THE REQUIREMENT FOR A DEDICATED UNCREWED SYSTEMS ESTABLISHMENT IN THE ROYAL CANADIAN NAVY

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NOTHING UNCREWED ABOUT UNCREWED SYSTEMS: THE REQUIREMENT FOR A DEDICATED UNCREWED SYSTEMS ESTABLISHMENT IN THE ROYAL CANADIAN NAVY

INTRODUCTION

In February 2022 Russia began a full-scale invasion of Ukraine in which they were anticipated to prevail in a matter of days. The resilience and ingenuity of the Ukrainian people however, has led to a protracted conflict in which Uncrewed Aerial Systems (UAS) have been employed in the maritime, land, and air environments to great effect. The rapid adoption and adaption of various technologies have provided Ukraine with a means of conducting asymmetric warfare, allowing low cost systems which do not directly expose their operators to the potential of harm, to attack Russian targets ranging from missile systems to individual soldiers. In the maritime environment, Uncrewed Aerial Vehicles (UAVs) have been employed to surveil and attack Russian ships, constraining the Russian Navy's freedom of maneouvre, and may even have been employed in the sinking of the former Black Sea Flagship, *Moskva*.[1] Additionally, in a world first Ukraine employed Uncrewed Surface Vehicles (USV) to attack Russian ships in port in Sevastopol, damaging at least one.[2] With these actions, the era of uncrewed systems employed in maritime combat operations has commenced.

The Royal Canadian Navy (RCN) recognized the potential operational benefits of operating UAS in the early 2000s and began to acquire UAS with the goal of employing them from His Majesty's Canadian (HMC) ships. These early forays into employing UAS had two objectives, tactical employment of UAS in conducting over the horizon (OTH) Intelligence, Surveillance, and Reconnaissance (ISR), and learning how to operate UAS in the maritime environment from HMC ships.

From 2012 to 2014 the Boeing Insitu Scan Eagle was employed from Halifax-Class frigates and contributed to narcotics shipment interdictions in the Arabian Gulf region.[3] A key lesson learned from the employment of this system was that in vessels the size of the Halifax-class, the large launch catapult and landing net systems employed in support of Scan Eagle operations were difficult to move from the flight deck, so were not ideally suited for ships wishing to concurrently employ crewed and uncrewed systems in an agile fashion.[4] The RCN's next UAS employed from HMC Ships was the Aerovironment Puma beginning in 2019. The Puma, which continues to be employed in an ISR capacity from Kingston-class vessels, was intended to provide OTH ISR. It also provided the capability of being hand launched and recovered via a water landing. While

[1] Schmidt, 'Innovation Power: Why Technology Will Define the Future of Geopolitics' Foreign Affairs 102, March/April 2023, 43. Wu, 'Ukraine Used Drones to Distract Russian Warship Moskva before Missiles Were Fired as Moscow Confirms Vessel Sunk' Accessed 4 April 2023, https://www.skynews.com.au/world-news/ukraine-used-drones-to-distract-russian-warship-moskva-before-missiles-were-fired-as-moscow-confirms-vessel-sunk/news-story/7e513fd23d2d265efb7f0194a0453f46.
[2] Bachega, '"Massive" Drone Attack on Black Sea Fleet - Russia', accessed 4 April 2023, last modified 29 October, 2022, https://www.bbc.com/news/world-europe-63437212 .
[3] Lookout, 'Navy Experiments with UAVs', accessed 4 April 2023, https://www.lookoutnewspaper.com/navy-experiments-uavs/.
[4] DNR 2-2, Teams discussion with author, January 24, 2023.

the lack of launch and recovery apparatus allow for agile deployment of the system, the water recovery method results in the ship having to break-away from any ships it may be surveilling or interacting with to recover the Puma and has resulted in water damage to the avionics systems in the UAV. An additional challenge identified when operating from a platform without an air search radar, such as the Kingston-class, was that to operate within the CAF flight safety regimes the Puma had to be operated within line of sight of the controller, rendering their OTH ISR capability limited.

The RCN's next UAS will be selected by the RCN Intelligence, Surveillance, Targeting and Reconnaissance (ISTAR) program, which is currently in the implementation phase, and is expected to commence delivery in 2024. Employing vertical take-off and landing (VTOL) from the Halifax-class, it should prove more capable and more flexible than previous RCN UAS while providing OTH ISTAR capability to the ships.

