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Making Waves

Comments on “Canada’s Submarines are Sunk Costs” by Michael Byers

Eric Lerhe

In the Winter issue of *Canadian Naval Review*, Michael Byers gave us a thoughtful review of the history of the *Upholder*-class submarines, valuable insights on the cost of maintaining submarines, and a good tour of today’s submarine market with its plentiful sellers and eager buyers.¹ I am not, however, sure as to his claim that the sunk cost fallacy is the “main reason” why Canada has stuck with the *Upholder*-class “instead of purchasing new ones” that is the central theme of his article (noting he also suggests getting rid of the class as another option).²

Sunk costs and the sunk cost fallacy have been defined as follows:

In economics, a sunk cost is any cost that has already been paid and cannot be recovered. The sunk cost fallacy is a mistake in reasoning in which the sunk costs of an activity – instead of the future costs and benefits – are considered when deciding whether to continue the activity.³

Byers illustrates this well with his example of the holder of a \$50 concert ticket holding back from selecting a viable, and in this case more preferable, alternative option of going to a friend’s party. Throughout the economic literature the presence of such a credible alternative option is key to understanding the sunk cost fallacy.⁴

Yet early in the 1990s and well before sunk costs entered the picture, credible options to buying used submarines were few and getting rid of them was indeed considered. Certainly, the 1992 Liberal Green Paper on defence had submarines, with some other equipment, under review with the note that “Canada must decide if they are cost-effective in the effort to enhance Canadian security and sovereignty interests.”⁵ Cost-effectiveness has been a recurring theme.

The 1994 Parliamentary review of defence policy that followed the election of the Jean Chrétien government soon heard more on submarines including calls for eliminating them. The Canada 21 Council, led by Ivan Head and Janice Gross Stein, was one of the most influential participants early in the review, and it argued for purchasing peacekeeping support vessels over submarines and

eliminating the existing ones.⁶ This recommendation and many of the Canada 21 Council’s other suggestions for eliminating combat capability more generally failed to gain the Parliamentary Committee’s support. In the end, the committee’s report on future defence policy argued for keeping submarines based on their effectiveness and low operating costs. Their recommendation, however, came with a major caveat in that it would not sanction a “conventional capital replacement program” for the aging *Oberon* submarines that would cost \$4-6 billion. Rather, it argued

If it should prove possible, in the current environment of military downsizing around the world, to acquire 3 to 6 modern diesel electric submarines on a basis that was demonstrably cost-effective (i.e. that could be managed within the existing capital budget), then the government should seriously consider such an initiative.⁷

Canada’s economic situation and strained government finances had effectively eliminated the ‘buy new’ option. In 1993, Canada’s 10.8% unemployment rate was exceeded only by Australia and Spain amongst the 13 heavily industrialized states, while the federal debt to GDP ratio approached 68%, a level only surpassed by Italy and Belgium. It was argued that Canada’s \$750 billion debt drove up interest rates, hazarded economic recovery and hampered the government’s future ability to pay for services to the hard-pressed and unemployed. As a result the 1993 election was fought on the two issues of debt and



Credit: Jacek Szymanski,
Navy Public Affairs, DND

HMCS *Victoria* transits in the vicinity of Esquimalt during sea training trials and exercises, 20 February 2012.



Credit: Chris Howell/http://www.shipspotting.com

HMCS *Onondaga* (S73), an *Oberon*-class submarine, Montreal, 8 October 1985.

the economy, with the Liberal Party's manifesto, the Red Book, promising to lower unemployment and reduce the government's annual deficit to less than 3% of GDP by 1997. The Department of National Defence (DND), ominously, was the only federal department specifically singled out in the Red Book for a spending cut.⁸ With the navy at that time consuming the largest part of DND's capital plan as a result of the Canadian Patrol Frigate Project, and the army carrying the weight of the multiple peacekeeping operations and needing new equipment, a \$5 billion brand new submarine program similar to the ongoing Australian *Collins* purchase was not a realistic option. The White Paper that followed concluded similarly, and stated it planned to "explore the option" of acquiring the *Upholders* which had recently been put up for sale.⁹ The case for retaining the submarine capability had been effectively made, and the *Upholder* purchase was named the 'Submarine Capability Life Extension' in order to make clear that this was not a new submarine buy.

This is not to say that buying used submarines did not bring problems. Certainly, the extended period – six to 10 years – the submarines lay awaiting a buyer until they were delivered to Canada presented reactivation issues and Byers makes this clear. However, Captain (N) Norman Jolin argues that during that reactivation:

Yes they found problems, but in speaking with four initial COs all were adamant that the British fixed all the issues *at their cost* and the submarines were turned over to Canada exactly as agreed to. So to suggest they were in poor material shape on turnover is not true.¹⁰ (Emphasis in original.)

After discussing the submarine purchase, Byers then argues that the sunk cost argument was resorted to whenever governments questioned the submarine capability.¹¹ However, on each occasion his wording is very tentative with no citations in support of DND's apparent sunk cost thinking. Thus we have his assertion that when the Chrétien and Harper governments questioned the need for submarines, "on both occasions, [mid-1990s, and 2007] proponents of the submarine program *would have* pointed to the large amounts of money that had already been spent," and "the sunk costs argument *may have* been invoked again [in 2012]."¹² (The italics are mine.)



Credit: Andrew Vaughan / CP

HMCS *Windsor*, one of Canada's four *Victoria*-class submarines, is returned to the waters of Halifax harbour after a five-year refit, in Halifax, 11 April 2012.

In the years since 1994 I have served as Director Maritime Force Development, Director NATO Policy and as a member of the Naval Board, and at no time was I ever aware of any example of DND resorting to the use of past high expenses – sunk costs – to justify retaining a submarine capability. More typically DND managers defend capabilities by arguing in precisely the opposite direction outlining how inexpensive a platform was, is and will be. In fact, the Leblanc article Michael Byers cites includes elements from a recent navy briefing note on submarines that brags:

“This [the *Upholder* buy] compares most favourably with the cost of six Australian submarines at over \$5-billion, or French or German submarines costing approximately \$600-million or more each,” the navy said. “The Victoria class submarines represent excellent value for the money invested.”¹³

Using past large expenses or future cancellation costs as a justification for retaining a program was also a sure loser with the Chrétien and current Justin Trudeau governments during elections. For example, the EH 101 helicopter program was summarily cancelled despite the known \$478 million contract closing penalty, while the F-35 fighter jet procurement was written off during the election despite Canada having paid some \$160 million, and possibly more, to be a ‘level three’ participant in the program.

Byers’ article is on far firmer ground when he discusses the high costs of submarine maintenance. Indeed, the excellent Andersson article he cites shows many navies are facing difficulty providing adequate and, especially, economical maintenance for their submarines. While Byers cites the case of HMCS *Windsor*’s refit stretching from two to five years, extended refit times are shown to be problematic elsewhere, including states with newly-delivered subs.¹⁴ In fact brand-new submarines do not seem to fare any better in this regard. The Australian National Audit Office has estimated that in 2008 the *Collins*-class (with six submarines) consumed some \$235 (A) million annually in contracted maintenance.¹⁵ Byers’ data show Canada’s annual contracted rate, based on \$2.6 billion over 15 years, equates to \$173 million per year, although this is for four submarines. New-build has not delivered significantly lower costs and the in-depth Andersson report provides no hint of any other state doing any better.

