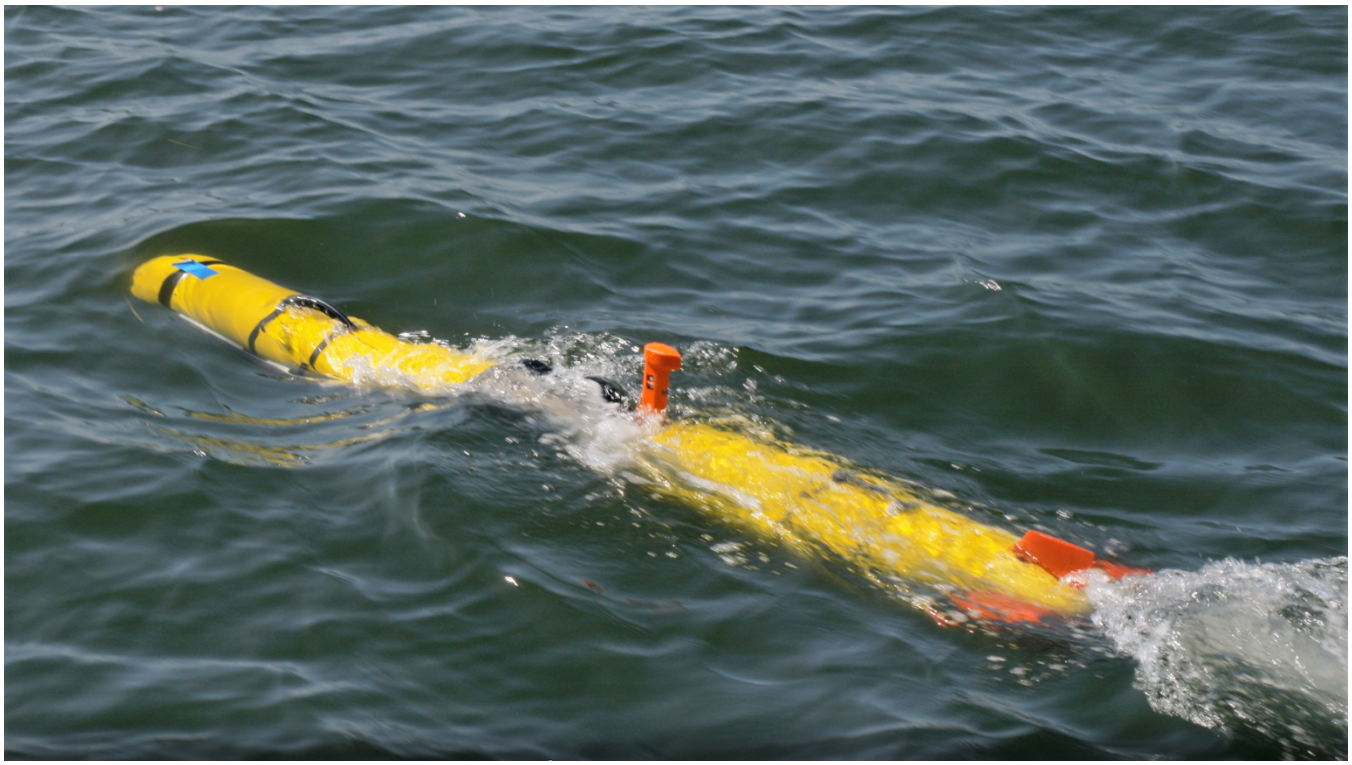

FIGURE 8 IVER MARITIME REMOTE PLATFORM. CREDIT: L3HARRIS

By having a small form factor platform, with a capability to operate with a diversity of payloads, the remote can be incorporated into a wide array of missions which can expand what the capital ship itself is capable of doing.

Indeed, the impact of remotes can expand what a support fleet can do.

There is no reason that a U.S. Military Sealift Command ship cannot incorporate remotes and expand the concept of what kind of support MSC ships can provide, beyond physical things such as fuel and supplies.

In other words, remotes can provide for con-ops diversification within the combat fleet, including the supply component of that fleet as well.

Clearly, such capabilities could provide significant enhancements with regard to perimeter defense in various ways, including masking what that remote actually is and what it is doing.

Currently, L3Harris has more than 300 Iver platforms operating worldwide, with 2/3 of them with military customers and 1/3 with civilian customers, including research centers as well.

We closed by discussing where the remote capabilities might be in five years' time.

Slocum saw Iver as being able to operate for longer times, and taking onboard new payloads. He projected that onboard processing capability would take a leap forward which would lead to making more timely use of the data being collected by the remotes.

A key breakthrough point will be when remotes can make a decision about which data needs to be sent back home to the human decision maker.

Defense.Info

Beyond the five-year time line, Slocum saw that after working through operational experience in that time period, the ability of remotes to work together would become more mature.

And as that capability evolves, the entire reworking of the decision cycle will evolve as well.

In short, it is not just about remotes as a platform; they are being introduced at the same time as the military is undergoing a transformation to shape an integrated distributed force.

And for the maritime forces, remotes will provide a core capability to fleet enhancement.

BUILDING OUT THE FLEET WITH MARITIME REMOTES AND AI: THE UK CASE

(2020)

The US, the UK and Australia are working closely together with regard on developing maritime remote systems to work with and transform their maritime fleets.

In early 2020, the UK Ministry of Defence has announced a new round of funding for their efforts in this area,

The Defence and Security Accelerator (DASA) has announced the first wave of £4 million funding.

The funding aims to revolutionise the way warships make decisions and process thousands of strands of intelligence and data by using Artificial Intelligence (A.I.).

Nine projects will share an initial £1 million to develop technology and innovative solutions to overcome increasing 'information overload' faced by crews as part of DASA's Intelligent Ship – The Next Generation competition.

Defence Minister James Heappey said:

"The astonishing pace at which global threats are evolving requires new approaches and fresh-thinking to the way we develop our ideas and technology. The funding will research pioneering projects into how A.I and automation can support our armed forces in their essential day-to-day work."

Intelligent Ship is focused on inventive approaches for Human-AI and AI-AI teaming for defence platforms – such as warships, aircraft, and land vehicles – in 2040 and beyond.

DASA, on behalf of the Defence Science and Technology Laboratory (Dstl), is looking at how future defence platforms can be designed and optimised to exploit current and future advances in:

Automation

Autonomy

Machine learning

Artificial Intelligence

These key areas of research will look to address the complex and constantly evolving threats to national security.

This work will inform requirements then develop applications essential to the future force in an increasingly complex and A.I. driven environment. Although titled Intelligent Ship, a warship is just the prototype demonstrator for this competition – the project will inform development relevant to all defence equipment and military services.

Julia Tagg, technical lead from Dstl, said:

"This DASA competition has the potential to lead the transformation of our defence platforms, leading to a sea change in the relationships between AI and human teams. This will ensure UK defence remains an effective, capable force for good in a rapidly changing technological landscape.

"Crews are already facing information overload with thousands of sources of data, intelligence, and information. By harnessing automation, autonomy, machine learning and artificial intelligence with the real-life skill and experience of our men and women, we can revolutionise the way future fleets are put together and operate to keep the UK safe."

The competition, currently backed by a total of £4 million over two phases, has the potential to transform the way the Royal Navy, British Army and Royal Air Force equipment platforms are designed, work together, operated and manned by the 2040s.

Innovations developed in phase 1 of the competition could later help determine the different platform types, size and role of future platforms as well potentially being adapted and integrated into the existing fleet.

DASA Delivery Manager Adam Moore said:

DASA brings together the brightest minds in science, industry and academia to turbocharge innovations to keep the UK, as well as those who protect us, safe from emerging and evolving threats to our way of life.

This project will ensure the Royal Navy and all our Armed Forces stays one step ahead of our adversaries.

DEFEATING "WEAPONS THAT WAIT" WITH UNMANNED SYSTEMS

(2020)

By George Galorisi

The November 15, 2019, a Latvian Public Broadcasting System article headline was as stark as it was disturbing: "NATO ships clear more than 50 mines from Baltic Sea."

The subtext was more explanatory: "November 14 saw the conclusion of the Joint Hod ops (Historical Ordnance Disposal Operation) exercise organized by NATO's 1st Standing Anti-Mine Squad and the Baltic Minesweeper Squadron (BALTRON) which began November 4."

Defense.Info

As the article noted: "During the Hod ops exercise, approximately 20 square nautical miles were cleared, finding 56 explosive items at the bottom of the sea, including various different types of mines. Currently, 43 mines have been destroyed, and the Navy will continue its work on neutralizing the remaining 13 mines."

The fact that these mines, some of which were WW II German-made mines weighing almost 1000 kilograms each were discovered, is a vivid example that the mine threat that exists in 2020 is real.

Few would disagree with the statement that mines represent one of the most vexing military challenges. Sea mines are perhaps the most lethal form of these weapons, as they are hard to find, difficult to neutralize, and can present a deadly hazard to any vessel—even those ships specifically designed to hunt them.

These "weapons that wait" provide almost any adversary with an effective means to thwart even a major naval power.

Even the threat of mines can stop any naval operation dead in its tracks. The use of sea mines adjacent to maritime choke points presents a threat that is at once ubiquitous and deadly. Further afield, sea mines have broader repercussions for global maritime trade routes as well. Sadly, western nations have given insufficient attention to dealing with the threat sea mines pose to naval and merchant activities worldwide.

While the United States and many of its NATO and other allies are laying up and "sun-setting" their mine-countermeasures (MCM) capabilities, peer competitors are enhancing their MCM inventory. In late 2019, Russia christened a new Alexander-Obukhov-class minesweeper, adding to their already substantial fleet of Aleksandrit-class and Natya-class minesweepers. China added new Wozang-class mine-countermeasures vessels in 2016 (Rongcheng and Donggang types) and in 2017 (Rudong type).