The challenge for the RCN is that in over a decade of UAS operation, only two systems have been operationally employed from HMC Ships. The RCN has learned lessons in terms of tactical employment of UAS in ships which were not designed with UAS employment in mind, and has gained experience in satisfying the requirements of the CAF Airworthiness Program but, and as will be demonstrated, not to the extent required to effectively implement the UAS program. To more effectively implement UAS in the RCN, a long-term plan for integration within contemporary and future RCN platforms must be created, an Officer of Primary interest, or Uncrewed Systems champion, must be designated, and a dedicated uncrewed system establishment must be staffed. In beginning to conceptualize the challenges faced by the RCN in integrating UAS within the fleet, a select analysis of our allies' efforts to do so will be conducted.

ALLIED UNCREWED SYSTEMS EFFORTS

United States of America

Spurred by the renewal of Great Power competition, The United States Navy (USN) is taking bold steps to field and integrate uncrewed systems within their overarching concepts of Distributed Maritime Operations (DMO) and Littoral Operations in a Contested Environment (LOCE).[5] The USN Unmanned Campaign Framework, issued in March, 2021, outlines the USN's overarching concepts for the doctrine, organization, training, materiel solutions, leadership and education, personnel, facilities and policy construct.[6] Chief of Naval Operations, Admiral Gilday, notes the USN is pursuing, "… a range of unmanned aerial vehicles (UAV), unmanned undersea vehicles (UUV), and unmanned surface vessels (USV) that will play key roles as we shift our focus toward smaller platforms that operate in a more dispersed manner."[7] This statement highlights the total integration of uncrewed systems envisioned by the USN within their force structure as an enabling mechanism, vice a simple combat system or tool.

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[5] 'Department of the Navy Unmanned Campaign Framework', 5.
[6] Department of the Navy, 'Department of the Navy Unmanned Campaign Framework', 1.
[7] 'Department of the Navy Unmanned Campaign Framework', 2.

While the USN currently fields a number of UAS, including the MQ-25A Stingray aerial refueller, the MQ-8C Firescout ISTAR platform, and smaller airframes such as the Puma and Scan Eagle, the Northrop Gruman X-47B UAV experimentation program exemplifies their holistic approach to the implementation of UAS.[8] In the early 2010s, the USN embarked on ambitious experimentation program with the X-47B. The program achieved several world firsts including the first catapult launch and arrestor recovery of a UAV from an aircraft carrier, as well as the first carrier based uncrewed/crewed flight.[9] Building on the success of the X47-B program, the MQ-25A was selected for further development and subsequently completed its first aerial refueling of a F/A-18 Superhornet on 4 June, 2021. To date, the MQ-25A has completed deck handling tests on the USS *George H.W. Bush* in preparation for further integration with carrier based logistics wings.[10] To support continued integration of the MQ-25A the USN has stood up the Unmanned Carrier-Launched Multi-Role Squadron (VUQ) 10, and will stand up two additional squadrons VUQ 11 and 12.[11] Capt. Chad Reed, program manager for the Navy's Unmanned Carrier Aviation Program highlights the USN's goal of developing the MQ-25A, "…an unmanned aircraft that frees our strike fighters from the tanker role, and provides the carrier air wing with greater range, flexibility and capability."[12] The USN's approach of conceptualizing an aim, experimenting to provide the best system to meet that aim, and then providing a fulsome organization to implement the capability stands as an example of how to act as a world leader in UAS implementation.

United Kingdom

The Royal Navy (RN) takes its strategic underpinnings for UAS operations from Joint Doctrine Publication (JDP) 0-30.2, Unmanned Aircraft Systems Change 1, published in 2017. The intent of the JDP is to establish the guidance for employment of UAS at the operational level, noting that each of the services will employ various systems to meet their operational requirements.[13] The doctrine pulls from uncrewed systems experience gained in both Afghanistan and Iraq, while also seeking to leverage the

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[8] 'Department of the Navy Unmanned Campaign Framework'.
[9] 'Carrier-Based Drone Makes History, Flies with Manned Aircraft', accessed 11 April, 2023, https://www.govtech.com/em/emergency-blogs/disaster-zone/carrier-based-drone-flies-manned-aircraft.html#:~:text=In%20tests%20aboard%20the%20Norfolk,allowing%20the%20Hornet%20to%20land. ; 'X-47B Unmanned Fighter Drone Lands on Carrier; Ushers in New Era of Unmanned Carrier Aviation' accessed 11 April, 2023, https://www.militaryaerospace.com/unmanned/article/16715856/x47b-unmanned-fighter-drone-lands-on-carrier-ushers-in-new-era-of-unmanned-carrier-aviation.
[10] Haynes, 'Fueling the Future', accessed 4 April, 2023, https://www.navy.mil/Press-Office/News-Stories/Article/2647709/fueling-the-future-mq-25-first-to-conduct-unmanned-aerial-tanking/. Naval Air Systems Command, 'Navy Completes Initial Carrier Demo for MQ-25 Program', accessed 11 April, 2023, https://www.navy.mil/Press-Office/News-Stories/Article/2879506/navy-completes-initial-carrier-demo-for-mq-25-program/.
[11] 'MQ-25 Achieves Another First, Conducts Air-to-Air Refueling with E-2D', last modified 20 Aug, 2021, https://www.navy.mil/Press-Office/Press-Releases/display-pressreleases/Article/2738228/mq-25-achieves-another-first-conducts-air-to-air-refueling-with-e-2d/.
[12] Haynes, 'Fueling the Future'.
[13] Ministry of Defence, 'Joint Doctrine Publication 0-30 UK Air and Space Power', 2.

lessons learned from crewed aircraft operations which remain applicable to the employment of UAS.

