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by Ron Lloyd and David Perry

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POLICY PERSPECTIVE

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The Canadian Surface Combatant (CSC) will replace Canada's Halifax-class frigates and decommissioned Iroquois-class destroyers with a fleet of 15 modern warships. These ships are the result of a long process of translating government policy direction and naval operational roles and doctrine into the requirements of a competitive procurement won by Lockheed Martin Canada in 2018. Those capability requirements now form the basis of the CSC as it is currently envisaged. Recently, the Royal Canadian Navy (RCN) made public some of the ship's key capabilities (see the figure below). This article will first outline the factors that shaped the CSC's capability requirements and then discuss what those capabilities will allow the ship to do.

Canada's defence policy, most recently reaffirmed with *Strong, Secure, Engaged*, calls for the RCN to be able to defend all three of Canada's coasts and the North American continent, alongside the United States. It must also contribute to international missions with single warships or by deploying a task group of up to four surface combatants (and a joint support ship, and when warranted a submarine).

The CSC will sail in a strategic environment characterized by a resumption of great-power competition and a significant buildup of global naval forces. Associated with these trends, submarine and cyber-threats are proliferating rapidly. And, most critical to the CSC, advanced missile systems are becoming more prevalent, easier for states and non-state actors to obtain, and also more difficult to detect and defeat. In this strategic landscape, Canada's navy anticipates that it will need to integrate its ships with those of its closest allies and partners, as well as other Canadian military units, on the open ocean (characterized as blue water) as well as close to shore (referred to as the littoral). That requires a range of operational capability stretching across a continuum from complex anti-submarine warfare and integration into carrier strike groups in the blue-water environments where peer navies sail, all the way to working in the high-traffic, densely populated regions close to the world's coasts where navies, commercial shipping and an enormous range of other activities, legitimate and illicit, all converge. This combination of future roles means the CSC must be capable of operating seamlessly with allied and partner navies across a spectrum of operations from humanitarian assistance and disaster relief to high-end conflict operations in both blue-water and littoral environments.

Accounting for all of the factors involved in putting a ship to sea, numerous independent studies, using different models, continue to demonstrate that at least 15 ships would be needed. This is the minimum number necessary to meet these commitments with minimal risk to the navy's ability to deploy and sustain forces to defend Canadian interests and values as directed by the federal government. Given the size of Canada's navy, the CSC will be Canada's only true warship, a vessel that can put offensive combat power into harm's way and sustain battle damage. It must be effective in a number of warfare functions, such as long-range air defence, anti-submarine warfare and anti-surface warfare, which are spread across multiple classes of ships in other navies.

The advancements in threat profiles in each of these warfare functions and the corresponding impact on the RCN's tactics, techniques and procedures have been significant, especially with respect to air defence. For example, the Iroquois-class capabilities that provided an area air defence for other ships, a more powerful radar and longer range missile, are now considered an integral part of a warship's layered defence against modern missile threats. The CSC will be able to provide effective air defence to ships operating nearby, providing the same type of extended protection the Iroquois class used to offer the RCN. While it will not meet the standard of a modern air warfare platform, defined by a larger missile-carrying capacity, the CSC's enhanced air warfare capabilities mean a specialized air defence ship is not required to provide the operational performance Canada needs.

Operating a common platform effective across the spectrum of warfare operations is anticipated to save in training and maintenance over 50 years of operational service. Further, a common fleet will also provide future governments with greater flexibility to respond with naval forces and to re-task forces already deployed, than a mixed fleet of ships with different specialized roles.

The naval requirements upon which the CSC's competitive procurement was based were developed by the RCN and informed by the wider defence team and extensive industry engagement. The extensive process culminated in an unprecedented level of review by the Department of National Defence's (DND) independent review panel for defence acquisitions and was approved by the chief of the defence staff (CDS) and the minister of national defence (MND).

Five foundational criteria were important throughout: platform survivability, anti-submarine capability, the potential for future growth, affordability, and procurement competition. The safety of the ship's crew and the ability to bring them home from harm's way were overriding considerations. Choices that might impact this were biased towards increasing the ship's survivability. A second factor, anti-submarine warfare will be a core mission for the CSC so key attributes required for that purpose had to be designed into the ship from the outset as these attributes cannot be incorporated later. Minimizing a ship's noise makes it harder for a submarine to detect it, and easier for the ship to find the submarine; thus, Canada needed a ship purposely designed to minimize the noise it creates. Third, Canada wanted the CSC, a ship that will sail for half a century, to have significant growth potential. In shipbuilding terms, "margin" refers to excess space and electrical capacity that, while unneeded at a ship's launch, will be used as additional equipment is installed. A fourth factor was cost. While more and better capability increases operational performance, it usually costs more, and the navy recognized it had to strike a balance between cost and capability. Fifth, the navy sought to maximize the possibility of the procurement being competitive, by not defining requirements that only one provider could meet.