Another point Byers tackles is the apparent low availability rate of the *Upholders*, noting “only one is currently



HMAS *Collins* arrives in Sydney Harbour, 24 September 2010.

available for immediate employment.”¹⁶ This availability rate is actually the norm in the US Navy which aims to have 10 submarines ready for deployment based on a fleet size of 40-48.¹⁷ The availability of Australia’s *Collins*-class appears similar and, again, the Andersson article does not suggest anyone is doing much better.¹⁸

Finally, the *Collins*-class submarine history also shows that new submarines do not necessarily have an easier or shorter route to full operational capability than Canada’s used submarines did. It took some 10 years for the *Collins*-class submarines to reach full capability and that required replacing the entire combat system and one of the submarine’s sonars and upgrading its torpedo to the US Mk 48 mod 7 standard.

Canada’s *Victoria*-class took the same time to get sorted out. It too eventually got the same high grade torpedo, a new firing system to manage it, the Canadian towed array, and the BQQ 10 sonar system, the same one fitted in the most advanced US nuclear submarines. Rear Admiral John Newton has called this sonar and torpedo combination “the most lethal submarine weapons system on the planet.”¹⁹ The article by David Perry in the same issue of *CNR* as the Byers’ article also outlines in detail how HMCS *Windsor* is performing very well in international exercises and was recently assigned by NATO to the tracking effort against four Russian nuclear and one conventional submarines operating near Greenland.²⁰

Byers correctly points out that Canada is fast approaching the time when it must consider the replacement of the submarines, and he provides an excellent review of the

alternatives. He also suggests that the decision to replace must also consider “shut[ting] the program down.”²¹ In his article, he approaches divestiture in a very balanced way, noting the many arguments for and against it. Canadian governments have also considered this option, but each time they have come solidly down for submarines and provided the funds to upgrade and maintain them. In part, this recognizes that Canada has no other vehicle offering stealth and lethality. However, it is also clear that with submarines we can expect Canadian governments to fund them, and defence needs generally, with, as Kim Richard Nossal has recently written, “the minimum money we can get away with.”²² 🍷

Notes

1. Michael Byers, “Canada’s Submarines are Sunk Costs,” *Canadian Naval Review*, Vol. 12, No. 4 (2017), pp. 20-24.
2. *Ibid.*, p. 20.
3. “Sunk Cost Fallacy: Throwing Good Money After Bad,” Strategic Thinking and Strategic Action, 21 March 2015, available at <http://leepublish.typepad.com/strategicthinking/2015/03/sunk-cost-fallacy.html>.
4. This important point was first raised in this context by David Perry at the Naval Association of Canada Conference in his presentation, “Recapitalising the Fleets of the Government of Canada – What Next for Canada’s Shipbuilding Strategy?” Ottawa, 20 October 2016. And many thanks.
5. Liberal Party of Canada, *Green Paper on Defence*, Ottawa: Liberal Party of Canada, 1992, p. 18.
6. Canada 21 Council, “Canada 21: Canada and Common Security in the Twenty-First Century,” Toronto: Centre for International Relations, University of Toronto, 1994, pp. 64, 79.
7. Canada, Special Joint Committee of the Senate and the House of Commons on Canada’s Defence Policy, *Report of the Special Joint Committee on Canada’s Defence Policy - Security in a Changing World 1994* (Ottawa: Parliamentary Publications Directorate, 1994), p. 38.
8. Liberal Party of Canada, *Creating Opportunity: The Liberal Plan for Canada* (the ‘Red Book’), Ottawa: Liberal Party of Canada, 1993, p. 20.
9. Canada, Department of National Defence, *1994 Defence White Paper*, Ottawa, 1994, p. 47.
10. Capt (N) Norman Jolin (Ret’d), email to author, 28 March 2017.
11. Further, the citations he provides do not fully support his claim that various governments “considered scrapping” the *Upholders*. The Ivison footnote provided makes clear the claim that the government of Prime Minister Jean Chrétien “considered getting out of the submarine business altogether” was made before the *Upholders* were purchased. In the 2007 and 2012 cases, the evidence that the Conservative government was thinking of eliminating the submarines is based entirely on the unsubstantiated and much-extended speculation of the reporter and no evidence of Conservative government intent is provided. Even the reporter admits “sources suggest the submarine fleet will survive Mr. Flaherty’s budget axe.” See John Ivison, “Sinking Canada’s Troubled Sub Program at Budget Time May Make Sense,” *National Post*, 28 December 2012. The other source provided cites “federal sources,” and “some officials,” not the Conservative government. In fact the only Conservative cited, the Minister of National Defence, “offered his full support to Canada’s submarine program.” See Daniel LeBlanc, “Submarines Good Value, Navy tells MacKay,” *The Globe and Mail*, 18 March 2008.
12. Byers, “Canada’s Submarines are Sunk Costs,” pp. 21-22.
13. LeBlanc, “Submarines Good Value.”
14. Jan Joel Andersson, “The Race to the Bottom: Submarine Proliferation and International Security,” *US Naval War College Review*, Vol. 68, No. 1 (Winter 2015), pp. 18-20.
15. Australia, Australian National Audit Office (ANAO), “Management of the Collins-class Operations Sustainment - Department of Defence,” Audit Report No. 23 2008–09, Canberra, 2009, p. 39. I have removed the Australian contracted training costs as this was not in the Canadian contracts.
16. Byers, “Canada’s Submarines are Sunk Costs,” p. 22.
17. Ronald O’Rourke, “Navy Virginia (SSN-774) Class Attack Submarine Procurement: Background and Issues for Congress,” Congressional Research Service, 22 March 2017.
18. John Coles, *Study into the Business of Sustaining Australia’s Strategic Collins Class Submarine Capability*, Government of Australia, November 2012, 1-111, pp. 9-14. See also ANAO, “Management of the Collins-class Operations Sustainment - Department of Defence,” pp. 57, 58

19. Canada, Standing Committee on National Defence, “Evidence,” 22 November 2016, No. 29, 1st Session, 42nd Parliament, p. 1130.
20. David Perry, “The Navy’s Prospects in Trudeau’s Defence Policy Review,” *Canadian Naval Review*, Vol. 12, No. 4 (2017), pp. 25-29.
21. Byers, “Canada’s Submarines are Sunk Costs,” p. 24.
22. Kim Richard Nossal, *Charlie Foxtrot: Fixing Defence Procurement in Canada* (Toronto, Dundurn, 2016), p. 108.