The RN embarked in UAS implementation in the early 2010s as small remotely piloted systems began to enter the market. To aid in the integration and operation of UAS, the RN stood up the 700X Squadron, the X standing for experimental, with dedicated personnel to manage the various components of UAS such as operations, training, and experimentation. The squadron is currently Commanded by a Lieutenant-Commander Engineer, and is staffed with 49 dedicated operators, maintainers, and force development personnel from both the RN and the Royal Marines.[14] Neither the RN or Royal Marines currently have a dedicated UAS operator or maintainer trade. Inherent to the squadron by virtue of its dedicated personnel is a robust flight safety program and appreciation of flight safety culture, rules, and regulations, which are very similar to those adhered to in the CAF. Additionally, a bottom up innovation approach is encouraged, exemplified by the fact that squadron personnel are able to use their expertise gained on operations to implement new solutions, such as by building small testbed UAS which are used to test new UAS payloads at low cost.[15]

Similar to the RCN, the RN's first forays into UAS involved the purchase and operation of Scan Eagle, 2014-2017, and the Puma system which is currently in operation in their fleet. Puma has been employed both from RN ships, as well as from landing craft during Royal Marine amphibious operations, providing ISR of enemy positions ashore.[16] The Schiebel S-100 Camcopter has also been purchased and is expected to be integrated into the Type-23 Frigate HMS *Lancaster* in 2024 for operations in the Persian Gulf. The S-100 will provide OTH ISR as well as a tactical data link feed to the mothership, a capability not currently provided by the ship's organic helicopter, as well as providing a communications relay capability.[17] Conceptually, the RN varies little in what they want to achieve with their UAS program as compared to the RCN, namely, to expand the ISR coverage around the ship at lower cost and risk to personnel than a crewed helicopter can provide. They vary primarily in having more robust UAS doctrine and via the employment of a UAS squadron with dedicated personnel. Given the similarities in capabilities sought and Fleet culture, there is significant opportunity for the RCN to leverage the RN for lessons learned and areas of future cooperation.

Australia

Following the Australian Prime Minister's announcement of the Defence Strategic update in July of 2020, the Australian Defence Force (ADF) entered a period of realignment to address the shifting balance of power within their area of operations. The Royal Australian Navy (RAN) has since released several guiding documents outlining the

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[14] Commanding Officer 700X Squadron, Teams discussion with the Author, 23 March, 2023.
[15] Royal Navy ,'700X Naval Air Squadron', accessed 22 March, 2023, https://www.royalnavy.mod.uk/our-organisation/the-fighting-arms/fleet-air-arm/support-and-training/700x-naval-air-squadron.
[16] Commanding Officer 700X Squadron, Teams discussion with the Author.
[17] Navy Lookout, 'Peregrine Rotary Wing UAV to Enter Service with the Royal Navy', last modified 10 February, 2023, https://www.navylookout.com/peregrine-rotary-wing-uav-to-enter-service-with-the-royal-navy/ .

long-term vision for Robotics, Autonomous Systems, and Artificial Intelligence (RAS-AI). The RAN's RAS-AI Strategy 2040 provides the strategic context for the adoption of RAS-AI in the contemporary operating environment, provides guidance on what systems can and cannot do in the maritime environment, and sets out four lines of effort encompassing personnel and training, research and development, and developing partnerships with industry and allies.[18] Subordinate to RAS-AI 2040, the Maritime Tactical Unmanned System Operation Concept Document (SEA 129-5) spells out in detail the tactical level justification for the use of UAS in RAN ships, defines the purpose of the RAN UAS program, conceptualizes the uses of UAS within the RAN, and outlines a four phase approach for implementation of the RAN UAS program.[19] Both documents are UAV-platform agnostic, providing the conceptual framework for the capabilities UAS can provide and how the RAN will implement systems to enable those capabilities as a force multiplier for the crewed fleet.