Mine Countermeasures Is an Ongoing Challenge

In the past several decades, rogue states have employed a wide variety of sea mines. Libya used mines to disrupt commerce in the Gulf of Suez and the Strait of Bab el Mandeb. Iran laid mines to hazard military and commercial traffic in the Arabian Gulf and Gulf of Oman. During Operation Desert Storm in 1990-1991, the threat of mines hazarded coalition forces operating in the Arabian Gulf.

Today, especially given the tensions between the United States and Iran, U.S. and allied military professionals are evaluating the ways that Iran could threaten the west. Many think that the most serious threat is that Iran could mine the Strait of Hormuz. The mines themselves would not only take an extended period to clear, but the minesweepers could only do their work once the Iranian navy was sunk and its anti-ship missile sites destroyed.

Beyond the Iranian threat, the challenge posed by potential adversary mining capabilities is real and growing. The number of countries with mines, mining assets, mine manufacturing capabilities, and the intention to export mines has grown dramatically over the past several decades. More than fifty countries possess mines and mining capability. In addition, the types, sophistication, and lethality of the mines available on the world market are increasing.

This threat is not lost on Navy and Marine Corps leadership.

During the November 2019 NDIA Expeditionary Warfare Conference, Vice Admiral John Miller, former commander of Naval Forces Central Command, noted that developing MCM capability is critical as the Navy faces increased mining threats from adversaries worldwide. During this event, Major General David Coffman, Commanding General of the 1st Marine Expeditionary Brigade noted, "The threat of mines is growing

globally. It is an asymmetric advantage that our enemy is trying to leverage and directly affects our maneuverability and our assets."

It falls squarely on the U.S. Navy to provide the MCM capability to enable the Joint Force to operate forward in support of United States' interests, as well as those of our allies and friends.

Indeed, the U.S. Navy's strategic document ***A Design for Maintaining Maritime Superiority 2.0 (Design 2.0)*** articulates the profoundly challenging strategic environment where peer competitors such as China and Russia and lesser (but more unstable) powers such as North Korea and Iran, have impressive inventories of naval mines.

Design 2.0 notes that, "It has been decades since we last competed for sea control, sea lines of communication and access to world markets." One doesn't have to be a Sun Tzu or Clausewitz to understand that the threat of naval mines is one of the key challenges that drives our emerging need to once again compete for freedom of movement on the world's oceans, as well as in the littorals.

Mine Countermeasures (MCM) is one of the most difficult and time-consuming missions for navies to successfully execute.

That is likely why, through the entirety of my U.S. Navy experience (which began in 1970), I have witnessed the Navy "admire the problem" of MCM. For example, in the late 1990s, Chief of Naval Operations, Admiral Jay Johnson, and Commandant of the Marine Corps, General James Jones, signed out the fourth edition of the unclassified and widely distributed Naval Mine Warfare Plan. Shortly thereafter came the 21st Century Warfighting Concept: Concept for Future Naval Mine Countermeasures in Littoral Power Projection. Several years later, the Commander in Chief of the U.S. Atlantic Fleet, Admiral Robert Natter, and Commander in Chief of the U.S. Pacific Fleet, Admiral Thomas Fargo, jointly published an unclassified Carrier Battle Group/Amphibious Ready Group Mine Warfare Concept of Operations (CVBG/ARG MIW CONOPS).

The U.S. Navy's MCM capabilities are little-changed today, even after decades of "aspirational" intentions to enhance the Navy's MCM posture. While the U.S. Navy has made some important strides, such as the MCM package aboard the Littoral Combat Ship (LCS), the significance of the MCM mission provides both the impetus and opportunity to do much more. And the time to do so is now.

The platforms that embody the U.S. Navy's primary MCM capability—the MH-53E AMCM aircraft and the Avenger-class minesweeper – are scheduled to sunset by 2025.

As Captain Chris Merwin of the Naval Surface and Mine Warfighting Development Center (SMWDC) pointed out at a military-industry event in October 2019, the Navy's follow-on MCM capability, embodied the MCM package aboard the Littoral Combat Ship (LCS), is not coming on line as rapidly as anticipated, and initial operating capability is not scheduled until 2023 – a date Captain Merwin described as "optimistic."

Based on my U.S. Navy experience—spanning half a century, first as a naval officer and now as a Navy civilian—this is not a new issue for the U.S. Navy, but one it has struggled with for decades.

The entirety of my professional involvement with the operational Navy strongly suggests that it is not a lack of "want," or even a lack of money (although MCM funding has lagged other procurement priorities), but rather, not having adequately mature technology to address the challenge.

Evaluating Unmanned Vehicle Technologies

Defense.Info

Today, one of the most rapidly growing areas of innovative technology adoption by military forces worldwide involves unmanned systems. In the past several decades, the expanding use of military unmanned systems (UxS) is already creating strategic, operational, and tactical possibilities that did not exist a decade ago.

While unmanned systems show great promise, most military professionals are keenly aware of the importance of not embracing every tool a technologist thinks might be of value to those in the fight. Employing unmanned systems in an ongoing series of exercises, experiments and demonstrations is a proven way of separating promising, but immature, technologies from those that will actually wind up in the hands of a warfighter as a proven capability.

Given today's compelling mine threat, as well as the age of current MCM force, to say nothing of the rapidity with which current MCM systems are sun-setting, it may be time for naval professionals to shift to a new technology paradigm and focus on technologies—often commercial-off-the-shelf (COTS) technologies—will likely deliver an MCM capability faster than traditional acquisition processes.

For all navies, there is only one way to completely, "Take the sailor out of the minefield," and that is to leverage unmanned technologies to hunt and destroy mines from a distance. As naval analyst Norman Friedman pointed out in a piece for Defense Media Network, "Gulf War 20th: Naval Lessons of the Gulf War," the severe damage done to U.S. Navy ships, USS Samuel B. Roberts, USS Tripoli and USS Princeton by simple sea mines is something that can be avoided in the future. In the past, unmanned vehicle technologies were not mature enough to be considered to take on the complex mine-hunting and mine-clearing task. They are today.

The U.S. Navy is accelerating the testing and fielding of unmanned systems.

Headlines such as, "Navy, Marines Moving Ahead with Unmanned Vessel Programs," appear in the defense media. Concurrently, other articles, such as "When Will the U.S. Navy be Able to Autonomously Seek and Destroy Mines?" emphasize the U.S. Navy's strong desire to take sailors out of the minefield. Similar efforts are likely going on in other navies, especially NATO naval forces.

As just one indication of NATO's concern in this area, and the reason that MCM efforts are gaining traction, the alliance has a long history of mine-countermeasures exercises, and has stepped up their periodicity and complexity. An article in Second Line of Defense in August 2018, "NATO Mine Counter Measures Group One Works in Norwegian Waters: August 2018," presented the challenge in compelling terms. Other articles, such as Ryan Hilger's "The Navy Needs Agile Mine Warfare," in the October 2019 U.S. Naval Institute Proceedings addressed the challenge this way: "The United States lacks the capabilities and operational concepts to deploy large-scale mine countermeasures against a peer competitor." Lieutenant Commander Hilger went further, noting;"

The U.S. Navy is not prepared to confront that level of mine threat, nor does it have a robust strategy for offensive mine warfare.

The current operational concept relies on manned surface platforms and sailors in or near the minefield for detection and clearance operations. The systems rely on a slow, methodical pace to complete the end-to-end countermine kill chain. The Avenger-class mine countermeasures ships and Freedom- and Independence-class littoral combat ships (LCSs) lack the survivability to conduct mine clearance operations in a denied environment—assuming the mine countermeasures module for the LCS ever reaches the fleet.

Other navies can capitalize on the work that the U.S. Navy has already conducted as it has explored ways to use emergent COTS unmanned technologies for the MCM mission. Given the severity of the mine threat, all navies would be well-served to leverage and build upon mature technologies that have been examined by commercial and other government agencies in the United States, and tested extensively in exercises, experiments, and demonstrations to field a near-term MCM capability.

Building on U.S. Navy and Marine Corps Experience

Earlier in this article I quoted both a U.S. Navy admiral and a U.S. Marine Corps general, both of who spoke of the severity of the mine threat as well as the challenges of fielding an effective and affordable MCM capability. This was not a set of random quotes, but rather an indication that the Navy and Marine Corps are united in their mutual efforts to deal with the worldwide mine threat to naval expeditionary forces.

The reason for this unity of effort is clear: Navy-Marine Corps expeditionary strike groups operate in the littorals close to shore, often on a coastline that the adversary defends with mines. That is one of the reasons why, over the past several years, in a series of U.S. Navy and Marine Corps events as diverse as the Ship-to-Shore Maneuver Exploration and Experimentation and Advanced Naval Technology Exercise, the Battlespace Preparation in a Contested Environment, the Surface Warfare Distributed Lethality in the Littoral demonstration, Dawn Blitz, Steel Knight, the Bold Alligator exercise series, and Valiant Shield, operators have field-tested wide range of emerging technologies, many of them adaptable to the MCM mission.

One of the technologies that performed well was the MANTAS unmanned surface vehicle (USV).

Over the course of the events described above, the MANTAS was scaled-up from a six-foot, to eight-foot, to twelve-foot version. During Exercise Valiant Shield, MANTAS was tasked with re-supply mission, carrying cargo to the troops ashore. As a result of that mission success, U.S. Navy and Marine Corps officials have asked MANTAS' manufacturer, MARTAC Inc., to scale-up the MANTAS further and design a thirty-eight-foot version.