Ocean Patrol Corvettes for the RCN Now

David Longdale

Limited budgets and rapid acceleration in the development of anti-ship weapons are all having a major effect internationally on the selection of future naval vessels, their weapons, defence and the strategic scenarios of future conflicts. High-value targets such as aircraft carriers, cruisers and destroyers are already vulnerable even after spending more on their defence than on offensive weapons.

Now falling into the category of high-value targets, at between \$2.5-3 billion USD each, are the new batch of sophisticated frigates now entering navies worldwide or under consideration by many navies including Canada. By the time these enter service from the late 2020s through until 2045, the threats will undoubtedly have multiplied, making their defence and weapons already obsolete at time of delivery.

To address this problem, the following commentary outlines the rationale to proceed with the immediate purchase of 12 Ocean Patrol Corvettes (OPC)¹ for the Royal Canadian Navy (RCN) – in the same urgent spirit of the WW II corvette program – to ensure Canada’s sovereignty in these challenging times.

The RCN’s duties and responsibilities are considerable and include homeland coastal and trading route protection, keeping alliance commitments globally, responding to crises worldwide, and protection of Canadian sovereignty. All this is to be achieved with a small fleet and the longest coastline in the world. This clearly is a major undertaking for a country with a small population as a tax base, and perhaps this is why an international survey puts Canada’s coastal defence on a level with Bangladesh and Indonesia.²

The RCN currently has capable, but limited, assets. These include the 12 frigates of the *Halifax*-class which joined the fleet as they were built from 1988 to 1996. These frigates have just completed the *Halifax*-class FELEX Modernization Program which has upgraded them mostly on weapons, defence and communications with only minor upgrades to the aging hull and machinery. These vessels are highly utilized covering extensive and mostly international commitments. Although upgraded, however, they



Credit: Naval Museum of Manitoba

HMCS Norsyd was a modified **Flower**-class corvette that served with the Royal Canadian Navy during the Second World War. She served primarily in the Battle of the Atlantic as a convoy escort.

are still below par in comparison with many in-service modern frigates including some NATO allies in Europe, as well as in Russia, China and India.

As well, the RCN has 12 *Kingston*-class Maritime Coastal Defence Vessels (MCDVs), which were built from 1996 to 1999. The MCDVs are being used as a substitute for the frigates in some cases but are unsuitable for many of these missions. The MCDVs were a compromise design and they are not suitable for all offshore use and are lightly armed with limited mine countermeasure capability to counter current sophisticated mine technology.

There are also four *Victoria*-class submarines which Canada purchased from the United Kingdom. This story has been well covered, and the RCN deserves better.

And, finally, there will be five (or six?) of the *DeWolf*-class Arctic Offshore Patrol Ships (AOPS) arriving between 2018 and 2022. These will be light ice class vessels with minimal armament, slow speed and not really suitable for deep ocean use or heavy multi-year ice. Although they are expensive at \$600 million each, they will still be no match for the high-powered Russian icebreakers which are being delivered in large numbers. In this regard, I lament the cancelling of the CCG Polar 8 in the 1990s, on which I was a member of the design team. It was an opportunity lost to show the world that Canada is serious about protecting its Arctic sovereignty.

With the National Shipbuilding Strategy, the Canadian Surface Combatant – the frigate replacement program

– has begun. But the process has slowed down, and it seems from the recent budget that there will be further delays. Also the competition has been opened to vessels that have no service experience which adds risk. The latest budget estimate being bandied around is north of \$40 billion³ which is bound to escalate further as there is no competition. There is also an estimated further \$64 billion for operations, crew and life-time support. I believe the first vessel will come into service after 2025 and the final ship is projected for 2045+. When delivered, it's likely the weapon, defence and communication systems will already be obsolete especially on the earliest vessels.

Naval history shows that by ignoring evolving threats even the mightiest vessels can come to grief. Changing technology and changing threats create obsolescence. For example, battleships of WW II were built only to fight other similar ships, and that meant that most were lost to air attack. As well, in the Falklands War in 1982, Royal Navy cruisers were vulnerable to Exocet missiles due to aluminum superstructures plus limited air defence.

In the 21st century will this be repeated? Up until now, aircraft carriers have survived due to a massive protective bubble, but they are now vulnerable due to these current (known) threats:

- multi-head anti-ship ballistic missiles;
- third generation cruise missiles (air, submarine and land launch);
- hypersonic anti-ship missiles with speeds to 4,500 mph;



The ship *Vigilant* of the Mauritius Coast Guard.

- 100+ knot long-range smart torpedoes (multi-launch) with 200 knot coming soon;
- cyber intervention including taking control of equipment (for example, denial of satellites, GPS);
- drones (surface, submerged and air drones);
- new generation stealth submarines;
- littoral-based threats (including, swarming, long-range shoulder-fired missiles, long-range smart shells and laser); and
- advanced smart mines.⁴

High-value targets will always be vulnerable to attack. After all, they are high-value not only to the possessor but also to the enemy. Will the new high-cost frigate replacements also be a major target? They will be high value to

Canada because they will be few in number and therefore each critical to any defence strategy.

But what if Canada had another option? Let us explore the Ocean Patrol Corvette concept as an option to the new CSC/frigates. The trend worldwide is a rapid build of OPV/Corvettes ranging in length from 75m to 110m with various degrees of military specialization which greatly affects cost and delivery. Most are commercial standard hull and machinery with optional weapons and defence packages. Australian and Indian Navy reports in 2016 indicate there are 136 on order worldwide in 24 countries, 276 are in advanced planning in 30 countries, and China has built 40 of 60 Type-056 corvettes with 30 in service.⁵

Why is the world building these ships in such quantity? These can be formidably equipped vessels. They can fulfil 70% of a frigate's platform requirements, at a fraction of a modern frigate's cost. They are versatile and they are easily adapted to different mission profiles, and they are ideal platforms for plug-and-play weapons systems (LCS model). As they are commercial-off-the-shelf (COTS) plus best available quality (BAQ) equipment and materials, they have low through-life costs and parts are available worldwide. They are built to high international standards in accordance with universally accepted marine inspection classification societies (such as ABS, Lloyds, DNV/GL) which approve design, equipment and inspect vessel compliance throughout the construction and delivery process. Because of this, they can be built at low cost in most countries, and with fast delivery.

These ships are not unknown to Canada – the RCN has had experience with corvettes. The RCN's corvette experience



Credit: Irish Defence Forces

The Irish Naval Service ship *LÉ Samuel Beckett* (P61) on naval exercise manoeuvres, 19 June 2014.



Credit: New Zealand Defence Force

Fleet Officer of the Watch manoeuvres in the Hauraki Gulf in northern New Zealand, including HMNZS Otago (foreground), and other ships of the New Zealand navy, 14 December 2010.

in WW II was the most significant contribution to winning the Battle of the Atlantic. By 1945 Canada had the fourth largest navy in the world. The RCN trained numerous emerging navies after WW II, including the Indian Navy, which purchased many of the Canadian corvettes. In the 1980s two OPVs were constructed for the Canadian Coast Guard (CCG)/Department of Fisheries and Oceans (DFO) – *John P. Tully* and *Lenard J. Cowley*. These ships are continuing to provide sterling service with their 75m length and 14m beam.