The RAN established the Navy Unmanned Aircraft Systems Development Unit (NUASDU) in 2012 and tasked it with experimenting, validating, and scoping the tasks to be performed for the RAN by UAS.[20] Initially consisting of 13 personnel to support two Scan Eagle flights, the NUASDU was formally stood up as the 822X Squadron and expanded to 32 personnel as of 2018 to support the deployment of one Scan Eagle system and to support integration work for the S-100.[21] RAN commissioned workforce studies have indicated that a workforce of between 140 and 180 personnel will be required to support 12 deployed "bricks" while the RAN strategic guidance has indicated up to 110 personnel will be available to support.[22]

SEA 129-5 states that the purpose of tactical UAS are to, "provide a cost effective, persistent and enduring ISR&T capability in the maritime environment, communications relay… and geospatial data collection; while reducing the threat exposure of platforms and personnel."[23] The aforementioned Scan Eagle and S-100 have been identified as the current platform solutions to enable this capability requirement. In May, 2023, the ADF selected the S-100 as the UAS for block one of a three block purchase at a cost of 1.3 billion Australian Dollars to acquire an unconfirmed amount of 40 UAVs.[24] This purchase represents a significant investment, not just in dollars, but in the platform itself as one can anticipate a large amount of research and development, as well as operational experience, will be garnered from the system. To benefit from the fast pace of technological advancements in UAS, the RAN intends a five-year rolling block upgrade program to inject new technology into the system.

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[18] Royal Australian Navy, 'RAS-AI Strategy 2040', 3.
[19] Royal Australian Navy, 'SEA129-5: Maritime Tactical Unmanned Aerial System Operational Concept Document'.
[20] Royal Australian Navy, 'SEA129-5'.
[21] Navy, '822X Squadron', accessed 23 March, 2023, https://www.navy.gov.au/about/organisation/fleet-air-arm/822x-squadron.
[22] Royal Australian Navy, 'SEA129-5', 68.
[23] Royal Australian Navy, 'SEA129-5', 68.
[24] Janes, 'Schiebel S-100 UAV Selected for Australian Navy Requirement', accessed 12 April, 2023, https://www.janes.com/defence-news/news-detail/schiebel-s-100-uav-selected-for-australian-navy-requirement.

There are common threads one can identify by considering allied efforts in UAS programs. They all have detailed strategic guidance on their force's overall concepts and designs for the implementation of UAS, they all have offices and stakeholders of interest identified through their organizations, and they have all allocated dedicated personnel assigned for the development and implementation of their programs. These common threads, which the RCN currently lacks or is only now beginning to invest in, are the cornerstones of an effective and timely implementation of UAS within a fleet.

INTEGRATION AND LONG-TERM GOALS

As described above, UAS have been in operational use with the RCN and allied navies for over a decade. The fact that our navies employ common systems is no coincidence, but rather a reflection of the limited state of the UAV market for proven systems which can operate from warships. As the maritime UAS market matures and diversifies, the RCN has the opportunity to take a long-term outlook to identify existing capability gaps which can be filled by UAS. To enable this capability driven outlook, one must consider what capabilities are best provided by UAS, vice crewed systems. Acknowledging that artificial intelligence is often mentioned in the same breath as remote and autonomous systems, artificial intelligence will not be addressed in this paper given the scope of legal, regulatory, and ethical considerations which would need to be considered.

UAS offer a broad array of payloads and capabilities at first glance but, as with any defence procurement, a value proposition must be made that justifies the fiscal expenditure and level of effort required to integrate and operate the system. Additionally, weight, power, and endurance considerations are an even greater concern in UAS as compared to crewed aircraft, given that a relatively low increase in weight or power requirements can significantly reduce the aircraft's endurance. Generally speaking, UAS are best employed to conduct, "boring, dirty, and dangerous missions", which are missions which would be too long or labour intensive for a pilot, take place in vicinity of chemical, nuclear, or biological threats, or when in the presence of enemy air defences.[25] The Chief of Naval Operations for the USN explains in the USN's Unmanned Campaign Framework that UAS can contribute to their concept of DMO by providing relatively inexpensive platforms that can create weapons and sensor effects while minimizing risk to personnel and high value units.[26] AUS and UK doctrine speaks to the ability of UAS to extend a ship's organic sensor range, thus increasing a ship's ISR picture while reducing the threat to personnel.[27] UAS also provide an additional benefit by being relatively small and therefore providing a lower radar cross-section for adversary radars to detect, allowing the mothership to remain undetected and therefore maintaining a tactical advantage.

