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QUANTITY OR QUALITY: VICTORY IN THE FUTURE MARITIME DOMAIN

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AIM

1. The aim of this service paper is to advise the Commander of the Royal Canadian Navy (RCN) on the issue of quality versus quantity in the context of the RCN's future naval fleet compositions. Given the rapidly evolving nature of future maritime threats the current recapitalization of the RCN's fleet, consisting solely of 15 Canadian Surface Combatant's (CSC), may lack the necessary distribution of capabilities to effectively operate in tomorrow's conflict areas. The discussion will investigate current allied (U.S. and Australian), as well as adversarial (China) approaches to future fleet compositions to illuminate avenues of exploration to ensure the RCN achieves superiority in future naval engagements. The paper will conclude with recommendations for further analysis pertaining to the incorporation of Unmanned Surfaces Vessels (USV) and/or the procurement of Air Independent Propulsion (AIP) submarines as a means of appropriately distributing the RCN's future capabilities.

INTRODUCTION

2. The future maritime threat environment will increasingly demand a greater reliance on systems and capabilities which afford naval platforms the ability to operate in all domains – Sea, Land, Air, Space and Cyberspace. Moreover, freedom of maneuver in the maritime domain will become increasingly more challenging as modern Intelligence, Surveillance, Targeting, Acquisition and Reconnaissance (ISTAR) capabilities compress the battlespace, making it increasingly harder to hide. Finally, the proliferation of precision guided munitions means that once detected, a warship's defences will quickly be inundated with vast salvo sizes of hypersonic and conventional missile threats.[1]

3. Into this new threat environment steps CSC the next generation of RCN ships; while envisioned by Leadmark 2050 as highly capable and adaptable combat platforms, their overall procurement and anticipated future operating costs have necessitated that Canada invest in a relatively small fleet. Paradoxically, because their numbers are limited and replacement cost so exorbitantly high, the loss of a single vessel represents a drastic reduction of overall RCN capability. This makes the risk calculus of employing ships into a future threat environment potentially unpalatable for governments and senior officials, a problem not unique to the RCN but rather a challenge faced by all modern navies. The following discussion will investigate how our allies and adversaries are attempting to balance the *quality versus quantity* conundrum in naval procurement and what technologies they are leveraging to achieve the right balance, or fleet mixture of ships, to distribute their capabilities and reduce the risk of deploying their navies into harm's way.

[1] Andrew F. Krepinevich, *Maritime Warfare in a Mature Precision-Strike Regime* (Washington, D.C.: Center for Strategic and Budgetary Assessments,[2014]).

DISCUSSION

4. Modern warship design and production is a complex, time consuming and costly process. The challenges faced by countries when selecting what future capabilities a warship should contain is frequently confounded by the pace of technological growth and evolving threat characteristics. Take for instance the HALIFAX class Canadian Patrol Frigate (CPF), whose design commenced in the 1980's predicated on conducting Cold War Anti Submarine Warfare (ASW) in the Greenland, Iceland and United Kingdom (GIUK) gap in support of NATO. Fast forward a decade and delivery of the first CPF's in the early 1990's coincided with the fall of the Soviet Union. As a result, the CPF operational history has been predominately in support of crisis management and counter terrorism operations in the Gulf and Mediterranean; certainly not the mandate the RCN had envisioned.

5. To the credit of the CPF designers, they had incorporated sufficient design elements into the ship allowing it to transition seamlessly from an ASW platform into a more multipurpose role. Subsequently, the push for multipurpose platforms that exhibit an abundance of modularity and flexibility has been the prevailing trend in modern warships designs since the end of the Cold War; where naval requirements analyst's attempt to *hedge their bets* when selecting capabilities necessary to defeat the next threat.[2] However designing modularity and flexibility into a warship drives up both the acquisition and operating cost, particularly as warships in-service lives are increasingly growing.[3] As a result, the current average acquisition cost for a modern Frigate / Destroyer is 1-2 billion dollars US (per ship)[4].