Canada's OPV/Corvette designs are currently recognized internationally, and include such design companies such as VARD, Naviform and Robert Allan in Vancouver. Since the 1990s, Canada has also been involved in constructing corvettes for other countries, including Ireland, New Zealand and Mauritius.

The Mauritius OPV example is interesting. Based on the CCG/DFO OPV design, Western Canada Marine Group (WCMG), an engineering, procurement, construction and maintenance (EPCM) company of which I was President, won an international tender for an OPV for the government of Mauritius in 1994 against fierce competition among naval shipyards including from the UK, France, Germany and the Netherlands to name a few. The ship was delivered in 1996. It was constructed in the Chilean Navy shipyard ASMAR as no Canadian yards were interested in bidding at that time.

This was the first of what is now a significant lineage of OPV designs from Canada. The Canadian influence on

OPV/Corvette design continued with the delivery of six Irish Navy vessels. I was involved in the contract negotiations for the first two *Rieson*-class 75m OPVs as President of WCMG. These evolved to the Irish Navy *Samuel Beckett*-class which are 90m long with a 14m beam. All are designed by VARD (then Polar Design) in Vancouver and

Table 1. Comparison of an OPV and a New Naval Frigate

Type	Irish Navy 90m OPV	BAE Type 26 Frigate
Cost each 2017 Can\$	\$80,000,000*	\$2,800,000,000++
In-Service Delivery	20 months	6 years?
LOA	90m/300'	150m/492'
Beam	14m/46'	21m/68'
Speed max	23 knots	26 knots
Crew	44 + 15	120 + 80
Standard	COTS/BAQ/Class	Mil Spec.
Weapons/Defense	1 x 76mm Ot.Mel. +LCS Pacs.	Full Suite
Upgrades/Refits	Fast/limited drydock	Extended periods
Features	Plug&play: high interior volume	Full Nav/Mil Spec.
Survivability	Steel construction/ subdivision	Full Nav/Mil Spec.

* *Plymouth Herald*, "Babcock Appledore announcement of another Irish Navy OPV priced 48 million pounds," (Cdn) \$80 million, 16 June 2016.

PACIFIC CORVETTE SQUADRON 2024



Credit: Author

Proposed Pacific Corvette Squadron 2024.

which was the naval architect for the original Mauritius OPV. They were all constructed at Babcock Appledore, UK.

The ship design is very flexible and there are different versions of this OPV concept. New Zealand's navy now has two 85m OPV with a large helideck. In September 2016 the US Coast Guard awarded a contract for 25 OP Cutters with a length of 105m to Eastern Marine, Florida. It is also a design by VARD, Vancouver and it is now completing the detailed design.

The typical OPC provides flexibility. It has space for weapon/defence systems, command centre and large crew accommodation. The main propulsion option of diesel electric provides low radiated noise, redundancy, flexibility and reserve power for weapon/defence systems. The option of split offset engine and control room provides for redundancy. There is space for a typical weapon/defence package. It has the option for a large helideck with hangar suitable for mid-sized helicopters or large unmanned aerial vehicles (UAVs). And, finally, it has space for four fast rescue/boarding RHIBs.

Is plug-and-play and low radiated noise realistic for corvettes? Yes. Modern OP corvettes have to accommodate the rapid installation and removal of weapon and defence packages to be effective in fulfilling many of the roles of the modern frigate. They also have to meet comparative low radiated noise criteria.

Recently I was Program Manager for the design and construction of two US Navy/Office of Naval Research 74m research vessels (*Neil Armstrong* and *Sally Ride*) and, in 2006, for the University of Delaware/NSF research vessel *Hugh R. Sharp*. These complex vessels met the following:

- very low radiated noise in accordance with ICES requirements. This was achieved by 3D resilient mounting of all rotating machinery, careful routing and support of piping, isolation from hull of all equipment and use of special tiles, etc.;
- zero cavitation propellers and zero bubble sweep down achieved by careful propeller design and special hull techniques;
- allowance for large arrays of sonars in various configurations with quick change out capability;
- easy access exposed layers of cable trays with transit between spaces and through decks for cables, piping, utilities;
- exposed area decks and designated internal spaces have high load sockets throughout to allow quick installation and removal of equipment; and
- adequate reserve clean electrical and utility power supplied to stations at strategic locations for fast removal/installation of systems.

By adopting these same features in the OPC design, construction is not an expensive item and provides the plug-and-play flexibility.



How will a Fleet of OP Corvettes Benefit Canada?

While Canada waits for the first new CSC/frigates to appear, a fleet of 12 (six East Coast/six West Coast) 90m OP corvettes could be in operation by 2024. The first could be in service by 2019. The cost of the 12 OPCs, excluding weapons and defence systems, based on an existing proven design such as the Irish OPV, would be (Cdn) \$1.2 billion. Adding weapon/defence mission packages for 12 vessels would cost (Cdn) \$3.0 billion, for a total of (Cdn) \$4.2 billion. This compares to 15 new surface combatants/frigates at \$42 billion (plus through-life costs plus expensive upgrades and spares due to military specification requirements, especially later in the life cycle).



Credit: Author

Design of a future Fast Attack Corvette with advanced wave-piercing hull form.

The OPCs would quickly be able to help perform the RCN's major roles and relieve pressure on the existing frigates at considerably reduced operating costs. It would also be possible to train crews on mission-specific packages ashore and/or at sea resulting in fast crew workup with specialized knowledge when deployed with their package. Finally, repair/maintenance of the OPC platform is relatively simple and easy due to COTS design and low-cost parts which are available worldwide.

There is also a possibility of an attractive support vessel option for the OPCs. It is recommended that the RCN investigate acquiring sophisticated inspection, maintenance, repair (IMR) vessels to support an OPC squadron. These are versatile vessels normally used extensively on deep well offshore oil work. They have many features that are ideally suited to OPV support including large helidecks, up to 250 crew accommodation, major fuel and water cargo capacity, highest dynamic positioning certification

(DP3), major propulsion redundancy, high volume storage space under and on deck, remote-operated vehicles (ROVs), large command centres and bridges, and up to 400 ton motion-compensated cranes, to name a few. They are available, often new out of a shipyard, for very low prices of around \$30 million. Prices would normally be \$160+ million but they are low now due to a major overbuilding of these types of vessels worldwide and low utilization because of the downturn in oil prices and production.

To make this project feasible, the Canadian government would have to adopt a hands-off approach and allow it to be organized as a commercial project. This is a new mindset but is the only way of avoiding long approval processes and having too many fingers in the pie which would escalate costs and disrupt the whole production process. I have had success with the EPCM ship construction projects in the past in a number of different formats and feel that this is the most advantageous approach in this case. An EPCM company – let's call it Corvette Constructors Canada (CCC) – would be totally responsible for the project including design, detailed engineering, procurement, quality assurance, management and, most importantly, in control of the funds. These can be very dynamic organizations and generally use modern management techniques. EPCM companies are common on large industrial projects worldwide.