Often overlooked are the disadvantages or costs of UAS, which are infrequently discussed in open source media covering uncrewed systems. The first is that uncrewed

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[25] Jeler, Eduard 'Military and Civilian Applications of UAV Systems' STRATEGIES XXI International Scientific Conference, 1-3.
[26] 'Department of the Navy Unmanned Campaign Framework', 2.
[27] Royal Australian Navy, 'SEA129-5', 8. Ministry of Defence, 'Joint Doctrine Publication 0-30.2.

systems still require personnel to operate and maintain them. In the RCN, for relatively simple systems like Puma, a three-person detachment of operator/maintainers and a crew commander are required to embark in a ship to conduct Puma operations. These personnel are typically able to contribute to other aspects of shipborne operations as they are drawn as volunteers from existing naval operator or engineer trades, but they are primarily onboard to conduct flight operations and require rations and accommodations, which are always a scarcity in a warship. More complex, larger systems, may require additional personnel to operate. For instance, an UAV large enough to carry multiple payloads may require a payload operator or flight engineer to assist the operator. Alternatively, an aircraft capable of prolonged sortie times may require multiple crews to control a single mission to avoid operator fatigue, each case could result in larger detachment sizes embarked onboard.

Another concern is the uncrewed systems themselves and their ability to operate from a ship. As mentioned above, systems such as Scan Eagle require large launch apparatus and recovery devices. These devices take time to setup and remove and are typically employed on a ship's flight deck as it is normally the largest open space on a warship's upper deck. The challenge for ships with helicopters is that while these apparatuses are on the flight deck, the helicopters are unable to launch or land. This is important when action is required from a crewed aircraft, such as the time sensitive interdiction of a vessel of interest or the recovery of a person in the water, which a UAS cannot accomplish. To alleviate launch and recovery equipment challenges, vertical take-off and landing (VTOL) systems can be employed. VTOL systems are very promising, yet the author can attest based on his experience as a Project Director at Director Naval Requirements in the UAS portfolio, there are relatively few VTOL systems which are proven to be able to operate at sea on a moving platform which provide adequate capability and range to be useful for ISR from a warship.

The last challenge to be addressed is one which will exist for the foreseeable future. The RCN's legacy and future platforms were not designed with a specific UAS concept of operation in mind. The Kingston and Halifax-class ships were designed well before UAS were capable of being deployed from maritime platforms and while the Joint Support Ship and Canadian Surface Combatant both have requirements to operate UAS, in the absence of a specific strategy or platform, the requirement is generic and neither project will deliver UAS with the platforms.[28] The challenge which exists for the RCN therefore, is how best to integrate platforms which require space, power, fuel, secure communications for UAV control and data link, and how to collect, display, process, and disseminate sensor data from the UAV. As an example, warships typically do not have space to spare either internal to the ship for aircraft and control systems storage, nor on the superstructure for communications arrays. For instance, one UAS could require up to 14 different antennas as well as the associated power generation and cable runs through the ship.[29]

[28] Deputy Project Director, Joint Support Ship, email to author, 17 April, 2023. National Defence, 'Canadian Surface Combatant Statement of Requirements', section 5.14.1.
[29] National Defence, 'RCN Joins NATO Initiative to Learn from Allies' Unmanned Systems'.

The challenges outlined above are not insurmountable, but they require a more detailed strategic vision than the one outline in the RCN's only direction on the subject, Director General Naval Force Development's Concept for Maritime Unmanned Systems (CMUS), a 15-page document released in 2015. The CMUS spends most of its efforts on defining key terms and speaks both generally and aspirationally of the RCN's future uncrewed systems operations.[30] A clear and deliverable strategic vision must be created for the RCN but, as noted in the USN's Unmanned Campaign Framework, "A vision alone will not bring about change. The Campaign will need advocacy and action to succeed in its vision. Central to the campaign is the creation of an enduring and dynamic plan of action, accountable through a concentrated group of senior Authorities."[31]

RCN UAS CHAMPION

In its current configuration, the RCN UAS team has no designated champion. The responsibility for the implementation and integration of UAS resides in three offices. The materiel program is lead by Director Naval Requirements 2 (DNR 2), who leads the materiel acquisition, contributes to airworthiness by routinely representing the RCN at RCAF airworthiness boards and working groups, completing initial airworthiness documentation in accordance with the RCAF airworthiness program requirements, and participates in NATO UAS working groups. Naval Force Readiness (NFR) has a staff officer whose secondary duty is to ensure that the integration of UAS in HMC Ships is accomplished by providing liaison between DNR and coastal authorities, to produce and maintain UAS policy, such as UAS CONOPS, and who completes some facets of airworthiness documentation. The RCN Puma detachment, led by a Lieutenant-Commander performing the role as a secondary duty, trains candidate operators, operates the Puma UAV from HMC Ships, and will migrate to crewing the selected aircraft from the RCN ISTAR project.[32]

