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POLICY PERSPECTIVE

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Today, the Royal Canadian Navy (RCN) is in the midst of a major and much-needed fleet recapitalization. Through open, transparent and competitive processes, the RCN has selected three classes of ships that will form the basis of its future surface fleet. All of these ship classes are based to some degree on pre-existing foreign designs. So why does the RCN need to modify, or "Canadianize", these already existing designs?

Design change can exist in many different forms, and usually results in a spiral of related changes. Specific equipment selection such as radars and ship's boats, two of many examples, may need to be changed to meet operational or technical requirements. These items may come in different physical sizes, or have ancillary requirements that differ from the original design, resulting in modifications to the ship's structure or electrical power distribution, wiring or cooling design – all of which must be captured and managed.

The need to adapt the pre-existing designs can be explained using the RCN's Joint Support Ship (JSS) procurement as an example. The JSS is part of the National Shipbuilding Strategy that was started in 2010 to reinvigorate the Canadian marine industry sector, as well as renew the RCN and the Canadian Coast Guard fleets. In 2013, the RCN decided that the German navy's Berlin-class auxiliary ship design would form the basis for replacing Canada's two aging supply ships – Her Majesty's Canadian Ship (HMCS) Protecteur and HMCS Preserver.

The Berlin-class was designed in the 1990s, with construction beginning in the early 2000s, and the third ship, Federal German Ship Bonn, commissioning into service in 2013. By starting from a mature design, the RCN can learn from looking at some previous design iterations of the Berlin-class and apply those lessons to the JSS design.

So then, what does it mean to "Canadianize" the JSS? Broadly speaking, design changes made to the JSS will fall into four categories:

- Statutory/regulatory
- Policy
- Technical
- Operational

First of all, ships have design elements that must meet national and international regulatory and statutory requirements. The United Nations International Maritime Organization (IMO) has agreed upon these international requirements. Especially in the past decade, the requirements in this category of design changes have become more stringent and span a wide range of design elements from safety of life at sea (SOLAS) to environmental regulations. New regulations have been introduced to address the inclusion of new technology, such as electronic navigation charts and emerging risks to cyber-security in communications systems.

As an example of a regulatory change the JSS must contend with, environmental regulations addressing engine exhaust gases are more stringent today than those that existed when the Berlin-

class was initially designed in the 1990s. These new regulations aim to limit nitrous and sulphur oxides as well as greenhouse gas emissions, which are all significant sources of global pollution. In order to comply with these new regulations, the JSS requires more efficient engine designs to meet its given speed requirements. These new designs will also have to account for new low-sulphur fuel formulas that have different lubricating properties than past formulas, and new technology such as exhaust gas scrubbers that must be designed into the ship. As updated engine designs for the JSS address these new environmental requirements, associated systems that support the engines must themselves be adapted or relocated to accommodate the new engines' size and shape.

While warships such as the JSS are exempt from complying with many of the IMO's regulatory requirements, it is Canadian Armed Forces' (CAF) policy to meet or exceed regulatory requirements wherever possible. There are many reasons for this policy. For example, if the JSS did not meet the regulatory requirements of a host nation, that nation may deny the ship entry to its ports, thereby restricting the RCN's operational freedom. The government of Canada also has strong environmental stewardship policies, and the RCN must aspire to be the best possible steward of the environment when considering ship design and efficiency.

The next category of change from the Berlin-class design that the JSS must address is policy. Policies such as physical and information security regulations, administrative and personnel policy, government procurement or even defence policy itself can result in a requirement to change the design. In the JSS's case, the German navy and RCN are NATO allies and share a close friendship, but do not share all the same governmental or military-specific personnel and operational policies. Indeed, even within the CAF, policies are continuously evolving and the future fleet must adapt to deliver ships to meet the needs of our future sailors. An example of emerging policy, and its implication on ship design, is the drive for cultural change in the RCN toward greater inclusivity. The heads and wash places (i.e., washrooms) in the JSS are being designed from a gender-neutral perspective. They will aim to avoid communal-type showers or stalls with just curtains in favour of those with lockable doors, and will have sufficient space for sailors to change and hang their clothes. The washrooms will forgo urinals and instead be equipped with toilets in their own area with lockable doors.