Sourcing would be worldwide using commercial-off-the-shelf material and equipment and best available quality, including the actual shipbuilding portion. Canadian content would be considered but not as a policy. It is recognized that Canada does have many companies with quality and technically competitive expertise and on the Mauritius OPV project over 100 BC companies supplied material and services. Non-traditional sources should be investigated especially from emerging naval powers such as India and Turkey that have a growing expertise in naval systems. For vessel construction, the UK, Korea, Poland (BC Ferries had all its recent ferries constructed in Poland with excellent results) and some non-navy yards in the United States could be investigated.

Why now? Commercial shipbuilding worldwide is in major recession due mainly to overbuilding of offshore oil service vessels, container ships and bulk carriers. Due to the collapse of oil prices and slowing trade, there is now a large surplus of building capacity worldwide for commercial vessels such as OPCs. This is not the case in naval construction. Worldwide naval vessel construction is at

record peace-time levels and growing fast in the Asia-Pacific region. It is the same in Canada where the three major players – Irving, Seaspan and Davie – are busy for the foreseeable future on RCN/CCG projects. Based on this, it is prudent and timely to go out into the market today with a large commercial project based on multiple numbers of the same vessel. This would get high interest and allow CCC to negotiate incentives, offsets, securities, bonds etc. Now is the time, it will not last.

Conclusion

Canada could be a leader by facing the new reality of naval operations and taking into account the rapidly changing threats to ships and homelands. Canada has the knowledge, experience, innovation and capability to lead in this new naval age by being bold, in the spirit of the WW II corvette program, and proceed immediately with a new corvette program. As Canada did in WW II, the navy could obtain extremely capable ships, quickly and at a reasonable cost. 🍷

Notes

1. These OPCs are sometimes also called Offshore Patrol Vessels (OPVs) or Frigates-lite!
2. See Mark Montgomery, "More Trouble for Canada's Navy and Its Only Destroyer," Radio Canada, Inet, 7 October 2015.
3. Murray Brewster, "Ottawa to Face Decisions on Navy's Frigate Replacement Program," *The Globe and Mail*, 20 March 2016.

4. See *Naval Forces*, Vol. 38, Numbers I, II (2017). These issues contain articles about the defence of and threats to aircraft carriers.
5. Defence IQ (UK), "Global Offshore Patrol Vessels Market Report 2015/16," Australia CASS-India Study "Role of Offshore Patrol Vessels (India)," 2016.

Diminishing Numbers

Poseidon

It is a bad time to be adding up numbers in Canada's Naval Order of Battle (ORBAT). Canada's last destroyer, HMCS *Athabaskan*, was paid off 10 March after 44 years of service, and will soon join her sisters at a scrap yard. The AOR *Protecteur* is being scrapped at Liverpool, NS, and HMCS *Preserver* is being de-stored and readied for a similar fate. Both of these ships were essential components of the fleet for four and a half decades: much longer than intended when the ships were built. The Naval Oceanographic Research Vessel *Quest*, one of the world's quietest surface vessels for many years, will join the disposal queue without replacement. Meanwhile, one modified interim AOR is being converted from a secondhand container ship at Davie Shipyard in Quebec and there are plans to build two Improved *Berlin*-class AORs at Vancouver Shipbuilding – one hopes that steel will be cut soon after many delays and promises. A cynic might say



Credit: Torphoto/Wikimedia Commons

The last of Canada's Iroquois-class destroyers. HMCS *Athabaskan*, 19 April 2009.



I'll believe they're really going to be built when the Prime Minister attends the keel-laying.

What of replacing the destroyers and eventually the existing frigates, with the Canadian Surface Combatant, or will that wait until the Liberal government balances the budget in 2050? Pardon me for expressing doubt, but while tuning in to Mount Olympus recently I heard an interview with Finance Minister Bill Morneau. He informed the interviewer that there was no intention for large defence capital expenditures until 2035. He may have been badly informed or he was telling the truth – I hope it was the former! Perhaps politicians actually believe destroyers, support ships and maritime aircraft last for 45 years (55 and counting in the case of the Sea King!) because that has become the norm in recent decades. In the case of the ships, they may continue to float and look impressive to the uninitiated alongside in their dockyards, but they have a propensity to develop cracks, undependable engines, or the odd unexpected fire due to the ravages of old age.

Such age-related issues are not the fault of their operators, who in my experience work very hard to squeeze the last few months and years out of their weary ships. It is the fault of uncaring politicians who don't believe that there are many votes to be won through defence spending, and who hope that these weapons will never be needed to defend the voters who elected them. In these increasingly uncertain times, I would prefer that the politicians spend the measly amount dedicated to defending Canadians in a more-timely manner, rather than pray the fleet is never needed to defend the country from a determined enemy. Perhaps they are also praying that President Trump will not hold Canada's feet to the fire to honour its promise to spend not 1% but 2% of Gross Domestic Product on defence?

With funding like that, the ORBAT could be fleshed out to adequate numbers composed of less arthritic ships. 🙄

Research and Development on Maritime Hybrid Warfare: It's in Canada's Interest

K. Joseph Spears

The President of the United States has called on Canada (and some other NATO members) to spend 2% of its Gross Domestic Product (GDP) on defence to meet its NATO commitments. There is no binding obligation under the North Atlantic Charter which has as its underpinning the

collective defence of all 28 NATO member states. Presently Canada spends \$20 billion a year on defence expenditures, and a major proportion of the government budget, which represents 0.9% of GDP. Canada takes the position that it is a strong NATO partner both historically and at present, and there will be no increased defence funding. Canada's political leaders argue that there are different ways to calculate the value received from defence expenditures and measure contributions to NATO not solely related to domestic defence expenditures. In the early part of the Cold War, Canada spent 7% of GDP on defence, much of it committed to NATO obligations in northern Europe.

The NATO discussion is a healthy one and highlights many issues in a rapidly changing and complex threat environment that the NATO alliance faces. Canada's ongoing defence review can provide a starting point for how Canada links research and development in its vital national interests which are interwoven with defence expenditures.

The defence review has been the subject of a number of articles.¹ The articles have examined national interests and the importance of defining these interests because they are the foundation on which an integrated foreign, security and defence policy rests. Arguably, this extends to Canada's commercial and international trade policy as well. All these issues are interconnected and interact in the national interest and real time.