While each organization operates to advance the RCN UAS portfolio, the lack of organizational unity risks the duplication of effort and failure to capitalize on a shared understanding of the current direction for the RCN. A lesson can be learned from another emerging capability in the Department of National Defence, the Cyber Forces. Assistant Deputy Minister (Review Services) (ADM(RS)), released an evaluation of the Cyber Force in 2021 which evaluated the performance of the force over a three-year period spanning fiscal year 2017/18 to 2019/20. In the review, findings included that the program implementation was hampered by a lack of personnel resources and funding, as well as an unclear establishment of accountabilities, responsibilities, and authorities (ARA) for the force.[33] In the detailed description of the challenges, the report highlights the lack of a Cyber Champion as a major contributing factor to senior-level leadership not having enough visibility on the cyber program, as well as a contributing factor to the

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[30] National Defence, 'Director General Naval Force Development's Concept for Maritime Unmanned Systems', November 2015.
[31] 'Department of the Navy Unmanned Campaign Framework', 9.
[32] Puma detachment OIC, email to the author, 19 April, 2023.
[33] National Defence, 'Evaluation of the Cyber Forces', last modified April, 2021, https://www.canada.ca/en/department-national-defence/corporate/reports-publications/audit-evaluation/eval-cyber-forces.html.

unclear ARAs, which had been allowed to remain as they were over the three year period despite widespread acknowledgment of their confusing nature.

The complex nature of UAS and the supporting program noted above, as well as the lessons identified in the ADM(RS) evaluation of the Cyber Forces, highlight the requirement for the designation of an RCN UAS Champion. This person should be charged with the overall implementation of the RCN UAS strategy, once released, and can act as a subject matter expert to senior leadership on the topic of uncrewed systems. As well, they will functionally administer training, operation, and airworthiness requirements of uncrewed systems to ensure an effective and efficient use of resources.

Given the span of authority and the need to engage directly with Senior RCN leadership, this champion is likely best suited to be employed within NFR at the Commander or Captain (Navy) rank level. This level ensures the ability of the champion to both effectively exercise their span of control, leverage requisite institutional knowledge to enable the UAS portfolio, and to provide regular access to senior leaders to ensure visibility on key UAS portfolio concerns. This champion need not be a UAS expert themselves, but by leveraging their team's expertise, would provide a higher level, future oriented, view for concepts and policies. As a comparison by which to gauge the appropriate level of seniority for this position, the RN leverages a Commander as the In-Service Capability Manager and a Colonel for Future Capability Development. In the RCN context, a construct in which a UAS detachment Commander acts as SME, reports to the Deputy Director NFR Policy and Operational Authorities, and subsequently to Director NFR, would provide the appropriate amount of seniority supported by the appropriate amount of expertise.

Having demonstrated the complexity of the UAS program implementation and integration challenges, and having identified the shortfalls created through the lack of a Cyber Forces Champion and associated ARAs, one can see the criticality of the appointment of an RCN UAS champion to oversee the RCN UAS program. Wherever this champion is established, there remains the requirement to conduct the detailed implementation and integration work of the UAS program. To effectively carry out this work, a dedicated UAS establishment must be created within the RCN in the near-term as the subsequent section will discuss.

RCN UAS SQUADRON

To effectively implement the RCN UAS program there must be dedicated staff associated. The requirement for dedicated staff stems from the specialist knowledge required to operate the systems, to direct the organization towards appropriate future goals, and to understand and fulfill the legal requirements associated with the CAF airworthiness and flight safety regimes. This proposed UAS establishment, hereafter referred to as the RCN Naval Uncrewed Air Systems Squadron (NUAS), should build off of existing staff positions to rationalize human resources allotments and to assign formal responsibility for the requisite components of the UAS establishment. These responsibilities can be grouped into three categories, airworthiness, standardization and evaluation, and operations.

The CAF airworthiness program is mandated by the Canadian Aeronautics Act and is led by the Commander of the RCAF in their role as the Airworthiness Authority (AA). A brief overview of the airworthiness program requirements will be provided herein to emphasize the complexity and importance of adhering to the program's requirements. The airworthiness program is comprised of three pillars, the Technical, Operational, and Investigate airworthiness programs. Each program is led by its respective authority, the Technical Airworthiness Authority (TAA), Operational Airworthiness Authority (OAA), and the Airworthiness Investigative Authority (AIA).[34] Each component of the airworthiness process is designed to certify that an Acceptable Level of Safety (ALOS) can be established for each aircraft and its associated systems so that it can receive an Airworthiness Certification (AC).[35] To achieve the AC, an Operational Airworthiness Clearance (OAC), an Investigative Airworthiness Clearance (IAC), and a Technical Airworthiness Clearance (TAC) are required. Following the attainment of PAC, IAC, and TAC, a Release to Service (RTS), as outlined in Air Force Order 8001-2, must also be achieved. The RTS further encompasses, "…issues such as Human Resources, infrastructure, training, materiel support, etc. which must also be addressed prior to the commencement of operational service."[36] Following the achievement of AC and RTS, a fleet of aircraft must also adhere to Continuing Airworthiness Responsibilities (CAR) which encompass fleet specific requirements designated by the TAA. The operator of the fleet, with oversight from the TAA, must ensure the adherence to the CAR throughout the life of the aeronautical product.