It is this USV—one that closely approximates the size of an eleven-meter RHIB used by many navies—that can be combined with surface and subsurface mine-hunting and neutralizing equipment to provide an over-the-horizon "single sortie detect-to-engage" MCM capability that takes the sailor out of the minefield and provides a potential solution for this vexing mission. While there are any number of USVs and UUVs that the U.S. Navy is testing, leveraging one that has been thoroughly wrung out for hundreds of hours during years of Navy exercises, experiments, and demonstrations provides the most important building block for a comprehensive MCM capability.

Achieving a Near-Term MCM Capability with COTS Technologies

The essential building block for a commercial-off-the-shelf technology MCM solution is a scaled-up version of the twelve-foot MANTAS high-speed catamaran proven in the events listed earlier. This USV—nicknamed the T38—is virtually identical in size to an eleven-meter RHIB carried by many naval ships. The T38 can operate in up to sea state five, has a cruise speed significantly greater than that of an eleven-meter RHIB and a range four times greater than the RHIB.

One of the most important attributes of this building block is the fact that the T38 has an aft-mounted twin tow station which houses both a mine-hunting sonar system and a mine neutralization remotely-operated vehicle (ROV). These towed subsystems are installed on two rails aft. The catamaran hull enables the MANTAS to conduct an angled submergence of the stern tow station. This unique configuration results in a flooded well-deck that facilitates a straightforward launch and recovery of the tows.

Defense.Info

The first key component of a commercial-off-the-shelf technology MCM solution is a towed-body-mounted sonar. A sonar for this mission must have a resolution sufficient to search for mine-like objects (MLOs). Such a sonar is also programmable for obstacle avoidance, bottom following and terrain referencing. Another important feature is automatic target recognition to identify likely MLO anomalies. At this stage, an operator can verify the MLO designated as such by the MANTAS sonar. Verified MLOs are then added as a waypoint for validation.

The second component of a commercial-off-the-shelf technology MCM solution is a Mine Neutralization System (MNS) Remotely Operated Vehicle. Mine-like objects that have been verified will be continuously updated. Once this is complete, the system will recommend a route for the MNS ROV. This route can be changed as needed as priorities shift or the tactical situation evolves. Once the area search is complete, the T38 transitions from hunting to neutralizing by conducting a well-deck recovery of the towed-body. This is followed immediately by the launch of the tethered MNS ROV.

The Mine Neutralization System Remotely Operated Vehicle then performs the work previously conducted by various classes of ships as it provides real-time video validation of mine-like objects. The MNS ROV autonomously executes the MLO route for final classification and man-on-the-loop validation of each MLO. As this is taking place, the T38 shadows and supports it as an over-the-horizon communications link. This process is repeated until the field is cleared.

If the technical and operational solution presented above sounds simple and achievable it is just that—a capability that exists today in the commercial subsystems that can be delivered far more rapidly than anything the traditional acquisition system can provide.

MARTAC is already completing the design and fabrication of the T38 MCM variant prototype for potential demonstration to the Navy as early as this summer.

The time is right to embrace an unmanned COTS solution to deal with deadly mines.

An MCM Challenge Demanding Action Today

During my decades of service in the operational Navy, I deployed to the Arabian Gulf a number of times—the same body of water where my shipmates on USS Samuel B. Roberts, USS Tripoli and USS Princeton were seriously injured by mines. Because ships and sailors operate daily in harm's way, The U.S. Navy and Marine Corps—and by extension other allied navies—need to accelerate their efforts to deal with deadly mines. The essential components for such a system exist today, and a robust COTS MCM solution can reach fruition in the near-term.

It is time to put a near-term solution in the hands of the U.S. Navy's sailors. While programs of record are developing next-generation technology, the Navy should invest in parallel-path solutions that leverage mature subsystems ready to provide speed-to-capability today. Once the Fleet sees the COTS solution that can be delivered with the system described above, the U.S. Navy—as well as other navies with the foresight to embrace such a system—will have an effective way to defeat today's deadly mine threat.

George Galdorisi is a career naval aviator whose thirty years of active duty culminated in fourteen years of consecutive service as executive officer, commanding officer, commodore, and chief of staff. His last operational assignment spanned five years as a carrier strike group chief of staff embarked in the USS Carl Vinson and USS Abraham Lincoln.

THE ARRIVAL OF TRITON IN THE PACIFIC: NEW MANNED-UNMANNED TEAMING CAPABILITIES AND DELIVERING NEW C2/ISR CAPABILITIES

(2020)

The first two MQ-4C Triton unmanned aircraft arrived in Guam in January 2020.

"The inaugural deployment of Triton UAS brings enhanced capabilities and a broad increase in maritime domain awareness to our forward fleet commanders," Rear Adm. Peter Garvin, the commander of Patrol and Reconnaissance Group, said in a Navy statement.

"VUP-19, the Navy's first dedicated UAS squadron supported by an outstanding NAVAIR (Naval Air Systems Command) and industry team, is superbly trained and ready to provide the persistent ISR coverage the Navy needs."

FIGURE 9AN MQ-4C TRITON UNMANNED AIRCRAFT SYSTEM (UAS) IDLING ON A RUNWAY AT ANDERSEN AIR FORCE BASE, GUAM AFTER ARRIVING FOR A DEPLOYMENT AS PART OF AN EARLY OPERATIONAL CAPABILITY (EOC) TEST. US NAVY PHOTO

"The introduction of MQ-4C Triton to the 7th Fleet area of operations expands the reach of the U.S. Navy's maritime patrol and reconnaissance force in the Western Pacific," Capt. Matt Rutherford, the commander of CTF-72, said in the statement.

"Coupling the capabilities of the MQ-4C with the proven performance of P-8, P-3 and EP-3 will enable improved maritime domain awareness in support of regional and national security objectives."

"This significant milestone marks the culmination of years of hard work by the joint team to prepare Triton for overseas operations," Capt. Dan Mackin, the manager of NAVAIR's Persistent Maritime UAS program office, said in a statement. "The fielding of the Navy's premier unmanned aircraft system and its additive, persistent, multi-sensor data collection and real-time dissemination capability will revolutionize the way maritime intelligence, surveillance and reconnaissance is performed."[1]

Andrew McLaughlin of ADBR noted the event from the Australian perspective and added comments with regard to its importance for Pacific defense.

Defense.Info

"The deployment of Triton to Guam brings the system a little closer to Australia and its maritime approaches. The RAAF currently has two MQ-4Cs on order of a requirement for six systems, the first of which is expected to be delivered in 2023.

"RAAF Tritons will be home-based at RAAF Edinburgh near Adelaide, although air vehicles are expected to be forward deployed to RAAF Tindal in the Northern Territory to provide a 'sixth orbit' to neatly complement the five planned deployed locations for the US Navy Tritons. Apart from Guam and Point Mugu, the US Navy also plans to base Tritons at NAS Jacksonville in Florida, the Persian Gulf region, and Sigonella Air Base in Italy."

We have visited the allied bases from which P-8 is being operated in both Europe and in Australia, and have visited Edinburgh where the data management system established there allows for a full-blown focus on manned-unmanned teaming in the maritime domain awareness and ASW area.

What can be missed is that this is a major step forward with regard to real world manned-unmanned teaming in a critical area of combat capability.

As we noted in an article published on 9/27/19:

The Triton unmanned system is a key building block for 21st century maritime operations.

In effect, the Triton provides capabilities similar to a low-earth orbiting system which can serve directly the maritime task force commander.

Indeed, a key dimension of the coming of Triton is to ensure that intelligence communities not consider this their asset but ensure that it is considered an operational asset for the fleet, and as part of the maritime domain awareness 360-degree capabilities for the fleet operating as three dimensional warriors.

After our visit to Jax Navy in 2016, we highlighted the importance of this aspect of the coming of Triton, or more accurately, of the coming of the P-8/Triton dyad to the maritime services.

Another key advantage is shaping domain knowledge of the key geographical areas where the dyad will operate.

"The Poseidon operates from 15-30,000 feet normally; the Triton will operate at 50,000 feet and take a broader view."

The world looks differently at each altitude but by rotating crews, a unique perspective is gained by operating at the different altitudes and with different operational approaches to gain knowledge dominance."

This is an approach for a new generation which "wants choice in their careers, rather than being locked into a single platform."

This is about crew resource management as well. It is about shaping, developing and deploying the right skill to the task.

But the capabilities of the dyad are so good in terms of richness and fidelity of information there is already a tug of war between the intelligence community and the operators.

In an era of distributed lethality or distributed operations in the extended battlespace, the decision makers in the fleet, need the information to inform time-constrained decisions.

The fleet commanders need to make timely decisions; the intelligence community wishes to collect information, first, and inform decision makers later. This structural division will simply not work in the era of distributed decision-making and distributed lethality.

The information-decision cycle has to change to adapt to the technology.

"We need an effective cross-domain solution.

The huge divide between intelligence and operations has to be closed."

Their experience is suggestive that there is a broader need for a very robust discussion on real time actionable intelligence information.

US National Command Authority enforcement of Rules of Engagement (ROE) has had a "good and other" progression over time. The "good" is thoughtful ROEs can save lives from fratricide and friendly fire while still allowing direct and indirect fires to destroy the enemy.

The "other" is what we have quipped is the new OODA loop, an OO-L-DA loop in which L stands lag time in combat tempo for Legal review. But after Navy Jax we came away with concern for what yet again is a roles and mission discussion on the flow of strategic and tactical "Intelligence ROE"

If not addressed and debated early, a template of actionable intelligence information going directly into IC NRO/NSA/NGO and upper echelon commands to be analyzed and disseminated may inhibit combat effectiveness and the decisiveness need to prevail in the contested and extended battlespace.

Time sensitive intel is critical at lower level direct action combat commanders from the Squadron pilots, CAG and Strike Group Commanders. The ROE in the traditional IC formula of "up and out" may not be in harmony with ever evolving speed of light sensor shooter technological advances.