One emerging area of defence which requires ongoing thinking and research and development is hybrid warfare. In general, commentators, scholars and military officers cannot agree on the definition of hybrid warfare. Leading naval thinker US Admiral (Retired) James Stravridis, a former NATO Supreme Commander, and now Dean of the Fletcher School of Law and Diplomacy in Boston, had this to say on the subject in a recent article:

Given its need to appear somewhat ambiguous to outside observers, maritime hybrid warfare generally will be conducted in the coastal waters of the littorals. Instead of using force directly from identifiable 'gray hull' navy platforms, hybrid warfare will feature the use of both civilian vessels (tramp steamers, large fishing vessels, light coastal tankers, small fast craft, and even 'low slow' skiffs with outboard engines). It also will be conducted and likely command-and-controlled from so-called white hulls assigned to the coast guards of given nations.²



Credit: Petty Officer 2nd Class Corbin J. Shea, USN

An unmanned underwater vehicle surfaces to be recovered in the Arabian Gulf during bilateral mine countermeasures exercise between the US Navy and Royal Navy, 27 October 2016. The exercise was designed to provide an opportunity to share knowledge of techniques to respond to mine threats.

It is clear that hybrid warfare, also often called asymmetrical warfare, is not limited to land operations. Given Canada's research capabilities, this presents an opportunity to develop expertise and research and development on this topic in the maritime domain. Canada's navy has been at the forefront of innovation in years past, and Canada has a long background in marine domain awareness, space-based sensors, synthetic aperture radar, artificial intelligence and the fusion of data from a variety of sensor sources. As well, Canada has longstanding proven expertise in applied ocean science and remote sensing. Interconnected with this is the use of cyber-technology which is growing in importance in the marine domain. Maritime hybrid warfare could be the core of the NATO Centre of Excellence in Canada.

Canada has had a long involvement in remote sensing and developing unmanned systems for various applied pur-

poses. This presents an opportunity for Canada to develop a hybrid warfare focus. Presently, through the National Shipbuilding Strategy, Canada is spending in excess of \$30 billion on naval vessels. This industrial output is for domestic consumption for the Royal Canadian Navy and there is very little opportunity for potential exports as this is not new technology. However, this increased shipbuilding capability could be leveraged and serve as a catalyst for a new approach to maritime defence and create new opportunities for Canada in maritime hybrid warfare. In commercial terms, the NATO market alone is 28 countries. Canada's future actions should be guided by the words of Admiral Stravridis:

The United States must start to consider its responses to hybrid warfare at sea, which may require developing new tactics and technologies, working closely with allies and partners, and



building U.S. hybrid capability to counter its deployment by other nations and eventually transnational actors.³

The development of technology and new ways of thinking and doctrine need to be integrated into addressing changing threats and changes to maritime warfare. Canada's investment in research and innovation could be leveraged into sales and cooperation with other NATO states that are all subject to the same maritime threats and who work together at sea. This presents a unique opportunity for Canada, and the creation of research clusters that bring together the scientific, academic and commercial communities is a step in the right direction. In Halifax, the Centre for Ocean Ventures and Entrepreneurship (Cove Centre) at the former Canadian Coast Guard base is moving forward to develop a marine sensor research cluster of academic institutions supported by government but does not at this time have a defence application.

Maritime hybrid warfare calls for a change in naval warfare and new thinking. It is in Canada's national interest to get involved on the ground floor. This mission and evolving threats present an opportunity for Canada to develop focused maritime expertise and research and development in a specific area. This would complement NATO's maritime capability to protect critical underwater infrastructure.⁴ As well, a focused national approach presents an economic opportunity for Canada. This is especially so as Canada is a maritime trading state, and dependent on maritime transport for exports and imports.

Getting the Canadian research and development community involved in the study of hybrid warfare in the maritime environment could have many positive commercial and defence benefits. This could lever in the \$30 billion expended in the NSS and create strong economic benefits for Canada. One of the most important results of developing a robust response to maritime hybrid warfare is that this will lead to increased stability in the global commons on which 90% of international trade flows. Like at Vimy Ridge in 1917, Canada is up to this maritime challenge which is a vital national interest. 🇨🇦

Notes

1. See the Special Issue published by CNR on the Defence Policy Review, Vol. 12, No. 1 (2016). See also Chris Maclean, "Defence Portfolio to get a Real Shake-up?" *FrontLine Defence*, Vol. 13, No. 1 (2016).
2. Admiral James Stavridis, USN (Retired), "Maritime Hybrid Warfare is Coming," *US Naval Proceedings*, December 2016.
3. *Ibid.*
4. See K. Joseph Spears, "Protecting Critical Undersea Infrastructure," *Frontline Defence*, Vol. 13, No. 1 (2016).

We Need a Navy, Right?

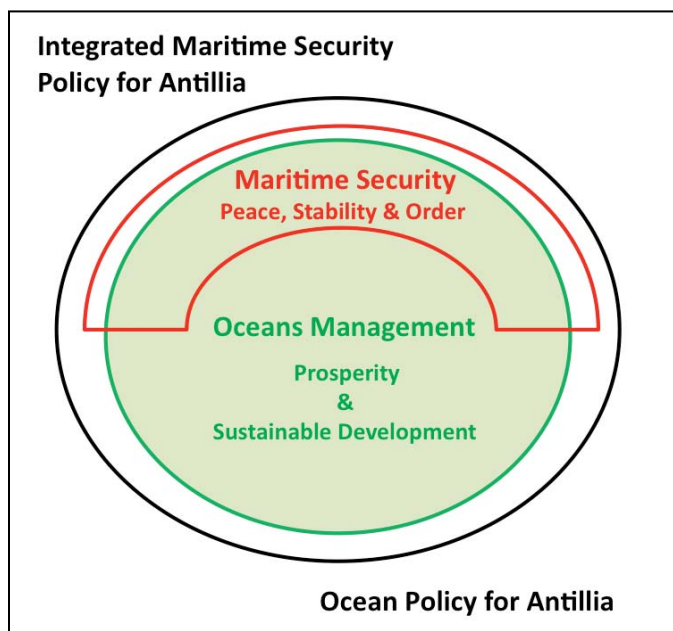
Bob Edwards

So, we need a navy. Right? Why not a coast guard instead – or do we need both? These are some of the questions overheard as training program participants begin work on developing a maritime security policy for 'Antillia,' a fictitious island state in the 'Lambent Sea.'

Neighbouring states are not unfriendly, but cooperation within the marine sector is virtually non-existent, and to the northeast lies Penagarria, a state with warlords and instability. The resulting piracy reaches into regional waters, and desperate migrants in unseaworthy craft pose a challenge to Antillia's leadership. Compounding the problem of confronting the multiple maritime threats facing Antillia are squabbles among government ministries for scarce funds, conflicting mandates and consistently poor on-scene coordination during marine incidents.