Other policies pertaining to physical and cyber-security differ in the CAF from those in the German navy, and Canada's own national and departmental security policies have rapidly evolved over the past decade. Updated policies on the handling of ammunition, quality of life at sea, training, nutrition and physical fitness are additional examples of change that all drove specific requirements in the JSS design process. Perhaps most significantly, the government of Canada's procurement policy has also contributed to design change. The desire to procure from Canadian suppliers, the inclusion of regional industrial benefits considerations and the establishment of a Canadian supply chain for future fleet support all drove differing levels of "Canadianization" of the Berlin-class. While Canadian suppliers may have products similar to the original design, they may nonetheless require additional changes, such as power supply, from the original design built for a different region of the world.

Technology is the third silo of design change. Undeniably, we live in a world of rapid change. A ship designed in the 1990s and produced through the 2000s simply does not integrate all the available technology that will enable the RCN well into the future. The use of the Naval Ship Code – the rules governing the design and construction of modern warships – is a new development since Berlin was first designed, and an example of leveraging future technology.[1]

Commercial vessels are built to classification societies' standards that ensure new ships meet the myriad of IMO and other regulatory codes. However, the use of classification societies is a relatively new concept for warships, and indeed the RCN. By using the codes, which are monitored by a classification society, Canada can further reduce risk during construction of the JSS, and more importantly, access new business analytics tools and technology for improving the future fleet's overall maintenance and serviceability. It dovetails nicely with the idea that the JSS is a digitally enabled ship, as it will have a Wi-Fi backbone to provide a quality-of-life network that future sailors can use to leverage other technologies like augmented and virtual reality, which have only recently been examined for consideration. Training on the JSS will include the use of virtual ship models, a sort of "digital twin" with embedded training lessons and the ability to support future operational and engineering analysis. This technology did not exist when the Berlin-class was designed and built, but if the RCN is to remain a relevant force well into the future, it must deliberately move into the digital world with vigour.

The fourth and final area of change is of course operational, in terms of procedures, equipment and conduct of operations. *Strong Secure Engaged*, Canada's defence policy, requires the RCN to have global reach, flexibility and staying power. Therefore, whether the JSS is operating in the heat of the Arabian Sea, the cold of Canada's Arctic or alongside in Dubai or Nanisivik, the ship's systems and the very steel of its hull need to be able to handle all extremes of climate and temperature. Canada also needs a ship that can operate independently, support a Canadian task group or integrate into a U.S., Five Eyes, NATO or other coalition force and contribute to the full spectrum of military operations. The ship must be capable of supporting combat operations in the future threat environment, which will require enhanced survivability measures and improved interoperability with the RCN's future fleet and partner navies. It must also be able to support the rapid provision of humanitarian relief, represent Canada through defence diplomacy and support a broad set of government priorities.

The weapons, shipboard combat, navigation and engineering management systems, along with command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) systems and networks for the JSS all differ from those of the Berlin-class and all require some level of adjustment to the original design. Furthermore, the manner in which the RCN deals with damage – be it a fire, flood or need for redundancy – to ensure that survivability of the JSS and our sailors' safety are of the utmost priority, are reflected in the design considerations and incorporate the hard lessons learned from disasters like the original HMCS Protecteur engine room fire.

[1] The Naval Ship Code is available at https://www.navalshipcode.org/Home/NavalShipCodes.

The JSS also needs to be capable of handling multiple CH-148 Cyclones, Canada's maritime helicopter, which has its own unique operational and maintenance requirements that need to be considered. A simple example – the need to move the ship's flag because it blocked the Cyclone pilots' sight lines – tells us not all changes need to be as large and complex as changing the engine design, but are nonetheless necessary.

While the Berlin-class is a highly capable class of ship operated by a close NATO ally, the RCN has had to modify certain key features to meet the capabilities and requirements to undertake the missions and roles Canada assigns it over the long term. Selecting an existing German design to form the basis of the RCN's future supply ships has substantially reduced overall risk by giving us a known starting point. Wherever possible and practical, design changes incorporate solutions that provide economies of scale in training, supply chain management and system maintenance and allow greater flexibility in crewing options.