INDIAN NAVY LOOKS AHEAD TO NETWORKING MANNED AND UNMANNED ASSETS

By Gulshan Luthra

New Delhi. The Indian Navy is looking at futuristic, manned and unmanned ships, submarines and aircraft, says Admiral KB Singh.

In an interview with India Strategic, the Navy Chief said that acquisition order for US General Atomics SeaGuardians with high Intelligence Surveillance and Reconnaissance (ISR) capability is on the anvil and that the Navy as well as the Army and Air Force are coordinating on inducting their required Predator variants. "We are progressing a joint case for procurement of 30 armed SeaGuardian HALE RPAs (10 each for the three Services) under the Foreign Military Sales (FMS) route of the US Government."

Defense.Info

According to diplomatic sources, the US Government had acceded to India's request, made at the highest levels, for arming these High Altitude Long Endurance Remotely Piloted Aircraft, and the Ministry of Defence is now working towards finalising the process by mid next year.

In another significant observation, Admiral Singh told his customary Navy Day press conference that the Navy has decided to go in for electric propulsion for its next aircraft carrier, dubbed IAC II, and that means another win for General Atomics, whose electric propulsion systems, EMALS catapult or Electromagnetic Aircraft Launch System) and AAG (Advanced Arresting Gear) to stop the landing aircraft are the new standards for US Navy aircraft carriers.

The IAC II, or Indian Aircraft Carrier 2, will be non-nuclear, and of 65,000 tonnes.

"The Navy's long-term capability plan envisages induction of three aircraft carriers, so that two CBGs (Carrier Battle Groups) are available for dispersed deployment in the Indian Ocean region at all times. The broad contours of IAC 2, to be constructed in India as a 65,000-tonne CATOBAR (Catapult Assisted Takeoff But Arrested Recovery) carrier with electric propulsion, have been formulated and the case will be processed for accord of AON (Acceptance of Necessity). The AON is the final determinant for the MoD (Ministry of Defence) to consider allocation of funds and move the files towards acquisition of a system.

Notably, the USN carriers, all CATOBAR, are generally of 100,000 tonnes. But they are deployed globally, and have unmatched escort, and resulting expenses, much beyond Indian requirements and expenses.

Admiral Singh also told India Strategic (www.indiastrategic.in) that the Navy is already "extensively using RPAs for coastal surveillance, and that three RPA Squadrons have been commissioned at Kochi, Porbandar and Ramnad with an aim of achieving enhanced surveillance ranges."
Augmentation of existing RPA control stations onboard ships is also in progress.

The RPAs, or UAS (Unmanned Aircraft Systems) or also UCAVs (Unmanned Combat Aircraft Vehicles if armed), are integral to modern warfare, and the Indian armed forces started inducting them from the late 1990s, from Israel, thanks to Pakistan's intrusion in Kargil heights, leading to the 1999 Kargil War to evict its troops.

The success of GA Predators, with endurance up to nearly 50 hours in air, has interested the Indian forces, particularly as they have successfully been used to neutralise hostile elements in Afghanistan, even while being controlled from California on the other side of the world through satellites. A video of one operation by USAF in Afghanistan, shown at one of India Strategic seminars, demonstrated how, and with patience, a Predator neutralised four terrorists and their vehicle one by one.

The Naval Chief observed that the Navy was very much keeping track of rapid changes in defence technologies, and that the effort was to put on the best possible sensors and weapons on board various ships and other assets.

Asked about the Boeing P-8I, which is perhaps the single most advanced piece of technology with the Indian armed forces, Admiral KB Singh said: The induction of P8-I was one such step and (it is) a force multiplier in the Indian Ocean Region."

Also, he pointed out: "The Indian Navy has a dedicated multiband satellite for communication, which has enhanced our connectivity footprint, enabling our platforms to operate seamlessly at extended ranges."

The Navy plans to use the Boeing P-8Is and GA SeaGuardians to observe and neutralize hostile elements at extended ranges. Both these are armed, and the P-8, which the Indian Navy is second to induct after the US Navy, has formidable onboard capabilities to detect and destroy hidden submarines. The Indian P-8Is have

360 degree radar coverage, and all of them are networked with other aircraft, shore facilities, various Commands, and the Navy's main 24 x 7 control centre IMAC (Information Management and Analysis Centre), located in Gurgaon, south of New Delhi.

At IMAC, officers keep a watch all over and along the Indian coasts, island territories and inputs from the P-8Is and other assets wherever they are. The Navy has already enhanced its presence and mission readiness across "our areas of maritime interests in the Indian Ocean Region."

"The recalibration of our operational deployment has resulted in increasing our footprint and strategic domain awareness of the vast expanse of IOR, enabling rapid deployment of our units to address emerging security challenges."

Admiral Singh said that the Navy has approval for six more P-8Is in addition to the eight operating and four on order, and to be delivered from next year.

Notably, the allocation for funds for the Navy is however down from 18 per cent to 13 over the past five years, and that is why the modernization of various assets with newer technologies like sensors and EW systems is the key to get the best out of them.

The number of ships planned has also come down from 200 to 175, and again, that is why, the Navy is looking at newer technologies on board its assets, and that too, through the indigenous route, he said.

He pointed out that the best of the EW (Electronic Warfare) systems were not easily available, while the Navy is also importing Marine Diesel Engines, Power generators and Shafting and Propellers. These need to be made in India by public or private companies. "Our aim is to reduce the import dependency and progressively increase indigenous content in our shipbuilding projects."

So, "the Navy has commenced the process of indigenizing complex and high-end technology equipment, which are presently being imported."

The key player in this effort will be DRDO (Defence Research and Development Organisation), and the future is clearly towards Networked Manned and Unmanned assets, the Naval Chief observed.

This article was published by India Strategic in December 2019.

https://www.indiastrategic.in/2019/12/04/indian-navy-for-networked-manned-and-unmanned-assets-admiral-kb-singh/

THE CHALLENGE OF OPERATING INTEGRATED MANNED AND UNMANNED SYSTEMS

By John Conway

The concept of a 'wingman' is as old as military aviation itself. Providing mutual support within a formation, the purpose of a wingman was established to protect the flight lead and provide him or her with the additional mental capacity to manage the formation, operate the aircraft, and make decisions.

As the role developed, the most important tasks for the wingman were to help avoid an attack by an unseen enemy, contribute to the formation's situational awareness, and watch out for obvious signs the leader had either missed something or made an error. At the very heart of the idea was an acceptance that the

Defense.Info

human is fallible and, in the heat of battle, task saturation was likely to result in mistakes and errors in tactical decision-making.

In the early years of aviation, a wingman would be positioned slightly behind the lead aircraft in close visual proximity to the wings of the leader. But as advances in technology introduced new inter and intra-flight data links, such as Link 16, and increased levels of integration with airborne early warning and control (AEW&C) systems such as the E-7 Wedgetail, formations became invariably separated beyond visual range of each other and able to benefit from the 'god's eye view' of the world and shared situational awareness.

There are, of course, still times when a wingman is required to be in close visual range, but these are becoming more suited to non-tactical reasons such as transits through controlled airspace or through poor weather conditions.

So what started out as a role providing visual lookout support has now been transformed by the introduction of multi-sensor fusion displays and data links, with mutual support by proximity now measured in miles rather than metres. The fundamental purpose of a wingman has changed over the years from supporting and protecting the leader, to one which is focused on the greater concentration of firepower and more effective application and multiplication of force.

GAME CHANGER

Yet perhaps the most transformational aspect of the evolving wingman role is that of the unmanned 'Loyal Wingman', a wingman that does as it is told and does not get distracted by the fear and chaos of battle.

This is not to say a human wingman is fundamentally disloyal, nor does it undermine the importance of a human in dealing with the complexities of highly dynamic, multi-dimensional fights in the air. But it does unlock what the incoming Commandant of the US Marine Corps calls, "the game-changing opportunities with manned and unmanned teaming".

The concept of the Unmanned Air System (UAS), or Unmanned Aerial Vehicle (UAV), is nothing new nor is their use in missions which traditionally challenge human performance, fragility, and endurance. Often described as the dull, dirty, and dangerous missions, unmanned systems have provided the commander with a far broader range of options for the application of force against even the most challenging target sets. However, ongoing operational experience confirms unmanned systems on their own are not the panacea.

When Boeing Defence Australia announced its Loyal Wingman project at Avalon earlier this year it sparked significant discussion and, not least, progressed the argument for greater numbers of unmanned platforms in a far more mature and balanced way than hitherto.

The manned-unmanned narrative is now sensibly shifting towards "and" rather than "or". Manned and unmanned teaming – the US Army coined the term MUM-T – is a powerful concept which leverages the strengths and mitigates the weakness of each platform and concentrates the mind on the important operational aspects, such as imaginative new roles and the challenges of integration.

It should come as no surprise, then, to see the expansion of the loyal wingman concept in recent times into the other warfighting domains.

The ADF formally recognises five warfighting domains, sometimes referred to as environments: Air (to include Space), Land, Sea, Information and Human. The applications of unmanned systems in the land environment are moving beyond tactical flying drones, with BAE Systems Australia recently awarded a

contract to support Australian Army plans to modify two M113AS4 armoured personnel carriers at the company's Edinburgh Parks facility in Adelaide, using autonomous technologies developed in Australia.

Moreover, reports are now emerging from the US about recent developments in unmanned surface and sub-surface combatants, which are opening new ways of warfighting and creating opportunities to reconceptualise joint operations and move away from the platform-on-platform engagements which have traditionally characterised the battlespace.

Yet these ideas cannot get too far ahead of policy and the dollars, with manned and unmanned teaming driving a wholesale reconsideration of the US Navy budget. Despite an increasingly complex threat and the rapid developments in autonomous technologies, there is still much to be done to build consensus that the future lies in MUM-T.