6. At the same time the rapid development of satellite, unmanned vehicles, radar and other sensor technologies have made surface vessel detection significantly easier. The relatively cheap cost and dramatically improved proficiency of anti-ship missile systems has made future naval engagements frighteningly one-sided. Consequently, modern navies now struggle with balancing the prohibitive cost of large fleets of multipurpose vessels and the need to distribute their naval capabilities; thereby avoiding the dilemma of putting all their eggs into one basket.

The US Navy Approach - Unmanned

7. The US Navy identified this issue in the early 2000's as the associated costs to building, maintaining and operating its then fleet of Cruisers and Destroyers was rapidly increasing. In the last decade they've stood up several projects aimed at achieving a more cost effective distributed fleet mixture.[5] The basic premise behind their new fleet

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[2] Milan Vego, "The Operational Impact of New Naval Technologies" Royal Australian Navy, 2015, 2015).

[3] John F. Schank et al., *Designing Adaptable Ships: Modularity and Flexibility in Future Ship Designs* (Santa Monica, CA: RAND Corporation, 2016), 11-21.

[4] John Harper, "Cost Estimates Questioned for New Navy Frigate," *National Defense*, sec. Online Article, 18 June, 2020. https://www.nationaldefensemagazine.org/articles/2020/6/18/cost-estimates-questioned-for-new-navy-frigate.

[5] Ronald O'Rourke, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress. CRS Report* (Washington, D.C.: Congressional Research Services,[2020a]).

mixture is to reduce the number of expensive and technologically complex *heavy* warships (Cruisers and Destroyers) and vastly increasing the number of *small* modestly priced surface combatants (Frigates and Littoral Combat Ships). To take their distribute capabilities one step further, the US Navy is turning to the use of Large and Medium sized USV's (LUSV and MUSV).

8. LUSV and MUSV's are remotely piloted (possibly autonomous) vessels intended to sail both in concert with manned vessels; or, independently as required by the mission parameters. USV's will be comparatively inexpensive and more versatile that manned vessels, leveraging Commercial-Off-The-Shelf (COTS) technology to reduce costs and employing modular payloads to facilitate the right balance of weapons and sensors to combat future naval threats.[6]

9. According to the US Navy, LUSV's are characterised as vessels ranging from 60 – 100 meters in length and displacing 1000 to 2000 tonnes, with an estimated cost of 50-100 million dollars US per vessel.[7] Their primary role is to support operations in all 3 dimensions – Air, Surface and Subsurface, effectively providing an additional *floating magazine,* equipped with Vertical Launch System (VLS), air – surface radar and other Intelligence, Surveillance and Reconnaissance (ISR) sensors. Similarly, MUSV's are characterized as vessels ranging from 15-60 meters and displacing roughly 500 tonnes, with an estimated cost of 35 million dollars US per vessel. Their primary role is to conduct Electronic Warfare (EW), Mine Counter Measure (MCM), ISR and ASW.[8] The LUSVs and MUSVs reduce the risk calculus of future naval surface engagements in a number of critical ways. First, by removing the humans from the equation, these vessels are suited to undertake missions which are considered "dirty, dull and dangerous".[9] Second, by saturating the battlespace with vessels, USV's complicate the enemy's targeting process; while, equally improving the overall survivability of manned vessels through an increased number of weapons and improved detection range.

10. Despite contracts issued in the fall of 2019 to industry to develop LUSV and MUSV for projected initial in-service dates of FY 2025, there remains a number of pressing issues to overcome; specifically, in the areas of International Law, Doctrine, Ethical Use and Force Employment. In the area of International Law, there exists a need to update the United Nations Convention on Law of the Sea (UNCLOS) and international collision prevention regulations (COLREGs) with respect to open ocean navigation rules on autonomous vehicles.[10] Doctrinally, navies need to establish CONOPS that detail the

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[6] Bryan Clark and Timothy Walton, *Taking Back the Seas: Transforming the U.S. Surface Fleet for Decision-Centric Warfare* (Washington, D.C.: Center for Strategic and Budgetary Assessments,[2019]).

[7] David Larter, *US Navy to Get Large Unmanned Surface Vessels in 2020 — with Strings Attached* (Arlington, VA: Sightline Media Group, 2019).

