



## The Modernization of Naval Ships

The regular maintenance of vessels is not the only requirement for a navy seeking to maintain an effective and efficient fleet. Indeed, a navy must also undertake naval modernization, defined as the process by which a navy upgrades its operational capabilities to ensure it can perform its government-assigned functions and/or in response to an emerging or existing threat.

Modernization also necessarily occurs when a system used on a vessel becomes technologically obsolete or unsupported – for instance, when the requisite replacement parts become obsolete and can no longer be acquired, or when the software used in the weapon, communication, or navigation systems ages and no longer meets requirements. Changing environmental standards and personnel composition (for instance, the integration of more women into the Royal Canadian Navy (RCN)) also requires that vessels be modernized to ensure they conform to new safety, accommodation, and technical standards. Cost considerations could also compel modernization, if a system is still operational but requires parts that have become too expensive to acquire. As a result, a vessel will typically need significant hardware, firmware, and software changes to continue to operate effectively, as such systems do not generally last for the entirety of a vessel's lifespan (particularly when warships are often used for many years). Since these changes involve the integration into the existing vessel of new elements, systems, or equipment, rather than fixing the preexisting systems, this is called modernization instead of maintenance. Modernization typically is a more time-intensive – and expensive – process than maintenance. Generally, modernization includes any significant changes, especially if those changes add a new capability.

There are two types of naval modernization. While ship modernization entails retrofitting an existing platform, fleet modernization consists of procuring an entirely new vessel. The modernization process commences with an assessment of the RCN's capacity to perform its requisite missions. The Directorate of Naval Requirements (DNR), with the aid of intelligence reports, information from allies, and engineering advice, compiles a Statement of Operational Capability Deficiency (SOCD), which in turn sparks a variety of processes. The Naval Engineering Test Establishment (NETE), the primary naval evaluation and test centre of the Department of National Defence (DND), could become involved to ensure that the engineered equipment is safe and effective.<sup>1</sup> The process could also include Defence Research and Development Canada (DRDC), in the event that new capabilities are being tested or developed. The Director General Maritime Equipment Program (DGMEPM) would be involved from an engineering standpoint in identifying the requirements of the modernization program, and the RCN could also draw upon and involve the Canadian Forces Maritime Warfare Centre, as well as other operational information/reports and intelligence from the DND or from allies. Today, the RCN and/or Assistant Deputy Minister (Materiel) (ADM Mat) also depend upon industry to determine the means by which requirement deficiencies can be addressed at the ship system or operational level. Following the determination of the operational requirements, ADM Mat (DGMEPM) assumes responsibility for overseeing the modernization program and ensuring its compliance with the RCN's needs. In the ensuing procurement process, ADM Mat works alongside Public Services

and Procurement Canada (PSPC), which is the contracting authority for the Government of Canada that assures that contractual commitments are fulfilled. The modernization process ends with the system or vessel's acquisition, installation, set-to-work, and RCN acceptance trials.

Navies often perform “mid-life” modernizations of the vessels in their fleets. An example is the RCN's *Halifax*-class frigates. By the mid-2000s, these vessels had exceeded a decade in service. As such, the Government of Canada commenced a refit program – the Halifax-Class Modernization/Frigate Life Extension (HCM/FELEX) – to modernize the vessels. The government awarded contracts for the program in November 2008, with a budget of \$4.3 billion.<sup>2</sup> Under the program, the vessels received new equipment and new capabilities, including a new Combat Management System (CMS-330) involving the computers controlling their sensors and weapons, new air surveillance radars, altered crew accommodations, better damage control systems, new fire control systems, Integrated Platform Management (including engine room monitoring), and updated navigation, communication, and electronic warfare systems. Seven vessels were modernized on the East Coast and five on the West Coast, with HMCS *Regina* (the final frigate to be modernized on the West Coast) being returned to the RCN in April 2016, and HMCS *Toronto* (the final frigate to be modernized on the East Coast) being finalized in November 2016. January 2019 marked the formal and official closure of the program. Such complex and extensive modifications like those performed under HCM/FELEX, which require overhauls of several systems within a vessel's hull, are undertaken by the contracted shipbuilder in a dry dock. Typically, these mid-life modernizations occur before the construction of a new platform that is able to meet both the current requirements as well as the anticipated requirements that the preexisting class cannot. In the case of the *Halifax* class, these modernizations are intended to keep the class functional and operational until their successors, the Canadian Surface Combatants (CSCs), are constructed and enter into service.

The RCN's Victoria-class of submarines provide another case study of the naval modernization process in Canada. Since their purchase in 1998, all four of the submarines have undergone Extended Docking Work Periods (EDWP). For instance, HMCS *Corner Brook* endured an EDWP from 2015 to 2018, which repaired damage the vessel had incurred in 2011 (including replacing its sonar bow dome and sections of its external structure) and installed upgrades to the torpedo combat system, primary sonar system, communications intercept capabilities, and satellite communication system.<sup>3</sup> The modernization of the *Victoria* class will continue in the coming years under the Victoria Class Modernization Program.

Overall, how a modernization program proceeds is contingent on whether the project is part of a package of installations, whether it is a one-off, or whether it is a combination of both. Modernization work must be prescheduled, with its scheduling depending on the anticipated time needed for the refit and major docking periods, as well as the program's impact on or place within the other docking or refit work occurring at the shipyard. The scheduling must also account for the need to maintain the readiness and capability of the overall fleet.

Scheduling complications are not the only challenges that arise from modernization programs. Indeed, integrating new equipment and systems into an older vessel, to function alongside older equipment and systems, can create interface issues. However, given that warships tend to remain in service for lengthy periods of time, and because weapon and communication technologies

evolve and change rapidly, modernization is a necessity for warships and naval vessels to remain operational, effective, and efficient throughout their years of service.

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## References

<sup>1</sup> The NETE offers independent validation and verification, in addition to expert evaluation and test services to the RCN and other defence organizations in Canada.

<sup>2</sup> Department of National Defence (DND), Media release, “Halifax-class modernization and frigate life extension,” 2018, <https://www.canada.ca/en/department-national-defence/services/procurement/halifax-class-modernization.html>. For more on the FELEX program, see *Maritime Engineering Journal*’s March 2017 special issue at <http://www.cntha.ca/static/documents/mej/mej-82.pdf>.

<sup>3</sup> DND, “Victoria-Class Submarines,” <https://www.canada.ca/en/department-national-defence/services/procurement/victoria-class-submarines.html>.