ORCA

The Boeing Company was recently awarded a US$43m (A$63m) contract for the fabrication, test, and delivery of four Orca Extra Large Unmanned Undersea Vehicles (XLUUVs) and associated support elements. The Orca XLUUV is described in open sources as a modular, open architecture, reconfigurable UUV with its own guidance and control, navigation, situational awareness, communications, power, propulsion and mission sensors.

Taking a closer look, this project appears to be the proverbial tip of the iceberg, with the US Navy in pursuit of a much broader family of unmanned surface and undersea vehicles based upon three core variants: Large Unmanned Surface Vehicles (LUSVs), Medium Unmanned Surface Vehicles (MUSVs), and Extra-Large Unmanned Undersea Vehicles (XLUUVs) such as the Orca. Reports suggest the USN is seeking to invest over US$600m (A$873m) in near term research and development for these programs and their enabling technologies.

While the platforms themselves are fascinating from a technology perspective, what is more significant is their wider employment in a distributed architecture when teamed with the manned surface and sub-surface fleets containing a greater proportion of smaller, agile platforms.

The new unmanned platforms are expected to carry a range of sensors and weapon systems almost certainly configured for anti-surface warfare and maritime strike. Yet the potential for broader counter-air missions set within the co-operative engagement framework opens up new possibilities and significantly leverages existing manned surface fleet capability as well as providing a means of enabling integrated fire control, with the air layer containing E-2D Hawkeye, F-35C, F/A-18F Super Hornets and EA-18G Growlers.

But as ever, the platforms are only half the story.

The distributed architecture alluded to earlier will require a complex web of advanced datalinks and communication systems to make it operate as a combat system. Designing and building this 'kill web' so that it can enable the delivery of manned-unmanned firepower across domains will be a huge challenge not least due to the laws of physics.

And then the ability to train, test, evaluate and validate tactics and procedures will add a whole new level of complexity to generate the 'trusted autonomy' required for warfighting. And that is exactly why we should do it.

It will be interesting to see whether the Commonwealth's policy settings and budget profiles for the Australian warship continuous build program allows the headroom for the RAN and the broader ADF to explore the full

potential for manned and unmanned teaming in the context of future joint operations alongside the US Navy, and indeed the USAF and US Army.

From its humble origins at the platform level, the opportunities and potential of the wingman concept can now be realised at the enterprise level, which will fundamentally transform Joint and Coalition operations.

The 'force level wingman' – game-changing indeed.

This Feature appeared in the September-October 2019 edition of ADBR.

RESHAPING THE FLEET IN THE PACIFIC: F-35BS, DISTRIBUTED LETHALITY AND UNMANNED SYSTEMS, AND ALLIED CAPABILITIES

By Robbin Laird

(2019)

The kill web approach at sea is tapping into a number of key real world operational developments as well as new technologies which will enhance distributed operations and lethality.

Three sets of new stories recently published although not linked in the press, clearly are linked in terms of operational opportunities.

The first is the coming of a large AMPHIB carrying what will become its normal compliment of F-35Bs onboard. And the normal can be plused up with more F-35Bs and Ospreys as aerial refuelers.

We have written for some time about what one might call the Lightning carrier — a large deck amphibious ship which can reach back to land-based F-35s to deliver significant combat capability to an area of interest.

We recently discussed the kill web and force structure evolution and made the point that the force appropriate to deal with full spectrum crisis management operations, is a natural for an F-35-enabled force.

The force we need to build will have five key interactives capabilities:

Enough platforms with allied and US forces in mind to provide significant presence;

A capability to maximize economy of force with that presence;

Scalability whereby the presence force can reach back if necessary at the speed of light and receive combat reinforcements;

Be able to tap into variable lethality capabilities appropriate to the mission or the threat in order to exercise dominance.

And to have the situational awareness relevant to proactive crisis management at the point of interest and an ability to link the fluidity of local knowledge to appropriate tactical and strategic decisions.

A recent article by Joseph Trevithick published on April 1, 2019, highlighted the entrance into the South China Sea of the USS Wasp.

The story lead in is as follows:

"U.S. Amphibious Assault Ship In South China Sea With Unprecedentedly Large Load of F-35Bs

The Marines are hoping to make this a more common occurrence and it could be a stepping stone to "Lighting Carriers" packed with even more F-35Bs".

From what we can see on deck, Wasp's current complement includes at least 10 F-35Bs from Marine Fighter Attack Squadron One Two One (VMFA-121), as well as four MV-22 Osprey tilt-rotors from Marine Medium Tiltrotor Squadron Two Six Eight (VMM-268) and a pair of MH-60S Sea Hawks from Helicopter Sea Combat Squadron Two Five (HSC-25).

A more typical aviation component onboard an amphibious assault ship would only have around six F-35Bs, in favor of more MV-22s, as well as a detachment of CH-53E Sea Stallion heavy lift helicopters.

This is by no means a hard rule, though, and Wasp-class ships have carried AH-1 gunships and UH-1 light armed utility helicopters at times, as well.

It's also important to mention that we don't know how many more aircraft were in the ship's hangar bay when the photos were shot.

The Marine aviation force in the Philippines right now reflects the development of high- and low-end force mixtures to respond to a variety of different crises, from a potential major conflict to a humanitarian disaster, that has been ongoing since at least 2012. How to employ the F-35B, which the Marine Corps officially said had reached initial operational capability in 2015, has been at the core component of crafting these concepts.

The key point in all of this is the economy of force linked to scalability which can enhance the forces available to deal with an adversary in a crisis, including a high-end one.

And the mix and match capabilities which can be deployed on or added to amphibious task force is why it is such a core crisis management approach.

We discussed the evolution of where the Marines and the Navy could go as the large deck amphib ship, notably in terms of a USS America, could go with regard to enhanced capabilities onboard the ship.

In a 2103 interview we did with Lt. General Schmidle, then the Deputy Commandant of Aviation, he laid out a possible path ahead:

We are looking at a sixteen-ship F-35B formation flying with a four-ship Osprey formation.

The Ospreys could fly with the Bs to provide fuel and munitions for rearming wherever the F-35Bs can land.

As you know, the F-35B can land in a wide variety of areas and as a result this gives us a very mobile strike force to operate throughout the battlespace.

This kind of flexibility will be crucial in the years ahead.

He also added: "I think that we're going to find ourselves in a situation where we, the Marine Corps, are going to be able to offer much more to the joint force in terms of capability.

Defense.Info

"And as General Hostage put it to me, Marine Corps assets will be considered an integrated part of the joint force, in a way he has not thought of it before.

"The Air Force commander will look at USMC or USN F-35s as part of his F-35 fleet from the perspective of the joint fight."

That leads us to the second news story.

With the Marines operating their F-35Bs in the Pacific and in this case off of the USS WASP, the linkage to the USAF also applies to allies flying their F-35s in the region.

What this means is that F-35 is a key asset which can lead to enhanced flexibility in deploying a scalable force to a crisis.

And it is the added advantage in that this does not simply need to be a US action.

What we have called for many years, the F-35 global enterprise, is becoming a reality as the Japanese declared their first squadron operational and regional allies are working together to deploy force in common in the region.

A recent article in Australian Defence Business Review highlighted the developing situation with regard to regional F-35 partners.

Japan has established its first operational F-35A squadron, while South Korea's first two F-35As have arrived in that country, bringing additional F-35 capabilities and operators into the region.

The Japan Air Self Defense Force (JASDF) established the 302nd Squadron, an element of its 3rd Air Wing at Misawa Air Base on Honshu on March 29. The first F-35As arrived at Misawa in January 2018, and the unit will have an eventual complement of 12 F-35As which have replaced the Mitsubishi F-4EJ-Kai Phantom in service.

"This is a major milestone for the F-35 enterprise, as it marks the first F-35 IOC for an Indo-Pacific region customer," F-35 program executive officer VAdm Mat Winter, said in a statement.

"This significant achievement is a testament to the global nature of this program, and the F-35 Joint Program Office (JPO) values the long-established bond with our Japan allies. This could not have happened without the hard work and collaboration between the F-35 JPO, the Japan F-35 program, our industry partners and the Japanese Air Self Defense Force."

Japan's first four F-35As were built by Lockheed Martin at Fort Worth, while the 302nd's remaining aircraft will be manufactured by Mitsubishi in Japan. Japan last December increased its planned order from 42 F-35As aircraft to a total of 147 aircraft, including 42 short takeoff and vertical landing (STOVL) F-35Bs to be deployed aboard its Izumo class helicopter destroyers.

And then in January, Japan announced that it would discontinue local production and instead take the increased aircraft order direct from Lockheed Martin.

In the meantime, the Republic of Korea Air Force's first two of 40 F-35As arrived in-country on March 29, flying in to Cheongju in North Chungcheong Province from the F-35 International

Training Centre at Luke AFB in Arizona where they had been involved in training Korea's first crews and maintenance personnel.

Korea's Defense Acquisition Program Administration (DAPA) said it was expecting a further eight F-35As would be delivered this year.

"We expect the deployment of the stealth fighters could enhance the Air Force's operational capabilities by strengthening military readiness posture against possible threats from all fronts," DAPA chief Wang Jung-Hong told local media.

The first ROKAF F-35A was rolled out at Lockheed Martin's Fort Worth in January 2018, and the first flight by a ROKAF pilot was conducted at Luke AFB that July. A video of the ROKAF F-35A arrival can be seen here.

Australia took delivery of its first two F-35As at RAAF Williamtown last December, and will accept a further eight aircraft this year, while the US Marine Corps has forward deployed in Japan and embarked on the LHD USS Wasp. Elsewhere in the region, Singapore indicated in January its intention to acquire the F-35.