In addition, a key consideration in defining the ship's requirements was deciding where they should fall on the technology development spectrum. Mature, fully tested technology can be fielded with less technical risk, whereas less mature technology can provide more capability and less risk of obsolescence on one hand, but more technical risk on the other. Choosing the right spot on the developmental spectrum for key pieces of equipment – radar in particular – was a significant consideration for the project. Radar is one of a warship's most critical capabilities. The

selected technical readiness level was viewed to best balance the need for advanced technology and solutions while minimizing the risk of fielding it. The feedback received from industry was that the ship's requirements were "demanding but achievable".

The preceding section is intended to explain the factors that shaped the ship as it exists today, depicted in the RCN fact sheet below. The following section will discuss some of the key implications of the itemized capabilities.

Capability Areas

Accommodations

In establishing a crew size for the CSC, it is critical for the navy to preserve a sustained 24-hours-a-day, seven-day-a-week availability to conduct operations at sea and the flexibility to conduct multiple missions at the same time, while being able to operate the ship even after sustaining battle damage. To ensure that the RCN had the right number of personnel (accommodations), it conducted rigorous crew studies to drive down the minimum number of personnel required while ensuring the ship can still effectively operate as needed. Having 204 accommodations will allow

the ship to embark additional personnel when needed, such as enhanced boarding parties, while maintaining its operational performance.

Surveillance and Weapon Sensors

The radars are critical pieces of equipment in a ship's design. Their weight and height fundamentally affect the overall design, including its size. They are also important to ensure a warship can track, identify and defeat hostile surface and air targets, including missiles launched from submarines, ships and aircraft, or from ashore. Canada's Halifax-class frigates have a medium-range radar and a long-range radar to perform these functions. With advancements in radar technologies, a single system can now deliver the capabilities of the long- and medium-range radars. One thing a single radar does not provide, however, is any redundancy if that piece of equipment fails, so the need for a second radar was a significant consideration for the RCN. Noting the impact of a second radar on the ship's design, size and cost and the improved availability of modern radar technology, the decision was made to go without a medium-range radar backup.

While the RCN decided that a single radar was the right choice, none of those currently in service at the time the CSC competition was launched provided the desired level of technical performance by the time the ship entered into service. In other words, all of the radars the RCN believed could meet the desired performance specifications were in various stages of development, and none had actually been deployed on another operational warship. By designating that the radar must be at technical readiness level 7 (on a scale ranging from level 1 (most developmental) to 10 (least developmental), the navy believed it was best balancing technological currency and the risks associated with making that radar operational on the CSC.

Command and Control

A ship's command management system processes and presents information from the ship's sensors (its radar, sonar, etc.) in a simplified and integrated manner that enhances the crew's decision-making. The RCN's objective for the CSC's command management system was that it be at least as capable as the system – CMS330 – used on the Halifax-class frigates. The system envisioned for the CSC combines CMS330 with AEGIS, a command management system that the U.S. Navy uses, which will allow Canada's ships to also use the co-operative engagement capability.

Co-operative engagement allows multiple sensor feeds (such as the ship's radar) to be combined into a single, usable picture of all of the air traffic in an operating area. It allows ships to operate and exchange command-and-control information seamlessly, allowing one ship to use another's radar as if it were its own in some circumstances. This effectively lets one ship "see" aircraft or missiles further away than it could using only its own systems. This provides greater awareness of any activity, more precise information about what is there and an enhanced ability to respond at a greater distance than the ship could operating on its own. The more accurately and farther away a ship can detect a potential threat, the more time it has to properly defend itself.

Cyber-Defence

The CSC will be a much more digital platform than any warship Canada has previously operated. Its sensors will collect orders of magnitude more data and do significantly more analysis of those data on the actual ship than its predecessors. Whether those data come from the ship's combat systems, machinery health-monitoring systems, aircraft, supply system or sailors, the data and the networks that support them need sophisticated protection from cyber-threats.

Aviation Facilities

The Cyclone helicopter will be the ship's longest range weapon and sensor. It extends the distance at which the CSC can detect and engage ships and submarines in a war-fighting scenario and support a range of other missions including humanitarian assistance and disaster relief by transporting people or supplies or acting as a surveillance and communication platform. Drones will provide a complementary aircraft that can stay airborne longer, allowing a better understanding of an area of interest to develop.