[8] Ronald O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress. CRS Report* (Washington, D.C.: Congressional Research Services,[2020b]).

[9] Department of National Defence, Canada, *Strong, Secure, Engage* (Ottawa: Government of Canada, 2017)pg 49.

[10] Koji Wariishi, *Maritime Autonomous Surface Ships: Development Trends and Prospects - how Digitalization Drives Changes in Maritime Industry* - (Tokyo, Japan: Mitsui & Co. Global Strategic Studies Institute,[2019]).

future role of USV's in support of the various operational functions. Equally, lawmakers and military officials will need to wrestle with the outstanding ethical and legal ramification of employing autonomous or semi-autonomous weapons systems. Finally, when it comes to force employment, the potential for USV's to be hijacked by foreign actors in an effort to gain a technological / intelligence advantage remains a significant risk to overcome.[11]

11. While the RCN would equally need to address these issues; the CAF has clearly signaled a desire for Canada to take a leading role internationally in the development of regulations and policies governing the military use of autonomous weapons systems.[12] Additionally, USV's represent a rapidly growing export market in military and commercial sales. Thus Canada could position itself as a world leader in this field; thereby furthering the strategic objectives of the National Shipbuilding Strategy (NSS), should RCN elect to design and build USV's within Canada.

The Australian Approach - Underwater

12. The Royal Australian Navy (RAN) is equally looking to distribute their fleet mixture, but are undertaking a more traditional manned approach. The RAN's latest strategic update on their new Force Structure Plan, indicates the procurement of up to 23 different classes of Navy and Army vessels at a cost of between $168-183 billion dollars US.[13] As part of this investment the RAN is building a traditional versatile multipurpose surface combatant - the HUNTER class (9 in total), a derivative design of the British Type 26 and sister design to the RCN's CSC, intended to act as the backbone of its surface fleet. The RAN is equally investing heavily in a fleet of versatile specialized minor war vessels, including 12 Offshore Patrol Vessels and various MCM vessels.

13. The teeth of the RAN plan, unlike the US Navy, is not on the surface but below the waterline. The RAN is procuring 12 new Air Independent Propulsion (AIP) submarines, to allow the Australian government to adequately patrol and deter incursions into their territorial waters (seventh longest in the world), as well as to project power and influence into the highly contested waters of the South China Sea.[14]

14. AIP submarines afford navies the stealth capabilities of a conventional diesel electric submarine with a vastly extended submerged range approaching that of a nuclear powered submarine, but for a fraction of the cost. By investing heavily in submarines the RAN is attempting to circumnavigate the challenges facing the surface fleets of

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[11] O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress. CRS Report* (Washington, D.C.: Congressional Research Services,[2020b]).
[12] Department of National Defence, Canada, *Strong, Secure, Engage* (Ottawa: Government of Canada, 2017)pg, 73.
[13] Australian Defence Force, *2020 Defence Strategic Update* (Sydney, Australia: Government of Australia, 2020).
[14] David Axe, "Australia has A Plan for Battling China—Add Lots and Lots of Submarines," *Forbes* Online Article, no. Online Article (3 Jul, 2020a).
https://www.forbes.com/sites/davidaxe/2020/07/03/australia-has-a-plan-to-grow-its-navy-add-lots-and-lots-of-submarines/?

tomorrow, thereby reducing the risk calculus of losing an asset to the combination of a shrinking ocean and the proliferation of advanced precision guided munitions. The RCN has yet to announce a replacement project for its aging conventional Victoria Class Submarine fleet. The ability to employ submarines within Canadian waters is critical to enforcing our sovereignty by both actively denying and deterring access to our adversaries. Submarines equally represent the lion share of the RCN's main offensive capability, due to their stealthy nature and first strike capability.