Being able to leverage the common SA and common targeting —kinetic and non-kinetic — capabilities of these aircraft through a secure data network is a 21st century combat capability which enables the US and allied combat forces in a very different way than a legacy force.

The third news story was about a Navy decision to rethink its next generation destroyer in terms of designing the ship to take in account the unmanned vehicle dynamic.

Asked about this apparent delay in the new ship's start, Chief of Naval Operations Adm. John Richardson told USNI News that the requirement for the ship is being revisited in light of the new focus on future operating concepts that emphasize distributed, lethal – and in many cases unmanned – platforms equipped with weapons still in development.

"I've got to tell you, given the discussion that's happened already, first question that we have to do is prove to ourselves that we need a large surface combatant.

"What is the unique contribution of something like that in the face of all these emerging technologies?" Richardson said while speaking to reporters after a speech at the annual McAleese Defense Programs event.

"Right now the discussions point to the fact that it brings a unique capability in terms of house larger types of weapons, larger missiles; you certainly get more aperture on a bigger sensor; those sorts of things."

This was an expression of what the Navy has called "distributed lethality" but it is clear that a common F-35 fleet flying top cover with an ability to work with surface and subsurface ships which can leverage a mix of weapons, and unmanned vehicles will lead to a much more lethal force able to provide presence, economy of force, scalability and appropriate lethality which we have focused upon.

Rather than three different news stories, these items are part of a common theme, building out the kill web.

Defense.Info

WORKING MANNED-UNMANNED TEAMING

By Todd Miller

(2018)

In what seems like a sci-fi movie of only a few years ago, "artificial intelligence empowered, war fighting drones" teamed with manned command and control are shaping up as the path forward. The last few years have seen several manned-unmanned teaming (MUM-T) initiatives by the USAF and private industry.

On July 30, 2018 Textron Aviation Defense, LLC announced that they had demonstrated MUM-T capability on the Scorpion Jetwith Textron Systems' "Synturian®" control and collaboration technology(official Textron Press release here).

MUM-T has been discussed by for several years and we are now starting to see the progress. The assessment of "drones" as "Loyal Wingman" (Air Force Research Laboratory), and in several other roles are simply early indicators that in some form, this is going to happen.

As reported in the July 2018 Mitchell Institute Policy Paper, "Manned-Unmanned Aircraft Teaming: Taking Combat Airpower to the Next Level"the USAF has a "serious capacity gap when it comes to fulfilling mission requirements with its current inventory". Later the paper notes that "to defend its interests around the globe," America needs "a robust and varied toolkit." The paper addresses roles to be filled by unmanned aircraft, bridging the capacity gap, logistics and much more. It's an enlightening read that incidentally touches on another Scorpion benefit demonstrated in this initiative, "the value of open missions systems for rapid integration of a variety of packages."

Manned-Unmanned Aircraft Teaming: Taking Combat Airpower to the Next Level

The move towards MUM-T achieves a number of desirable outcomes; closes the capability gap positively with much lower costs than traditional systems; prioritizes unmanned systems for high threat areas; supports and empowers the information battlespace; may reduce impact of pilot shortage vs capability etc.. and more.

An interesting video of the demonstration shows the Scorpion's cockpit with display of the integration with Synturian. The demonstration utilized the Live, Virtual and Constructive (LVC) environment, with the Scorpion ***live***in the air, the unmanned aircraft systems (UAS) in the ***virtual***and the UAS sensors in the ***constructive***.

his is one more example of the transformation that is the 21stcentury battlespace; MUM-T on a Scorpion with Synturian in an LVC environment. LVC is a training methodology that is critical to train cost effectively for missions in the 21stcentury battlespace.

The ability to function as a "node" in the 21stC battlespace space is no longer optional. In LVC participants can experience multi-domain fusion warfare with simple or extraordinarily complex scenarios.

After flying the capability demonstration, Textron Aviation Defense Senior Flight Test Pilot, Brett Pierson commented; "The tactical and operational ramifications of this new capability are enormous.

"Further extending Scorpion's sensor suite and penetrating a weather layer to generate target coordinates; or creating a triangulated solution independently; or adding layers to a multi-spectral fused solution, deliver an entirely new set of tactical capabilities that have never been possible in a fighter-typed aircraft."

The capability to extend the kill web through MUM-T is a desirable capability, particularly with new stand-off munitions like the Raytheon SDB-II.

Such a combination certainly extends the mission set and capability of the Scorpion giving it the ability to execute ISR and attack missions at some distance into hostile space – from the relative safety of a more permissive airspace.

Textron extols a similar business model with the Scorpion as has been applied to the smartphone.

In which case, the Synturian System and MUM-T capability looks like a compelling "App" in the Scorpion's "App store."

UNMANNED AIR SYSTEMS AT MAWTS-1: THE TRAINING AND TPP CHALLENGE

By Robbin Laird

(2018)

There is probably no single air platform more affected by the transition from the strategic shift from counter-insurgency to the high-end fight than unmanned aerial systems.

These systems have come to the fore during counter-insurgency operations and have provided significant persistent surveillance for the ground forces.

They have grown in significance in working targeting options for air and sea strike forces as well.

But such systems are not well placed to operate in the contested air space and counter-battery fires, which would characterize force-on-force conflict with a peer competitor.

They suffer from several problems ranging from vulnerability to electronic warfare and jamming to becomes targeting drones rather than UAVs for combat aircraft, and the rapid growth in counter UAS systems associated with advancing technologies such as directed energy.

There is no easy way for the theoretical potential of remotes to be translated into combat reality until cyber security, counter EW, jamming, communications and an ability to operate against a variety of strike threats are attenuated.

There is no magic wand going to get from 2018 to the mythical ghost fleet any time soon.

During the recent WTI course, the Marines focused on generating a variety of contested operational threats, and jamming proved to be an effective means in attenuating the utility of their own UASs.

It is also the case that the smaller UASs which are very useful to provide ISR and C2 support to the ground force are not very effective in the presence of an adversary with high speed ground maneuver capabilities as well.

While at MAWTS-1, I had a chance to talk with two Marine Corps officers involved in working with the evolution of UAS capabilities in the Marine Corps.

Both officers have significant backgrounds in rotorcraft as well as in operating UAS systems, in the USMC squadrons, which operate their unmanned systems.

Defense.Info

Major Daniel "Postal" Weber and Major Donald "Grace" Kelly have worked with UAS systems for a number of years, and provided significant insights into the challenges of moving forward effectively with UAS capabilities.

One challenge facing the MAWTS-1 team is how to shape the TTPs for UASs.

The challenge is that in the absence of a significant cohort of systems it is difficult to test, and to operate UASs enough to shape standardization norms for the fleet.

As the Marines look to operate in a contested objective area, what can the UAS bring to the party?

How does it fit in with an evolving MAGTF that is looking for extended reach fires integration?

How do they work with Ospreys, Ks, and F-35s?

The focus on MAGTF integration, and now what one might call extended reach MAGTF operations puts significant pressure on shaping what an effective UAS element would look like.

The con-ops are in progress; and so is the question of how best to fit UAS systems into that evolving concepts of operations.

The Marines clearly have adopted UASs into their operations, but the best fit is in the counter insurgency effort.

To shape an effective role in the contested environment, Majors Weber and Kelly underscored a number of aspects for a way ahead.

How best to leverage other service's platforms and capabilities in the UAS area and leverage them for the USMC?

How best to leverage the Blackjack system to gain more operational experience with a class three UAS while they expand their thinking and reach into a class five UAS, which is being considered for future shipboard operations?

How best to build up a cadre of experienced personnel working with UAS systems and leverage that experience to shape a realistic way ahead?

How to handle the trade-offs between airframes and payloads? In effect, the question of which payloads that could be carried by a UAS are most useful to the Marines as they evolve their con-ops is central.

And how to best carry those payloads on an effective unmanned aircraft then becomes the focus of attention, rather than focusing primarily on the unmanned aircraft itself?

As Lt. General (Retired) Trautman put the objective:

The current Deputy Commandant for Aviation (at the time Lt. General Davis) has been very prescient in laying out a requirement for a program called MUX (MAGTF Unmanned eXpeditionary UAS) which the current aviation plan says will be ready for initial operations in the 2025 time frame.

That platform, whatever it becomes, should have the capability to take off and land from the sea base, to take off and land from an expeditionary operating location ashore and deliver long

range relatively high speed service to the fleet so that you can use that range and speed to your advantage.

It should also come in with adequate power and non-proprietary "hooks" so that future users can employ whatever payloads make the best sense for the force as it evolves.

This is a very exciting time for the development of unmanned systems in support of the amphibious task force and the Marine Corps.

https://sldinfo.com/2017/05/the-role-of-unmanned-aerial-systems-in-the-remaking-of-the-amphibious-task-force-the-perspective-of-lt-general-retired-trautman/

This target goal for a Marine Corps going into contested areas is a work in progress.

What Majors Weber and Kelly are suggesting is that to get to that goal will require building a cadre of operators engaged in the evolution of current capabilities to be able to leverage that experience and help shape the desired goal, which is a class five UAS able to operate off a ship and to contribute to an extended reach MAGTF.

Given that MAWTS-1 is working closely with VMX-1 in shaping a way ahead for the MAGTF as the new technologies such as G/ATOR and F-35 are leveraged to shape an extended fires capability, clearly VMX-1 and MAWTS-1 are key players in help work the challenge and the opportunity for a new class of UAS to work with the future MAGTF.

But it must be done with a close eye to the core challenges which UASs pose as well, such as survivability, payload useability, and vulnerability to electronic warfare threats.

THE COMING OF UNMANNED VESSELS TO MARITIME WARFARE: OR ARE THEY WEAPONS?

By Robbin Laird

(2020)

The work of Robert Sparrow, an Australian analyst, has raised key questions about the implications of the coming of the various types of unmanned systems to the warfare domain for the rules of war, or the ethical implications of their use.

