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A Holistic Approach to the Canadian Fleet

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A HOLISTIC APPROACH TO THE CANADIAN FLEET

By Lieutenant-Commander A. Mascarenhas

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AFCCL – Automatic Firearms Country Control List

AOPS – Arctic Offshore Patrol Ship

ATT – Arms Trade Treaty

BAE – British Aerospace Systems

BC – British Columbia

CAE – Canadian Aviation Electronics

CDA – Conference of Defence Associations Institute

CSC – Canadian Surface Combatant

DWP – Docking Work Period

FREMM – Frégate Européenne Multi-Mission

GDP – Gross Domestic Product

IMCS – Integrated Machinery Control System

IP – Intellectual Property

IPMS – Integrated Platform Management System

ISS – In-Service Support

ISSC – In-Service Support Contract

ITB – Industrial and Technological Benefits

JSS – Joint Support Ship

LLP – Limited Liability Partnership

MCDV – Maritime Coastal Defence Vessel

MDA – MacDonald Dettwiler and Associates

NATO – North American Treaty Organization

NS – Nova Scotia

NSP – National Shipbuilding Plan

NSPS – National Shipbuilding Procurement Strategy

NSS – National Shipbuilding Strategy

RAND – Research and Development

RCN – Royal Canadian Navy

SDSR – Strategic Defence Security Review

SMB – Small and Medium Businesses

SME – Subject Matter Expert

STEM – Science, Technology, Engineering, and Math

UK – United Kingdom

UN – United Nations

US – United States

VP – Value Proposition

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ABSTRACT

Canadian shipbuilding history is plagued with disappointment and failure. Canada has proved that the injection of projects can sustain an industry, but it can only do so for the period that the injections exist. The NSS provides Canadian shipbuilding with a long-term framework. This framework intends to allow for the longer-term sustainment of the Canadian shipbuilding industry. The longer sustainment of the shipbuilding industry will let Canada take on a more holistic approach to government fleets, from cradle to grave. This approach will ensure the maintainability of the new fleet into the future.

Canada is leveraging the use of domestic shipbuilding yards, tertiary benefits such as directed investments through Industrial Technological Benefits (ITBs), and Intellectual Property (IP) to do this. The decisions made by Canada may limit the effectiveness of the sustainment that Canada seeks to obtain. This includes the idea of international sales. Practically, the idea of international sales is a reasonable course of action to sustain an industry. Unfortunately, the Canadian shipbuilding industry is not well-positioned to succeed in international sales and therefore should not explore this avenue.

Despite some errors in decisions, Canada is positioned on a course that will likely allow the sustainment of the Canadian shipbuilding industry. Canada will therefore be able to take on a more holistic approach to the future Canadian fleet.

INTRODUCTION

Shipbuilding is a complex Industry. It is dependent on several aspects and intertwined with many factors, including policies, economics, and political desire. Some countries have established thriving shipbuilding industries almost overnight. Most notably, Japan following the Second World War.[1] Countries that have been able to establish a thriving shipbuilding industry have realized that this can only be accomplished with the support of the government.

Not only does this require significant financial contributions from the domestic governments, but it also requires policy support to ensure the long-term institutional commitment of the nation.[2] The Canadian government has indicated support for shipbuilding in the past. The introduction of the *Buy Canadian* policy for competitive federal procurements is but one example of this.[3] Unfortunately, a lack of rigid policy has allowed Canada to disappoint industry. Despite the policy holes, the Chretien government had been able to see the value of shipbuilding. The government issued contracts to build ships.[4] Once again, the lack of policy prevented any level of sustainment of the industry. Short of rigid policy, recent governments have realized the need for a framework for the long-term sustainment of the shipbuilding industry. This framework is the National Shipbuilding Strategy (NSS).[5] While historically it has not been the case, it appears that

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[1] Rima Mickeviciene, "Global Shipbuilding Competition: Trends and Challenges for Europe," in IntechOpen, 2011, doi:10.5772/17215. https://openresearchlibrary.org/viewer/c540c941-d68f-4650-8720-018f22c1fec3.

[2] Rima Mickeviciene, "Global Shipbuilding Competition: Trends and Challenges for Europe," in IntechOpen, 2011, doi:10.5772/17215. https://openresearchlibrary.org/viewer/c540c941-d68f-4650-8720-018f22c1fec3. p. 207-208.