15. Although the RAN approach may seem extremely compelling to the RCN, particularly in light of the shared procurement of major surface combatants (i.e. CSC and HUNTER classes), the ability to adopt the RAN strategy of enhancing distribution of capabilities through the production of multiple major and minor war vessels, in addition to a substantial number of submarines, might prove prohibitively expensive from both an RCN personnel and budgetary perspective. Currently, procurement cost of CSC is 70 billion dollars US, the HUNTER class is comparatively priced at 75 billion dollars US. The addition of another 70-90 billion dollars US to procure a comparable 8-12 submarines would prove politically challenging in Canada. Equally bothersome is the political sensitivity surrounding the question of where those submarines would be designed and built. Despite its early success Canada's NSS has yet to demonstrate the capacity to successfully produce a warship; while its ability to do so is deemed highly likely, there exists a quantum leap between Canada's industrial capacity to build a warship and the resources and talent necessary to build submarines. Therefore, the procurement of submarines realistically would need to occur offshore, making it a perplexing political endeavour.

The Chinese Approach – Strength in Numbers

16. In contrast, China has gone *all in* when it comes to building quantity over quality in an effort to *out gun* their main rivals the US**.** The Chinese are building ships at a breakneck speed, the People's Liberation Army Navy (PLAN) now proclaims to have 360 front line warships, 63 more than the current US Navy fleet. From 2010 to 2020 their shipyard construction and fleet maintenance outputs jumped by 500% over the previous decade. [15]

17. As a testament to their pace of production, the PLAN produced 30 - Type 054A Frigates, equipped with a modern and respectable AAW, ASW and ASuW capability, in only 10 years. The PLAN surface fleet is posturing to directly take on the US, consisting of the Type 055A Cruisers at 13,000 tons; Type 054A and its successor 054B multi-role Frigates at 4000-5000 tons; and the Type 052D Destroyers at 7000 tons.[16]

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[15] David Axe, "The Chinese Navy Can't Grow Forever—The Slowdown might Start Soon," *Forbes* Online Article, no. Online Article (12 November, 2020b).).
https://www.forbes.com/sites/davidaxe/2020/11/12/the-chinese-navy-wont-grow-forever-the-slow-down-might-come-soon/
? Rick Joe, "What Will the Chinese Navy's Next Frigate Look Like?" *The Diplomat* Online Article, no. Online Article (15 May, 2020). https://thediplomat.com/2020/05/what-will-the-chinese-navys-next-frigate-look-like/.

18. Perhaps somewhat reassuringly to western navies the pace of production achieved by the PLAN is representative, to some extent, of the lack of sophistication of the technology being employed on their vessels; as a large portion of modern ship building time is dedicated to the integration effort of advanced weapons and sensors. Despite having achieved numerical superiority over the US the PLAN continues to trail most western navies in a number of critical capabilities such as joint operations, replenishment at sea, ASW, as well as gaps in sensor, stealth, and propulsion technology; although these gaps are closing quickly. [17]

19. Clearly the RCN cannot undertake a campaign of amassing quantities of manned vessels to rival the PLAN. Achieving numerical superiority against the PLAN will continue to exist through the combined naval capacity of alliances, such as NATO. As such, the RCN's interoperability with the US Navy's upcoming USV fleet or the RANs future AIP submarine fleet is essential to the RCN's survival. Furthermore, given the speed at which PLAN technology is advancing, the RCN can equally no longer dismiss the idea that someday soon the technological capabilities of a Chinese Frigate or Destroyer will rival those of CSC. In this regard, the RCN must consider how best to distribute its future naval assets.

CONCLUSION

20. The threats facing the RCN in the future maritime domain call into question whether or not our current procurement of 15 CSC vessels sufficiently distributes our capabilities to win the next naval engagement. Our allies have recognized this fact and are taking steps to incorporate unmanned vessels; or, alternatively increase their submarine assets in an effort to change the calculus of confronting future threats. If the RCN expects to contribute to future naval coalitions in any meaningful way; to maintain interoperability with our allies; or, to exercise a credible independent naval power in a future maritime domain, then Canada must take steps to better distribute its future fleet.

[17] Ronald O'Rourke and LIBRARY OF CONGRESS WASHINGTON DC CONGRESSIONAL RESEARCH SERVICE, *China Naval Modernization: Implications for U.S. Navy Capabilities - Background and Issues for Congress* (Washington, D.C.: Congressional Research Services, 2020), 1-10.