Are they vessels and thus governed by current maritime conventions or are they weapons and to be treated differently from the current maritime conventions governing vessels?

In a piece which he coauthored with George Lucas, an American analyst, they posed a number of key questions which they believe are raised by the applications of autonomous UUVs and USVs:

Should armed autonomous UUVs and USVs be understood (as the comparatively modest body of legal literature to date has posed the problem) as "vessels" or as "weapons"?

With what sorts of operations might autonomous UUVs and USVs legitimately be tasked in international, as opposed to territorial, waters?

Is the operation of armed autonomous systems compatible with freedom of navigation in international waters?

Defense.Info

What is the capacity of future maritime and underwater autonomous systems, when weaponized, to abide by the requirements of distinction and proportionality in naval warfare?

What are the implications, with regard to the design and the ethics of the use of autonomous UUVs and USVs, of customary maritime duties, e.g., toward persons lost at sea?

"What seems clear to both authors, despite specific differences, is that much more work remains to be done to resolve the question whether—or per- haps which—UUVs and USVs should be conceptualized as vessels or weapons, and to settle the role that should be accorded to legal conventions and historical debates about mine warfare in shaping future practice regarding UUVs.

The fact that such systems blur the lines between weapons platforms and weapons means that ethical as well as legal frameworks may need to be rethought and refined in the pursuit of an appropriate balance between the demands of military necessity and humanitarian concerns in the naval warfare of the future."

They raise these questions notably with regard to the search and rescue mission. Certainly, UUVs and USVs could add situational awareness to situations in which search and rescue are required as a result of armed conflict, but is more required than SA?

The question of the potential role and responsibilities of naval autonomous systems for search and rescue is explicitly pursued in an article which Sparrow then wrote with Rob McLaughlin and Mark Howard. They argued that given that search and rescue will clearly be a key element resulting from maritime conflict, there is a need to ensure that maritime remotes should be configured to be able to execute this mission.

According to the authors: "The designers of early UUVs and USVs should provide these systems with this capacity and publicize the fact that they have done so. In order to motivate this policy, we would strongly encourage those who are responsible for the design of these systems to imagine that they might be fighting alongside them – or might at least have to go to sea during wartime – and thus might one day find themselves in need of rescue."

In my view, I am persuaded that the information generated by maritime remotes clearly is part of the ISR and C2 environment which is being built out for the evolving fleet structure. And such data can be put to use across the spectrum of operations, including search and rescue.

I am not sure that envisaging USVs to be able to be designed to do search and rescue is likely unless one is considering engaging the logistical support capabilities which clearly will be built in the future to support amphibious operations.

But these systems are very likely to operate with manned systems in a mesh network but considering how this capability might be tasked for search and rescue makes a good deal of sense to me.

USMC AND UNMANNED SYSTEMS FOR SUSTAINMENT

By Paul McLeary

(2019)

The Marines are testing unmanned platforms to quickly refuel and rearm F-35Bs it plans to operate out of remote, austere bases in the Pacific — part of an effort to be more nimble, and unpredictable, as the traditional American dominance at sea and in the air erodes.

For years, the Corps has talked about flying its F-35Bs from hastily assembled bases on small islands and remote locations to avoid sophisticated surface-to-air missiles being developed by China and Russia. The basing effort would not only keep the stealthy planes tactically unpredictable, but also untether them from big deck ships that would be prime targets for hypersonic cruise missiles and other weapons in any future fight with an advanced enemy. This was a key driver behind the Marines deep commitment to the F-35B, which can do short takeoffs and vertical landings, as well as the rare vertical takeoff from a road or other flat surface.

One of the holdups to the plan has always been how to ensure the planes could get fuel, ammunition and parts out to these locations. "If I can't sustain it, I'm hosed," Maj. Gen. Mark Wise, deputy commander of Marine Corps Combat Development Command told a handful of reporters at the Pentagon on Thursday.

Getting more fuel and ammo for those planes, quickly, would allow the Marines to "turn up the battlefield tempo at a much faster rate," he said, which is critical in an area swarming with manned and unmanned platforms looking for American planes sitting on the ground for too long.

That's where the Advanced Naval Technology Exercise, (ANTX) comes in.

The July event at Camp Lejeune brought together dozens of companies and academics to show off technologies focused on autonomy, command and control, communications, and unmanned systems and logistics for the Marines and the Navy. All told, there were 53 different systems that were put into the hands of sailors and Marines to evaluate.

The ANTX, one of several planned this year, laid out several unmanned options that can be developed and pushed out to the field in a relatively short period of time, Wise said, which would "enable the movement of that very heavy gear very quickly. I don't have to commit somebody to it."

The ANTX efforts aren't for technologies already in the acquisition pipeline, but focus on gear the Navy and Marine Corps want to kick around to see what might be useful in the future.

"Anybody that brought equipment there got assessments from many of the folks who were there," said James Geurts, the Navy's research and acquisition chief. The makers can then take that feedback and circle back around to their new military contacts for another bite at the apple. But the big takeaway from the Navy and Marine Corps side was that they now have a better idea of everything they don't know. "We got exposure to cutting-edge stuff that we may not have known we had a requirement for until we saw it," Geurts added.

The goal, like so much else at the Pentagon these days, is speed, Geurts said he wants to make decisions on whether or not to begin developing — and buying — some of this new kit within 12 to 18 months "If there's things that have demonstrated value in the field with some minimal amount of development that we can begin to turn those around and put contracts in place," he said.

Geurts was excited about the new "combinations of autonomous systems" he saw at Lejeune.

"What was remarkable to me was seeing autonomy in all those different operating environments starting to play together. And we can start to piece together operating concepts that may be closer to [being available to] us than we had originally conceived."

He declined to get into specifics, but Wise said he's interested in taking a harder look at "some of the seaborne platforms and the autonomous capability with weapon systems," which he called "fairly impressive at what they could do."

Defense.Info

This article was published by ***Breaking Defense*** on August 2, 2019.

UNMANNED SURFACE VEHICLES IN SUPPORT OF THE SUSTAINMENT MISSION

By George Galorisi

(2019)

While logistics isn't a topic that typically evokes deep passion, it should be.

Almost four decades ago, General Robert Barrow, USMC, Commandant of the United States Marine Corps, coined a phrase that is still a staple of U.S. War College curricula, "Amateurs talk about tactics, but professionals study logistics."

More recently,at the 2019 USNI/AFCEA "West" symposium, Brigadier General Arthur Pasagian, USMC, Commander, Marine Corps Systems Command, noted, "Logistics is a key enabler for all we do."

Second Line of Defense has featured a number of articles focused on logistics and the supply chain.

The majority of these have focused on "big picture" logistics issues, for example, Robbin Laird's, "The US Logistics Systems: The Challenge of a Strategic Reset."

Second Line of Defense has also featured articles about expeditionary operations, especially those conducted by the U.S. Navy-Marine Corps team, such as, "Presence, Economy of Force and Scalability: The New Amphibious Task Force."

The Navy-Marine Corps team has been proactive in pushing the edge of the envelope in leveraging new technologies to make the nation's expeditionary assault force more distributed, lethal, survivable and sustainable.

Many of these technologies have aided high-end and highly visible missions, but others have looked at missions conducted by the Navy-Marine Corps team that are typically "below the radar."

Given the importance of logistics to the success of any amphibious assault, the sustainability function is one that is ripe for new technology insertion.

To be clear, the U.S. Navy and Marine Corps don't have a monopoly on leveraging new technology to support the logistics function.

Readers of ***Second Line of Defense*** are likely well-versed in terms such as "dumb, dirty and dangerous work" referring to military operations that put warfighters at risk and that are well suited to have unmanned vehicles perform.

The U.S. Army – having suffered significant human loses in fuel convoys in the Middle East conflicts – is leading the way in this area, experimenting with unmanned fuel trucks to perform this vital logistics task.

Enhancing Expeditionary Logistics with Emerging Technology

Navy-Marine Corps exercises such as a series of Advanced Naval Technology Exercise (ANTX) events and the annualBold Alligator series have looked at a wide-range of emerging technologies that can make

expeditionary assault forces more lethal, agile and survivable. Other events have examined different missions conducted by the Navy-Marine Corps team, specifically the logistics and sustainment function.

One doesn't need to be a Clausewitz or Sun Tzu to understand the importance of logistics to warfare over many millennia. For the Navy-Marine Corps team, this plays out most prominently during an amphibious assault. The INDOPACOM Joint Exercise Valiant Shield exercise, overseen by Commander Marine Forces Pacific (MARFORPAC) and conducted on the Marianas Island Range Complex, experimented with using emerging technology to provide sustainment to Marines on the beachhead during this critical juncture of an amphibious assault.

Marines in the fight use enormous quantities of fuel, food, ammunition and other material as they attempt to move off the beachhead. If my three tours in command positions with the amphibious assault Navy taught me anything, it is that while many functions are important in an amphibious operation, once the assault is underway and Marines are on the beach, sustainment is crucial in ensuring their success. The mission will ultimately fail if the Marines are not able to have reliable and continuous sustainment.

Using manned naval craft for this sustainment mission puts operators at unnecessary risk of enemy fire, as well from near-shore obstacles that were not cleared prior to the assault phase. Using scarce manned craft to perform this mission also takes them away from more necessary roles. That is why this major Navy-Marine Corps amphibious exercise evaluated the ability of unmanned surface vehicles to conduct this sustainment mission.

MARFORPAC used USVs during Valiant Shield 2018 to resupply the landing force. The exercise coordinator used a catamaran hull, 12-foot MANTAS USV to provide rapid ship-to-shore logistics sustainment. While this small, autonomously operated, USV carried only one hundred and twenty pounds of cargo, the proof-of-concept worked and demonstrated that unmanned surface vehicles could effectively resupply troops ashore.