[3] Industry Canada, *A New Policy Framework for the Canadian Shipbuilding and Industrial Marine Industry Focusing on Opportunities 2001,* Government of Canada, 2001.

[4] Jeffrey F. Collins, *Overcoming 'Boom and Bust'? Analyzing National Shipbuilding Plans in Canada and Australia,* Canadian Global Affairs Institute, 2019.

[5] *Canada's National Shipbuilding Strategy 2018 Annual Report.*

the Canadian Government is taking steps to ensure the sustainment of the domestic shipbuilding industry.

This policy support is vital. It will ensure that the industry is supported beyond the term of the current government. Canada has historically demonstrated a weak ability to support the shipbuilding industry. It has disappointed shipbuilding firms like Vickers and Yarrows, which set up yards in Canada with the expectation of contracts for a fledgling RCN.[6] These disappointments have set up a level of distrust between shipbuilders and the Canadian government, a distrust that is difficult to overcome.

Despite the failures of the past, the government of Jean Chretien is credited with realizing the economic value of shipbuilding. Canada saw the jobs it created and the industry required to support it. In an attempt to sustain the industry, Canada purchased twelve Maritime Coastal Defence Vessels (MCDVs) and twelve Halifax Class frigates.[7] While these purchases did maintain the economic shipbuilding industry for a period, they did not sustain it over the long-term. The Chretien government did introduce *A New Policy Framework for the Canadian Shipbuilding and Industrial Marine Industry*. While this framework was weak in policy support, it did establish the requirement to purchase federal ships in Canada.[8]

Recent governments have realized the need for a sustained shipbuilding industry to ensure Canadian fleets are cared for throughout their life. This led to the requirement

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[6] James S. Pritchard, *A Bridge of Ships: Canadian Shipbuilding during the Second World War* (Montreal: McGill-Queen's University Press, 2011), p. 4.

[7] Collins, *Overcoming 'Boom and Bust'? Analyzing National Shipbuilding Plans in Canada and Australia*

[8] Industry Canada, *A New Policy Framework for the Canadian Shipbuilding and Industrial Marine Industry Focusing on Opportunities 2001*

for a long-term framework. A long-term framework will allow some level of sustainment for the shipbuilding industry into the future. NSS, initially labelled the National Shipbuilding Procurement Strategy (NSPS), is the attempt of recent governments to reestablish a shipbuilding industry.[9] NSS provides a loose policy framework in an attempt to avoid the short term disappointments of the past.

In most countries, shipbuilding is only viable through support and subsidies from the government. For shipbuilding to succeed, it must meet the needs of domestic requirements. In contrast, it must also appeal to the international community.[10] Canadian shipbuilding has for a long time relied on government contracts for ships. The industry, by nature, is very cyclical.[11] Canadian shipbuilding has suffered the effects of a boom and bust industry. Without enough commercial business to sustain it, shipbuilding in Canada goes up and down according to government interest and procurement policies. With every project to build ships, Canada has also had to rebuild an entire industry.[12] This has also led to a significant lack of support capability for ships throughout their life. The National Shipbuilding Strategy represents an attempt to provide stable government contracts to private industry for three decades.

Canada and Australia have adopted similar approaches to shipbuilding. Both nations have established an overarching plan for the industry and are in the early stages of their plan. In both cases, the intent is to approach shipbuilding from a long-term

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[9] *National Shipbuilding Strategy* Government of Canada, 2021.

[10] Rima Mickeviciene, "Global Shipbuilding Competition: Trends and Challenges for Europe," in IntechOpen, 2011, doi:10.5772/17215. https://openresearchlibrary.org/viewer/c540c941-d68f-4650-8720-018f22c1fec3, p. 203.

[11] Tom Ring, *The National Shipbuilding Procurement Strategy* Canadian Global Affairs Institute, (2016), p. 1-2.

[12] Tom Ring, *The National Shipbuilding Procurement Strategy* Canadian Global Affairs Institute, (2016), p. 2.

perspective to ensure the domestic industry has the predictability it requires for long-term sustainment. The goal is to entice private industry to make investments in shipbuilding to secure government contracts.

Shipbuilding can be seen from four perspectives. The first perspective is that of major shipbuilders, the nations that have recently dominated the shipbuilding industry. The second is the United Kingdom and their work to maintain their current warship building industry. Australia and their work to redevelop a shipbuilding industry provide a third perspective to view shipbuilding. Finally, the work Canada is doing to develop a shipbuilding industry provides the final perspective.