Weapons

Lightweight Torpedoes – These provide the ship's primary "hard kill" (physical contact or a nearby explosion) self-defence against a submarine.

Sea Ceptor Missile – An anti-air missile that provides self-defence against incoming missiles at close range.

Naval Strike Missile – Primarily an anti-ship missile, it can also strike targets on land.

Naval Gun – An anti-ship weapon, it can provide fire support to forces ashore and a self-defence capability.

Vertical Launch Cells - Several types of missile launchers can launch the missiles Canada envisions using today, but the RCN believed it was prudent to select a system that provided the CSC with the most flexibility to evolve over the next 50 years of advancements in missile technology. That meant selecting the strike-length launcher which can hold longer missiles, thus allowing the ship to carry a broader selection of missile types. The more vertical launch cells the ship has, the more missiles it can carry, providing it with more combat power and greater survivability.

The combination of the long-range Standard Missile 2 and the close-range Evolved Sea Sparrow provide a layered air defence against incoming missiles. The Tomahawk missile provides an anti-ship capability as well as a precision-guided capability against land targets that can support forces ashore. This missile is anticipated to be used either to support other forces onshore, or provide the ship with protection against land based anti-ship missiles, which are proliferating rapidly around the world.

Reconfigurable Mission Bays and Boats

The CSC will carry its own naval boarding teams, as well as personnel and equipment from other government departments and special operations forces. These facilities will house and launch boats and other equipment for a range of missions.

Propulsion and Power Generation

The ship requires sufficient electrical power to support all current roles, as well as the margin to allow additional equipment to be added. The ship's propulsion system needs sufficient, sustained speed – including while turning – to provide a measure of anti-ship missile and torpedo defences.

Integrated Underwater Warfare Systems

A ship's most challenging mission is to locate, track and defeat a submarine. The CSC has a sophisticated and integrated underwater warfare suite comprised of a towed, low-frequency active and passive sonar, a hull-mounted sonar, towed torpedo countermeasures, sonobuoy processing and expendable acoustic countermeasures. This combination allows a ship to search for a submarine, listen for one without revealing its own location, process all of these acoustical data and confuse incoming torpedoes. These capabilities work in conjunction with the anti-submarine warfare elements built into the ship's design, such as shock-mounting equipment to reduce the noise the ship emits into the water. The CSC will also have a degaussing system, which reduces the ship's magnetic signature, providing a defence against some types of mines.

Electronic Warfare and Countermeasures

Electronic warfare and countermeasures enhance or complement hard-kill measures used for self-defence. These soft-kill measures are designed to confuse or distract weapons and sensors, reducing the chances of a weapon actually hitting the ship. Advancing missile technology increasingly requires a co-ordinated hard-kill/soft-kill response for effective defence.

Conclusion

The CSC will be the backbone of the RCN, the government's most flexible instrument of national power, for a half century beginning in the early 2030s. The last CSC to be built will likely not enter service until the 2040s. To put that into perspective, the youngest sailors that will crew that ship have not been born yet. Defining the ship's requirements to ensure that these young Canadians can deploy into harm's way with every expectation of being successful and returning to their families was an extremely challenging and rigorous process, one that has not been taken likely. Over the last decade, the RCN, in partnership with other government and industry partners, rigorously analysed and defined the requirements to preserve survivability, competition, anti-submarine warfare capability, and enable future growth while being fiscally responsible.

The result is a ship that will significantly enhance Canada's naval capability, providing more fire power, better sensors and greater connectivity across a wide range of missions. The value the CSC provides to Canada will be a function of the cost of building it and the naval capability it provides to the Royal Canadian Navy.

About the Authors

Vice-Admiral (Ret'd) ***Ron Lloyd*** *was the 35th Commander of the Royal Canadian Navy from 2016-2019. During that time he was also "double hatted" as the acting Vice Chief of the Defence Staff for almost half a year and as the first Chief Data Officer for the Department of National Defence and Canadian Armed Forces for a full year.*

During his 38 year career in the RCN, he was privileged to have commanded HMCS CHARLOTTETOWN, HMCS ALGONQUIN, the PACIFIC Fleet and the ATLANTIC fleet. He has extensive operational experience having deployed on numerous occasions globally.

Lloyd has over a decade of experience at National Defence Headquarters having also served as the Deputy Commander of the RCN, the Chief of Force Development for the Canadian Armed Forces, the Director General of Force Development for the RCN and Executive Assistant to the Commander of the RCN.

Today, as Principal of Leadmark Ventures, he shares his experience in leadership, strategic planning and digital transformation with organizations committed to providing innovative solutions that enhance public sector performance in defence and non- defence related activities.

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