



KEEPING WARSHIPS AT SEA MODERNIZATION OF NAVAL SHIPS

This Briefing Note on *modernization* of naval ships should be read in conjunction with Briefing Note #31 which discusses *maintenance* of naval ships. Naval modernization is a process of upgrading operational capability in response to an existing or emerging threat, and/or in order to be able to execute new tasks assigned by the government. Modernization could be said to occur when a system is no longer supportable for technological reasons, for example, when obtaining replacement parts, coding, etc., is no longer possible. Thus major software, firmware and hardware changes are usually required as they will not last the life of the ship and likely not meet the threats – current or in the near term. And cost could be a consideration, i.e., a system may still work but the cost to fix parts becomes, or is predicted to become, so high that replacing it is the only option.

While maintenance involves fixing what assets already exist, modernization means bringing something new that was not in the original design. It can involve either retrofitting a current platform (ship modernization), or acquiring a completely new vessel (fleet modernization). To continue with the example of your car used in Briefing Note #31, maintenance is when you take your car to the garage to get the oil changed so your engine runs smoothly. Modernization would be if you took your car to the manufacturer to get a different engine so you can go faster.

As we discussed in Briefing Note #31, maintenance can include, among other things, painting the deck, flushing coolant and aligning weapons and sensors. The difference between maintenance and modernization begins when you integrate new equipment with the existing platform. Any big changes, especially new capability, fit into the category of modernization. Modernization usually requires larger, longer and more expensive effort than maintenance.

Because warships are utilized for many years, they need to be modernized. As we know from our personal lives, technology changes quickly. So what might have been cutting edge 10 years ago is now almost obsolete. A warship that is 10 years old – a relatively young age in a warship – can be far behind in technology, including navigation, communication and weapon systems, all of which are hugely important in a warship. As well, environmental standards change, and more women are joining the RCN, both of which may mean that a ship has to be modernized to comply with new technical, safety and accommodation standards.

The RCN has a number of assets (see Briefing Note #10). These include frigates, maritime coastal defence vessels and submarines. In this Briefing Note, we will focus on the *Halifax*-class frigates and *Victoria*-class submarines.

The modernization process begins with an assessment of the navy's ability to conduct its assigned missions. Based on intelligence reports, advice from engineers and information from allies, the Directorate of Naval Requirements (DNR) comes up with a Statement of Operational

Capability Deficiency (SOCD). This triggers a number of agencies and processes. This could involve the Naval Engineering Test Establishment (NETE), the Department of National Defence's (DND) main naval test and evaluation centre.¹ This ensures the engineering safety and effectiveness of naval equipment. It could also involve Defence Research and Development Canada (DRDC) if new capability is being developed or tested. From an engineering perspective, Director General Maritime Equipment Program (DGMEPM) would also identify requirements as part of a modernization program. The RCN could also involve the Canadian Forces Maritime Warfare Centre along with other intelligence and operational reports/information from within DND or allies. In addition, these days the RCN/Assistant Deputy Minister (Materiel) (ADM Mat) rely heavily on industry to identify how to address requirement deficiencies from an operational or ship system perspective.

Once the operational requirements are identified ADM Mat (DGMEPM) is the authority which will oversee and 'shepherd' the modernization to meet the RCN's requirement(s). Following this, ADM Mat will work closely with Public Services and Procurement Canada (PSPC) which is the government's contracting authority and which ensures that contractual obligations are met. The process ends up with acquisition, installation, set-to-work and, finally, acceptance trials by the RCN.

Normally navies undertake a 'mid-life' modernization of their ships. For example, by the mid-2000s, the RCN's frigates were just passing 10 years in service, and the government established a refit program to modernize them. The contracts for the Halifax-Class Modernization/Frigate Life Extension (HCM/FELEX) program were awarded in November 2008, and \$4.3 billion was allocated as the budget.² Five ships were modernized on the West Coast and seven on the East Coast. What made this modernization rather than maintenance was that new equipment was installed, leading to new capabilities.

Complex modifications, such as HCM/FELEX, that require massive change of numerous systems inside a ship's hull are conducted in a dry dock under contract with a selected shipbuilder. This kind of undertaking usually precedes construction of a new platform – for example modernizing the frigates is to keep them going until the Canadian Surface Combatants (CSC) are constructed – because no matter how much the *Halifax*-class frigates are modernized, it is unlikely that the ships will be able to satisfy current *and* forecasted warfare requirements.

The upgrades to the frigates included: a new Combat Management System (CMS-330) which involves the computers that control weapons and sensors; new fire control systems; new air surveillance radars; new systems of electronic warfare, communication and navigation; Integrated Platform Management which includes engine room monitoring; improved damage control systems; and changed crew accommodations.

¹ NETE provides independent verification and validation, as well as expert test and evaluation services to the Royal Canadian Navy (RCN) and other Canadian defence organizations.

² Media release, "Halifax-class modernization and frigate life extension," 2018, available at <https://www.canada.ca/en/department-national-defence/services/procurement/halifax-class-modernization.html>. For an in-depth examination of the FELEX program see a special issue of *Maritime Engineering Journal* (March 2017), <http://www.cntha.ca/static/documents/mej/mej-82.pdf>.

In April 2016, HMCS *Regina* was returned to the RCN as the fifth and final frigate on the West Coast to be modernized, and in November 2016, the modernization of HMCS *Toronto* was complete, the seventh and final frigate on the East Coast. The program was officially closed out in January 2019.

The *Victoria*-class submarines have also been modernized since they were purchased in 1998. All the submarines have been through Extended Docking Work Periods (EDWP). For example, HMCS *Corner Brook* entered its Extended Docking Work Period in 2015, which was completed in 2018. The EDWP included repairs to the damage the submarine sustained in 2011, including the replacement of some of its external structure and the sonar bow dome, as well as upgrades to key combat systems, including the torpedo, upgrades to the primary sonar system, installation of a new modern satellite communication system, and communications intercept capability.³ Continuing modernization projects will be undertaken as part of the Victoria Class Modernization Program.

How modernization is executed depends on whether the projects are one-offs, done as a package of installations and/or a combination of both. As noted in Briefing Note #31, the scheduling of work on ships must take into account a number of factors, including maintaining the overall capability and readiness of the fleet. How the work is scheduled depends on length of expected refit and major docking periods, impacts on other refit/docking work, among other considerations.

While it makes sound policy, modernization is not without problems. One of the major challenges inherent in modernization efforts is that the new system/equipment has to be integrated with the legacy equipment onboard. This ‘old/new combo’ can be problematic, and there can be significant interface problems.

Communication and weapon technology can change quickly but warships stay in service for long periods. This means that if the warships are to remain effective, in addition to regular maintenance, they have to be modernized through their service lives.

³ Department of National Defence, “Victoria-Class Submarines,” no date, available at <https://www.canada.ca/en/department-national-defence/services/procurement/victoria-class-submarines.html>.