While only a brief description of airworthiness requirements has been outlined, the complexity of the program cannot be overstated. AW publications associated with general airworthiness, TAA, OAA, and AIA are hundreds of pages in length and require detailed knowledge of their contents. In 2018, upon acquisition of the Puma UAS, DNR and NFR staff officers began the process for Puma RTS yet, despite their efforts, RTS has not been achieved as of writing. The failure of achieving RTS for a relatively safe and proven airframe is due to a lack of a single Officer of Primary Interest (OPI) who could act as the designated staff officer to gain expertise in the airworthiness program and subsequently steer the appropriate staff products through the system.

Encapsulated within the airworthiness program is the RCAF Flight Safety Program (FSP), the aim of which is to, "…prevent accidental loss of aviation resources while accomplishing the mission at an accepted level of safety."[37] Under the authority of the CAF AA, the FSP shall be adhered to by each level of Command including all units operating, maintaining, providing logistics in support of, or controlling flight operations.[38] The details of the FSP are outside the scope of this discussion, but of particular relevance are some of the mandatory positional requirements inherent to the program.

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[34] Defence, 'DAOD 2015-0, Airworthiness'.
[35] National Defence, 'Department of National Defence/Canadian Armed Forces Airworthiness Program', 1-1–4.
[36] National Defence, 3-1–2.
[37] National Defence, 'Flight Safety for the Canadian Armed Forces', 4.
[38] National Defence, 'Flight Safety for the Canadian Armed Forces', 4.

The Flight Safety Officer (FSO) is a unit level position which is charged with the oversight and maintenance of the unit's flight safety program, conducting flight safety awareness training, and conducting independent investigations on behalf of the AIA.[39] Further, the unit FSO shall be able to occupy their position for a minimum of 18-24 months, have attained the Basic Investigator two (BI2) course, and should not be assigned secondary duties.[40] In an HMC ship, a member of the Air Department fulfils the role of the FSO or, in the absence of an Air Department, the Deck Officer acts the alternate FSO. This arrangement has served the RCN for UAS operations to date, but it is worth considering whether the current arrangement meets the spirit and the letter of the FSP given the anticipated expansion of the RCNs UAS activities and the fact that future systems, such as the system which will be furnished for RCN ISTAR, is likely to be based ashore.

The OAA also requires dedicated positional assignments for a Standardization and Evaluation Team (SET), the purpose of which is to ensure OAA requirements regarding training, currency, doctrine, and flight checks are conducted properly.[41] The OAA has communicated to the RCN that SET positions are to be filled as soon as possible and DNR has succeeded in creating four SET positions, the first of which has been filled as of writing.[42] However, the continued issuance of RCN UAS flight permits has been called into question recently as the RCAF Staff Officer Uncrewed Systems has communicated to the OIC of the Puma detachment that the lack of a dedicated RCN flight safety program and associated personnel must be rectified to continue certification.[43]

Finally, the operation of the aircraft themselves seems an obvious requirement for position establishment, but there remain questions of how many operators are required and whether or not a dedicated UAS operator trade should be established. In this case, the systems will designate the requirement to some extent. Currently, the RCN Puma detachment has six operator positions on the west coast, three of those positions are loaned from Director Naval Personnel and so are not permanently established, and three positions exist on the east coast. RCN ISTAR, the RCNs next large UAS acquisition should drive the near to mid-term goal for operator positions. The intent of RCN ISTAR is to use the extant Puma operators as their initial cadre of operators and trainers, but the number of airframes purchased by the project should drive the final number of operators required to operate and train the next generation of operators. Given the complexity of UAS being operated by the RCN, a dedicated UAS Operator trade is not likely required. For a relevant comparison, the RN and RAN, which operate UAVs of similar size and complexity to those being considered by the RCN, have not created a UAS Operator trade.[44]

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[39] National Defence, 26.
[40] National Defence, 24–26.
[41] Royal Canadian Air Force, '1 Canadian Division Orders, Volume 5, 5-508'.
[42] OIC RCN Puma Det, 'Status of RCN Puma Detachment', 19 April 2023.
[43] OIC RCN Puma Det, email to the author, 25 April, 2023.
[44] Royal Australian Navy, 'SEA129-5: Maritime Tactical Unmanned Aerial System Operational Concept Document'. Commanding Officer 700X Squadron, Teams discussion with the Author, 23 March, 2023.