Using unmanned vehicles for the sustainment mission can be a game-changer for expeditionary assault forces. Beyond taking operators out of harm's way, using USVs in this role frees manned craft for other missions. Additionally, having a continuous, preprogrammed, logistics resupply process to perform one of the dull, dirty and dangerous functions important in an amphibious assault means that there is one less thing for the commander to have to manage during these operations.

This proof-of-concept with a 12-foot MANTAS USV achieved positive results. That said, resupply in 120-pound increments is far less than is required to provide what is needed by the Marines on the beach. The Valiant Shield exercise provided the impetus and inspiration to continue to explore the use of USVs for amphibious force sustainment. Now, the Navy and Marine Corps are looking to "scale-up" small USVs and continue to experiment with using larger USVs to provide larger sustainment quantities.

"Scaling-Up" to Deliver Logistics Sustainment

To undertake this scaling-up effort, the maker of the MANTAS family of USVs (Maritime Tactical Systems, Inc.) was asked by the Navy and Marine Corps to develop a larger proof-of-concept unmanned surface vehicle for this logistics sustainment mission using the same catamaran hull design as the smaller vessel used in Valiant Shield.

Plans for larger MANTAS unmanned surface vehicles ranging from 38-foot to 50-foot long are on the drawing board for further review by Navy and Marine Corps officials. While this may not be the ultimate size for the USV the expeditionary assault force needs as a long-term solution, it will go a long way to advancing the state of the art in unmanned semi-autonomous or autonomous logistics support.

Defense.Info

While there are a range of larger USVs that can be evaluated by the Navy and Marine Corps, the basic specifications of the 38-foot MANTAS (T38) will provide an indication of the ability of USVs to provide a steady, continuous stream of logistics support to Marines on the beach. The T38 can carry a payload up to 4,500 pounds. The vessel travels at cruise speed of 25 knots and draws just 18 inches of draft. Additionally – and importantly for an amphibious assault – the T38 has a burst speed of 80 knots. Given the speed and carrying capacity of the T38-sized USV, it is readily apparent on how it can fulfill this, and other important logistics functions.

Delivering Logistics Sustainment to Troops Ashore

As any observer can see from a hilltop near one of several U.S. Marine Corps bases, an amphibious formation typically stands no more than 15-25 nautical miles off the beach being assaulted. Using a notional stand-off distance of 20 nautical miles, an amphibious formation equipped with four T38s traveling at their cruise speed of 25 knots could deliver 18,000 pounds of material from the amphibious ships to the beach per hour, allowing the short time needed for loading and unloading the craft. Multiply that by twenty-four hours and you get a buildup of well-over 400,000 pounds of vital material per day, enough to support a substantial force of troops ashore.

During the 2019 SNA Symposium, NAVSEA's Program Manager for Unmanned Maritime Systems (PMS-406), Captain Peter Small, explained the attributes most desired in maritime unmanned systems: (1) endurance; (2) autonomy and precision navigation; (3) command, control and communications; (4) payloads and sensors; and (5) platform integration. As the Navy continues to explore new missions – to include this vital logistics sustainment function – for unmanned surface vehicles, these qualities will help the Navy choose the optimal USVs that will provide our warfighters with a decisive edge in combat.

The Navy is planning an ambitious array of exercises in the years ahead: several ANTXs, Sea Dragon, RIMPAC 2020, Bold Alligator, Valiant Shield, Valiant Blitz, Large Scale Exercise 2020, and others. Based on the promising performance of small unmanned surface vessels in support of expeditionaryassault forces, the Navy and Marine Corps would be well-served to experiment further with larger USVs to perform this vital logistics sustainment mission.

Over 2,500 years ago, Sun Tzu noted, "The line between disorder and order lies in logistics." Those nations and navies with significant amphibious assault forces would be well served to leverage what the U.S. Navy and Marine Corps have already demonstrated in exercises such as Valiant Shield and explore the advantages of using unmanned surface vehicles to rapidly, reliably and continuously resupply troops ashore.

THE ROLE OF UNMANNED AERIAL SYSTEMS IN THE REMAKING OF THE AMPHIBIOUS TASK FORCE: THE PERSPECTIVE OF LT. GENERAL (RETIRED) TRAUTMAN

By Robbin Laird

(2017)

President Trump has come to power at a time when a very flexible force able to insert from the sea and rapidly return to the sea has emerged.

This USN-USMC capability has migrated beyond the classic Amphibious Ready Group-Marine Expeditionary Unit (ARG-MEU) into a very flexible and lethal amphibious task force.

The evolving Marine Corps aviation assets, coupled with the reshaping of Marine Corps concepts of operations for conducting force insertion from the sea, are shaping a new capability and within that capability unmanned aerial assets are playing a key role.

One of the key architects of the Marine aviation revolution has been Lt. General (Retired) Trautman.

During his tenure as Deputy Commandant for Aviation, the Osprey began its first deployments to the Middle East, the H-1 Venom and Viper were introduced to the Fleet and the F-35B was coming to its initial fruition.

With the continued development of the CH-53E into the K and the addition of unmanned aviation, the mix of flying assets that would work with the Ground Combat Element to shape new MEU capabilities was put into motion.

I had a chance recently to talk with Lt. General (Retired) Trautman about the unmanned element and its role in the evolving way ahead for Marine Corps transformation.

Question: The UAVs going on ships now really had their origin in the land wars.

How did the process get started?

Lt. General (Retired) Trautman: It goes back to the time General Jim Conway was in Iraq with the 1st Marine Expeditionary Force and he found a little company that was making the Scan Eagle UAV.

Believe it or not, the Scan Eagle was being used for the Albacore fishing fleets up in the Pacific Northwest at the time.

In other words, Scan Eagle has a shipboard legacy already built right into it.

But, the Marines evolved the Scan Eagle principally as an asset for land based operations in Afghanistan and Iraq.

And, in recent years with the focus placed on returning to the sea it became obvious that a similar capability on board our amphibious task force would be quite useful.

That is what led us to make the selection of the RQ-21 Blackjack which is now deploying on our Marine Expeditionary Units and by all accounts it is doing quite well so far.

Question: It is very challenging to operate unmanned air systems onboard ships and could you discuss those challenges?

Lt. General (Retired) Trautman: Many people who have not spent a lot of time at sea really don't grasp the inherent challenges that you have when you launch and recover from a sea base.

The Marines over the years, along with their partners in the US Navy, have built an aviation force that's quite credible from the sea. F-35Bs, MV-22s, H-1s and the evolving CH-53K all come into the force at a very important time as our nation evolves into a better understanding of the value and proper use of the amphibious task force.

In parallel with those developments, we must figure out how to take advantage of unmanned aerial systems.

As we do that operationally, we at the same time have to experiment and learn and use systems from the sea in ways that cause us to understand what new systems we should procure in the coming decade as well.

Defense.Info

In other words, the foundation for the future is being built with our experience on board our amphibious ships today as the new aviation assets marry up with the unmanned systems onboard our ships.

Question: And having the UASs onboard allows the Marine Corps commanders to sort out how best to use those assets in operations as well. How might they do that?

Lt. General (Retired) Trautman: If I'm a task force commander and I'm deployed somewhere around the globe, I want to be prepared to conduct operations at a moment's notice when the mission dictates.

I also want to have the flexibility to conduct all of my sorties from the sea or if necessary transition to an expeditionary land base for short duration operations that make an impact on the enemy before quickly returning to sea.

I want unmanned aerial systems that enable me to do whatever I need to do in order to accomplish the mission.

That means I need range, speed, endurance, the ability to take off and land vertically, a wide range of payloads, non-proprietary payload "hooks," and the best Size, Weight and Power (SWAP) advantage I can attain.

To do that, you have to think long and hard about the types of capabilities that you wish to procure.

Whether it's classic UAS capabilities like intelligence surveillance and reconnaissance, the delivery of precision weapons, or electronic warfare, there are a whole host of missions that unmanned systems can do with the right payloads.

The key is to have those systems with me, use them and determine how to get the most effective use from them in the widely varied operations that an amphibious task force will pursue.

Question: When you were DCA you worked the decision to sunset the Prowler electronic warfare aircraft.

That clearly has an impact on the payloads which you want to have on a UAS as well?

Lt. General (Retired) Trautman: It does.

We made the decision in 2009 to sunset the Prowler a decade out in 2019.

We did that with our eyes wide open knowing that the F-35B would be coming into the force in a more robust way by that time.

There are inherent electronic warfare capabilities resident in the F-35 but our vision also included the need for unmanned aerial systems to proliferate in the battle space to round out the electronic warfare requirements that the force will have.

We're in our infancy right now in developing those capabilities, but the first step in achieving something is to get started, and to put the capabilities in the hands of young men and women who are in the force and then evolve the capability in a way that makes sense.

I'm confident that we are on that trajectory with our unmanned aerial systems and the payloads that we will develop for those systems in the next few years.

Question: And the experience being gained now and in the next decade will clearly shape the way ahead not only for the amphibious task force but for the unmanned element. In other words, the approach is to experiment by operational use.

What happens next?

Lt. General (Retired) Trautman: The current Deputy Commandant for Aviation has been very prescient in laying out a requirement for a program called MUX (MAGTF Unmanned eXpeditionary UAS) which the current aviation plan says will be ready for initial operations in the 2025 time frame.

That platform, whatever it becomes, should have the capability to take off and land from the sea base, to take off and land from an expeditionary operating location ashore and deliver long range relatively high speed service to the fleet so that you can use that range and speed to your advantage.

It should also come in with adequate power and non-proprietary "hooks" so that future users can employ whatever payloads make the best sense for the force as it evolves.