The examples provided herein are only some of the many changes – ranging from relatively simple to very complex – that go into "Canadianizing" a warship design, and all of this change is important to delivering the right ship for Canada.

Building a warship remains an incredibly challenging and highly complex undertaking that requires specialized skills and experience. The process of "Canadianization" forms the critical bridge from a mature design to one that meets the RCN's unique circumstances and operating requirements.

Figure 1: Artist's rendering of the JSS

Figure 2: HMCS Protecteur under construction at Vancouver shipyard, January 2021

Figure 3: Artist's rendering of the JSS supporting a Halifax-class vessel during replenishment at sea

Figure 4: 3D model of HMCS Protecteur

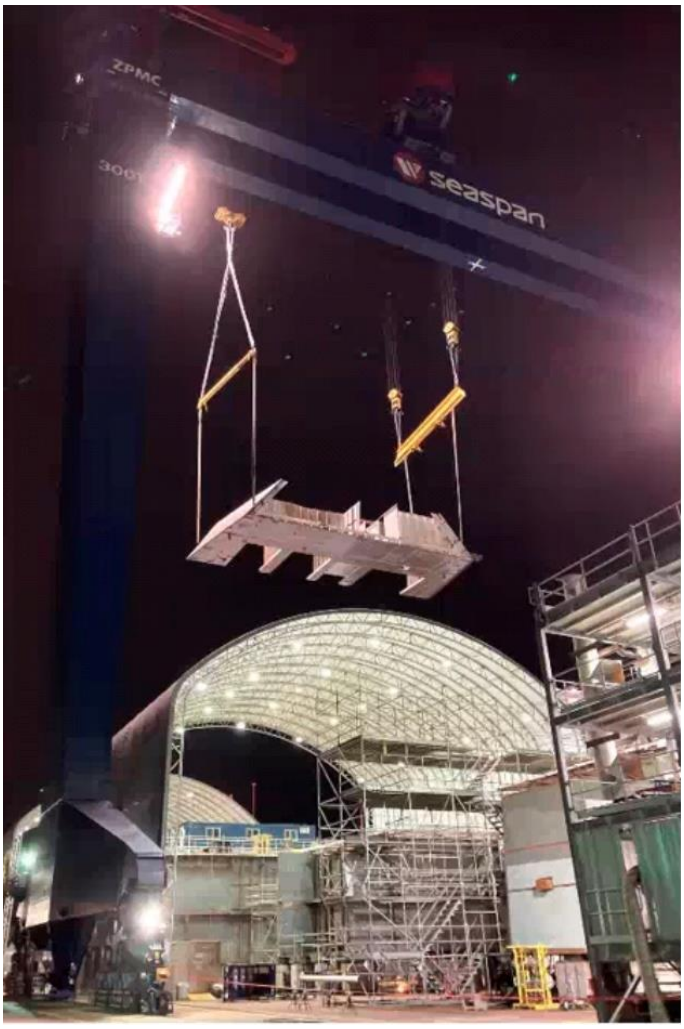

Figure 5: Block being lifted onto HMCS Protecteur at Vancouver shipyard, December 2020

About the Author

Captain (Navy) ***Douglas Campbell****, MSM, CD is the Director of Naval Major Crown Projects for the Royal Canadian Navy.*

Having held numerous operational positions on four different Halifax Class frigates, his time at sea was highlighted when he assumed command of HMCS St Johns in 2012. Following his command, he was appointed as the Military Advisor to His Excellency, the Governor General of Canada, David Johnston. He also worked in various directorates for the Chief of Force Development of the Canadian Armed Forces.

Captain (Navy) Campbell is a graduate of the Royal Military College (Kingston), Joint Command and Staff Program (Toronto) and the Australian War College. His advanced degrees are in Defence Studies (Royal Military College) and Politics and Policy (Deakin University, Melbourne, Australia).

Canadian Global Affairs Institute

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