Having outlined some of the key arguments for the creation of the RCN NUAS, it is worth emphasizing that the USN, RN, and RAN have all established UAS squadrons within their navies to ensure the effective management and future development of their UAS programs. It is also worth noting that the RCN ISTAR project has proposed the establishment of approximately 50 personnel billets to crew the program, and that these billets could be used to staff the NUAS as proposed. While a fulsome military employment structure study should be conducted to validate these requirements, by using a comparative analysis of the RN's 700x squadron structure and the 12 Wing Shearwater organizational structure, a notional NUAS organization if presented at figure 1 to assist the reader in visualizing a potential construct that is within the personnel bounds of the RCN ISTAR 50 pers capacity.[45]

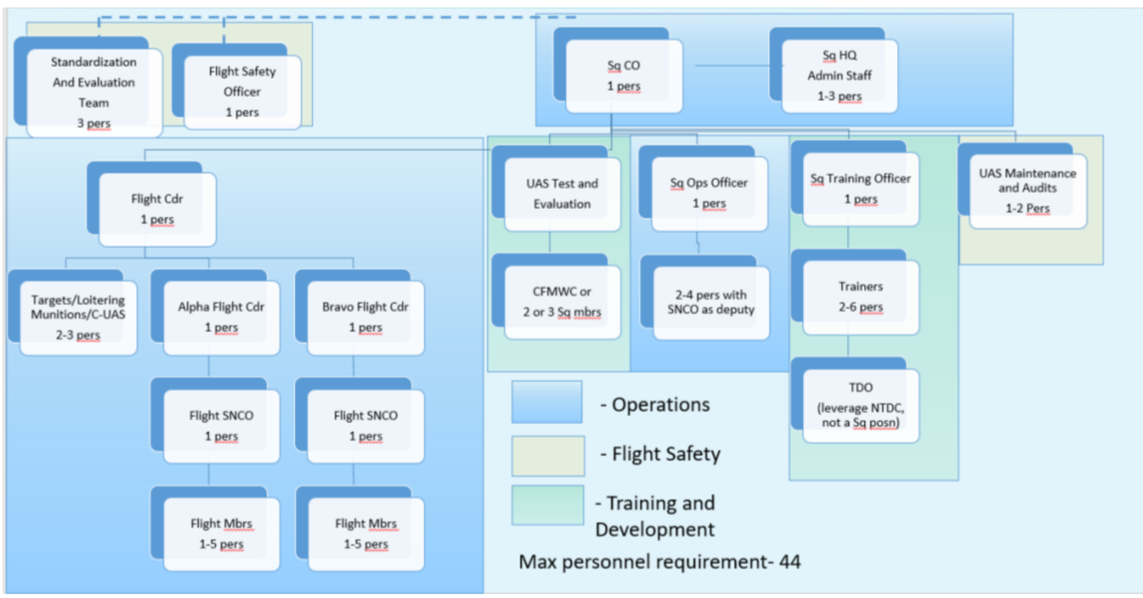

Figure 1. Notional RCN NUAS Squadron Organization

CONCLUSION

UAS are an increasingly relevant means of creating effects in the maritime domain, as exemplified by the ongoing Ukrainian-Russian war. In analyzing the RCN's allies' efforts in the UAS realm we can see that they employ a robust structure of UAS doctrine, offices of primary interest, and UAS squadrons crewed by dedicated personnel to enable their UAS programs. The RCN currently has none of those institutional frameworks enabled, and given the complexity from both a UAS technical and policy perspective, risks duplication of effort, a lack of future oriented development program, and failure to fully comply with the CAF Airworthiness program.

The RCN is understaffed by approximately 1,400 sailors and so a reticence to dedicate the approximately 50 personnel to crew the NUAS can be anticipated.[46] This

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[45] Commanding Officer 700X Squadron, Teams discussion with the Author.
[46] Press, Staff, and Contact, 'Canadian Navy Struggling with Personnel "Crisis"', accessed 24 April, 2023, https://www.ctvnews.ca/politics/canadian-navy-struggling-with-personnel-crisis-commander-1.6086582 .

paper has demonstrated, using an analysis of allied UAS programs, that to effectively integrate, lead, and operate UAS a dedicated NUAS is required. The approximately 50 personnel employed by the NUAS should be considered an investment in a high tech and rapidly advancing capability, one that is sure to excite sailors and keep them engaged with the RCN. By creating a NUAS, the RCN can create a force multiplier in terms of both the operational effect achieved, as well as the excitement and engagement inspired in its sailors.

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