Each summer, Halifax's Dalhousie University hosts the International Ocean Institute (IOI) training program on ocean governance.¹ A diverse group of international participants from various marine-related disciplines are brought together for an intense interdisciplinary eight-

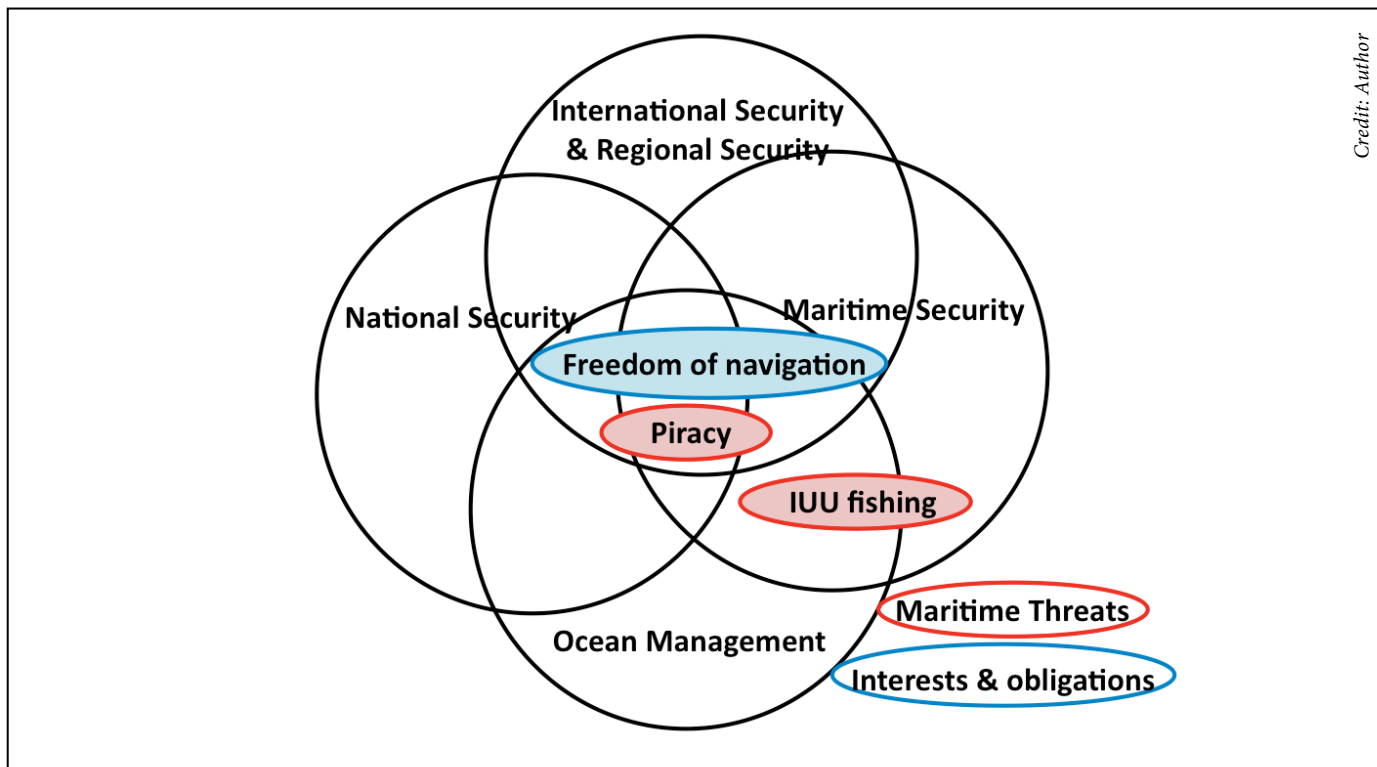
Figure 1. Maritime security as both an 'umbrella' over and an integral component of ocean management



Credit: Author

Source: Francois N. Bilet, Fred W. Crickard, Glen J. Herbert, *Integrated Maritime Enforcement: A Handbook* (Halifax: Centre for Foreign Policy Studies, Dalhousie University and International Ocean Institute, February 2000), p. 5.

Figure 2. Concepts and Principles



week program run by IOI-Canada, one of five IOI training centres worldwide. The program is aimed primarily at developing country mid-career professionals and has trained more than 680 people from over 100 countries – mainly from Asia, Africa, the Americas, the Caribbean and the South Pacific – since its inception in 1981.²

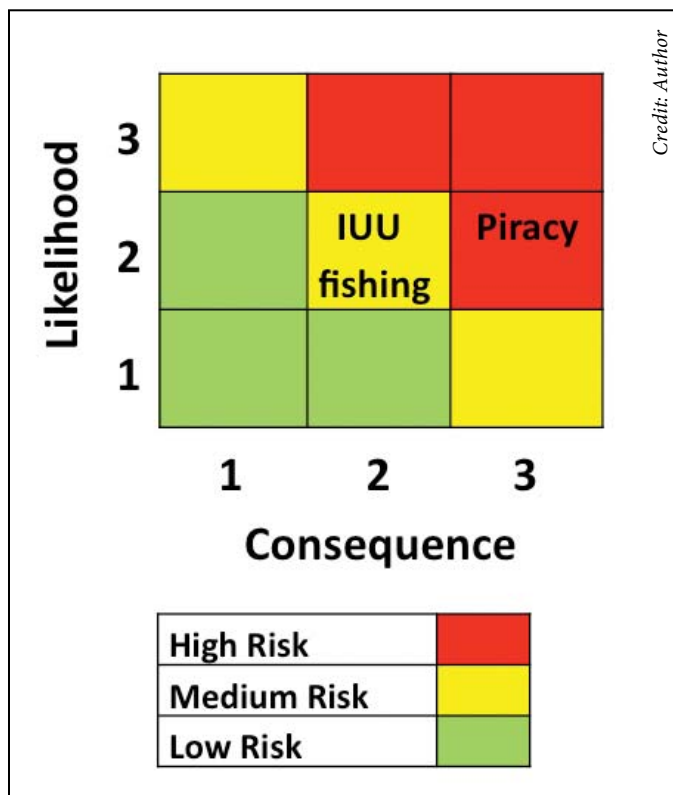
Conflicts and multiple users are ongoing features of ocean usage, so the IOI training program is grounded in the Law of the Sea Convention and international law. Prevention, response, cooperation and the peaceful use of the seas and coasts are ongoing themes.

The IOI program covers a range of thematic areas including: ocean sciences; integrated coastal and ocean management; fisheries and aquaculture; law of the sea and principled ocean governance; communication and negotiation; maritime security; marine transportation; and energy. A sophisticated program-long group simulation serves to consolidate the knowledge gained by the participants from these modules and has them form a national task force to develop an ocean policy for Antillia.

As part of this process, the participants must produce a maritime security policy which can then be integrated into the more comprehensive ocean policy document. A challenge for anyone thrown into group work is the issue of personal dynamics (been to Staff College?), but more

Figure 3. Risk Matrix

(IUU fishing = illegal, unreported and unregulated fishing)





so on this course with participants from very different backgrounds and cultures and, in some cases, representing states on different sides of current maritime disputes.