RECOMMENDATION

21. Recommend that the RCN revisit its intended future fleet composition, with the aim of increasing the distribution of capabilities, specifically:

a. Conduct a detailed analysis of the potential national, strategic and tactical benefits and detriments associated with RCN employment of LUSV and MUSVs. To include the potential for production of LUSV and MUSVs in Canada under the NSS framework. Finally, investigate the force generation and employment issues associated with RCN USV deployment either independently; or in concert with US Navy or other allied Navies.

b. Conduct a detailed analysis of the potential national, strategic and tactical benefits and detriments associated with procurement of AIP submarines; to determine the number and capabilities required by the future RCN; as well as, potential candidate foreign submarine designs.

BIBLIOGRAPHY

Australian Defence Force. 2020. *2020 Defence Strategic Update*. Sydney, Australia: Government of Australia.

Axe, David. 2020a. "Australia has A Plan for Battling China—Add Lots and Lots of Submarines." *Forbes* Online Article (Online Article). https://www.forbes.com/sites/davidaxe/2020/07/03/australia-has-a-plan-to-grow-its-navy-add-lots-and-lots-of-submarines/?

———. 2020b. "The Chinese Navy Can't Grow Forever—The Slowdown might Start Soon." *Forbes* Online Article (Online Article). https://www.forbes.com/sites/davidaxe/2020/11/12/the-chinese-navy-wont-grow-forever-the-slow-down-might-come-soon/?

Clark, Bryan and Timothy Walton. 2019. *Taking Back the Seas: Transforming the U.S. Surface Fleet for Decision-Centric Warfare*. Washington, D.C.: Center for Strategic and Budgetary Assessments.

Department of National Defence, Canada. 2017a. *Strong, Secure, Engage*. Ottawa: Government of Canada.

———.. 2017b. *Strong, Secure, Engage*. Ottawa: Government of Canada.

Joe, Rick. 2020. "What Will the Chinese Navy's Next Frigate Look Like?" *The Diplomat* Online Article (Online Article). https://thediplomat.com/2020/05/what-will-the-chinese-navys-next-frigate-look-like/.

Krepinevich, Andrew F. 2014. *Maritime Warfare in a Mature Precision-Strike Regime*. Washington, D.C.: Center for Strategic and Budgetary Assessments.

Harper, John. 2020. "Cost Estimates Questioned for New Navy Frigate." *National Defense*, 18 June, 1-5. https://www.nationaldefensemagazine.org/articles/2020/6/18/cost-estimates-questioned-for-new-navy-frigate/.

Larter, David. 2019. *US Navy to Get Large Unmanned Surface Vessels in 2020 — with Strings Attached*. Arlington, VA: Sightline Media Group. https://www.defensenews.com/naval/2019/12/21/the-us-navy-gets-its-large-unmanned-surface-vessels-in-2020-with-strings-attached/

O'Rourke, Ronald. 2020a. *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress. CRS Report*. Washington, D.C.: Congressional Research Services.

———. . 2020b. *Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress. CRS Report*. Washington, D.C.: Congressional Research Services.

O'Rourke, Ronald and LIBRARY OF CONGRESS WASHINGTON DC CONGRESSIONAL RESEARCH SERVICE. 2020. *China Naval Modernization: Implications for U.S. Navy Capabilities - Background and Issues for Congress*. Washington, D.C.: Congressional Research Services.

Schank, John F., Scott Savitz, Ken Munson, Brian Perkinson, James McGee, and Jerry M. Sollinger. 2016. *Designing Adaptable Ships: Modularity and Flexibility in Future Ship Designs*. Santa Monica, CA: RAND Corporation. https://www.rand.org/pubs/research_reports/RR696.html

Vego, Milan. 2015. "The Operational Impact of New Naval Technologies." Royal Australian Navy, 2015.

Wariishi, Koji. 2019. *Maritime Autonomous Surface Ships: Development Trends and Prospects - how Digitalization Drives Changes in Maritime Industry* - . Tokyo, Japan: Mitsui & Co. Global Strategic Studies Institute.