Prosperity and sustainable development within the marine sector require, of course, order and security on the oceans and along the coasts, and IOI's maritime security module with its policy exercise component addresses this important issue. In a way, the policy exercise is a legacy of the extensive work done at Dalhousie University by the Centre for Foreign Policy Studies (CFPS) since its founding in 1971.³

Among a number of ocean policy projects, the CFPS and Dalhousie University's Marine Affairs Program (MAP) produced a training manual in 1992 titled *An Integrated Approach to Maritime Enforcement*.⁴ This was used as the basis for a workshop which was incorporated into MAP

and IOI-Canada programs. The updated *Integrated Maritime Enforcement: A Handbook*⁵ provides both a sound theoretical and practical basis, as well as the methodology, for the current IOI maritime security policy exercise, and adds the important compliance component, which includes ocean users such as industry and coastal communities, to the model.

The training program participants are asked what they think of this diagram showing the overarching necessity of stability in order to achieve prosperity (see Figure 1). The point is to engage the participants and force them to assess ideas and material critically to assist them as they work through the policy development phase. Further, although efforts are focused on the end result, it is really the *process* which is important.

Figure 4. Example of a Final Matrix Worksheet (SUR = surveillance, MON = monitoring, CON = control)

Maritime Security - Shortfalls & Excess Capabilities

	Maritime Sovereignty			Illegal Activity			Marine Environment			Marine Resources						Marine Safety					
	S	M	C	S	M	C	S	M	C	Living			Non-living			Prevent			Respond		
	SUR	MON	CON	SUR	MON	CON	SUR	MON	CON	SUR	MON	CON	SUR	MON	CON	SUR	MON	CON	SUR	MON	CON
Operational																					
Underwater																					
Surface																					
Air																					
Space-based																					
Shore-based																					
Legal																					
National																					
International																					
Political																					
National																					
International																					
Non-state																					
Industry/user																					
Community-based																					

Minor shortfall	
Major shortfall	
Excess capability	

Credit: Author

Source: Worksheet adapted from *Integrated Maritime Enforcement Matrix*, in Francois N. Baillet, Fred W. Crickard, Glen J. Herbert, *Integrated Maritime Enforcement: A Handbook* (Halifax: Centre for Foreign Policy Studies, Dalhousie University and International Ocean Institute, February 2000), p. 31.

Figure 5. Point of departure for discussions about cooperation-coordination-integration.

(SUR = surveillance, MON = monitoring, CON = control)

Maritime Security - Shortfalls & Excess Capabilities																					
	Maritime Sovereignty			Illegal Activity			Marine Environment			Marine Resources						Marine Safety					
										Living			Non-living			Prevent			Respond		
	SUR	MON	CON	SUR	MON	CON	SUR	MON	CON	SUR	MON	CON	SUR	MON	CON	SUR	MON	CON	SUR	MON	CON
Operational																					
Underwater																					
Surface																					
Air																					
Space-based																					
Shore-based																					
Legal																					
National																					
International																					
Political																					
National																					
International																					
Non-state																					
Industry/user																					
Community-based																					
Minor shortfall																					
Major shortfall																					
Excess capability																					
Cooperation? Coordination? Integration?																					

Credit: Author

Credit: Author

Source: Worksheet adapted from *Integrated Maritime Enforcement Matrix*, in Francois N. Bailet, Fred W. Crickard, Glen J. Herbert, *Integrated Maritime Enforcement: A Handbook* (Halifax: Centre for Foreign Policy Studies, Dalhousie University and International Ocean Institute, February 2000), p. 31.

As the discussion proceeds, questions fly. What's the difference between a policy and strategy? *Canada's Oceans Strategy* leads off by stating it is a 'policy framework,' so what gives? What does 'integrated' mean in *Africa's Integrated Maritime Strategy*, and why doesn't it use the term 'cooperative' as in the *US Cooperative Strategy for 21st Century Seapower*? Guidance is provided rather than a definitive answer. And considering the participants' backgrounds, which are almost exclusively in non-security marine sectors, as well as the plethora of relevant material, efforts are made to concentrate on basic concepts, information and principles (see Figure 2).

Antillia has a navy and coast guard. But does it have the right balance of capabilities to counter the numerous maritime

threats and protect its national interests? Is the navy too small, too big? As the discussion unfolds, the complexity of these issues sinks in. Talks move in a building-block approach from the make-up of a warship on to force structures, doctrine, costs, interoperability issues, and so on. Case studies and examples are used to draw out important lessons. Throughout, a focus is kept on what capabilities navies and coast guards provide across the spectrum of marine activities, and on the benefits of effective coordination between the two.

The analysis itself is straightforward. After identifying maritime challenges, threats, interests and obligations as they relate to Antillia's maritime security, participants move on to a risk assessment to prioritize maritime threats (see Figure 3).



The next steps involve completing two matrix worksheets using a numerical system to determine, first, what is needed and, second, what capabilities currently exist. These two matrices are then compared to determine shortfalls and excess capabilities, as shown in Figure 4. Figure 4 shows an example final matrix worksheet which shows shortfalls which need to be bolstered, and excess capabilities which can be reassigned or deleted.

Armed with an analysis of the threats and a good sense of Antillia's maritime interests and obligations under international law, along with a visual representation of capability shortfalls, the group can then progress to an informed discussion as it develops its maritime security policy. At this stage, the emphasis is on where efficiencies can be gained through cooperation or coordination, or even integration where possible, both horizontally across the range of marine activities as well as vertically within the operational, legal, political and non-state areas. Figure 5 provides a point of departure for discussions concerning cooperation-coordination-integration.

As the group continues its work, there is an interruption – a garbled voice message was received from the M/V *Super Puffin*. Something about being shadowed by a small vessel thought to be a pirate mothership. Last known position about 250nm to the northeast of Antillia. Of course, the national task force is preoccupied with policy development, but some have 'day jobs' as well within their ministries and are expected to respond in crisis situations. What to do? Later, word is received that foreign naval

vessels have been spotted operating unannounced within Antillia's Exclusive Economic Zone. Is that allowed by international law?

And on it goes until the group finishes its work and presents its maritime security policy for Antillia. Understandably, the result is very much a work-in-progress, but it is always gratifying to see the participants' progress over the course of the exercise.

Back to the original question, we need a navy, right? To date, each training program has responded yes. 🇨🇦

Notes

1. See International Ocean Institute, Training at IOI-Canada, available at <http://internationaloceaninstitute.dal.ca/training.html>.
2. International Ocean Institute, IOI-Canada, 2016 Course Report, available at <http://internationaloceaninstitute.dal.ca/2016CourseReport.pdf>.
3. For example, see John Orr, *Canada's Oceans Strategies Project – The Atlantic*, 3 July 2014, available at www.dal.ca/dept/cfps/Pillars/mspp/canada_oceans-strategies-project-the-atlantic.html.
4. Fred Crickard, Bruce Donaldson, Iain Stewart, Jeremy Conway, *An Integrated Approach to Maritime Enforcement: Training Manual* (Halifax: Marine Affairs Program and Centre for Foreign Policy Studies, Dalhousie University, 1992).
5. Francois N. Bailet, Fred W. Crickard, Glen J. Herbert, *Integrated Maritime Enforcement: A Handbook* (Halifax: Centre for Foreign Policy Studies, Dalhousie University and International Ocean Institute, February 2000).

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