Until the middle of the previous century, Europe dominated the shipbuilding industry. With the rise of the Japanese shipbuilding industry following the Second World War, Europe and Japan shared 90% of global shipbuilding.[13] Since then, many countries have realized the value of shipbuilding and have ensured that they can capitalize on shipbuilding domestically. Countries with cheaper labour, like Vietnam, Russia, and China, are only some of the countries that rose to take a significant piece of the global shipbuilding industry.[14] These countries capitalized on opportunities that shipbuilding industry provided by leveraging government investment to support the national vision. They saw shipbuilding as a way to build a nation. While Europe continues to maintain a niche shipbuilding market, the days of Europe dominating the shipbuilding industry are

[13] Rima Mickeviciene, "Global Shipbuilding Competition: Trends and Challenges for Europe," in IntechOpen, 2011, doi:10.5772/17215. https://openresearchlibrary.org/viewer/c540c941-d68f-4650-8720-018f22c1fec3

[14] Rima Mickeviciene, "Global Shipbuilding Competition: Trends and Challenges for Europe," in IntechOpen, 2011, doi:10.5772/17215. https://openresearchlibrary.org/viewer/c540c941-d68f-4650-8720-018f22c1fec3.

long gone. The orders placed with the newer entrants into the market are far exceeding the orders placed within Europe.[15] This was due to the shift in economic activity and trade towards Asia.

The approach of the Japanese shipbuilding industry in the 1990s is tremendously similar to the approach Canada is attempting to take. Japan rose quickly following the Second World War through efficiencies and willingness to change their approach. The limitation in their approach, however, was the internal focus of the shipbuilding program. More than 60% of the shipbuilding industry of Japan focused on internal shipbuilding. This internal focus limited the innovation and efficiencies within their system.[16]

South Korea was able to establish itself as a frontrunner in the shipbuilding industry as well. It did so through the development of several robust laws and policies including, ""Special Maritime Administration Committee" together with Shipbuilding Promotion Law (1958), Shipbuilding Industry Encouragement Law (1967), Shipbuilding Industry Promotion Plan (1975), Industrial Development Law (1985), Shipbuilding Industry, Rationalization Measurement (1989)."[17] These laws and policies ensure that the developing shipbuilding industry has the necessary support to succeed. A clear demonstration of this is the fact that today, several of the world's top-ranked mega shipyards are located in South Korea.

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[15] Rima Mickeviciene, "Global Shipbuilding Competition: Trends and Challenges for Europe," in IntechOpen, 2011). doi:10.5772/17215. https://openresearchlibrary.org/viewer/c540c941-d68f-4650-8720-018f22c1fec3. p. 220.

[16] Rima Mickeviciene, "Global Shipbuilding Competition: Trends and Challenges for Europe," in IntechOpen, 2011). doi:10.5772/17215. https://openresearchlibrary.org/viewer/c540c941-d68f-4650-8720-018f22c1fec3, p. 203.

[17] Rima Mickeviciene, "Global Shipbuilding Competition: Trends and Challenges for Europe," in IntechOpen, 2011). doi:10.5772/17215. https://openresearchlibrary.org/viewer/c540c941-d68f-4650-8720-018f22c1fec3, p. 207-208.

These new entrants into the shipbuilding industry have two similarities: the realization of the value in shipbuilding and the desire to make the necessary changes within their organizations to support the emerging industry. These countries also established a heavily subsidized steel industry, of which shipbuilding is an offshoot.

The United Kingdom

The United Kingdom also values the shipbuilding industry. As such, they have taken on a direct role in supporting the industry. British shipbuilding is largely focused on defence needs, like France, where shipbuilding takes place in arsenals and private shipyards. Even before the establishment of the National Shipbuilding Strategy (NSS) in the UK, there was awareness around the need to ensure that the shipbuilding industry was sustainable. The Strategic Defence and Security Review (SDSR) conducted in 2015 indicated the need for an affordable frigate to ensure that the shipbuilding industry in the UK would remain attractive to other nations.[18]

Major shipyards in the UK risk closure or have closed. The NSS intends to combat this. The NSS provides a consolidated effort to ensure that the UK shipbuilding industry is maintained. The UK is focusing on the niche market of warship design and building to sustain its shipbuilding industry. While the European shipbuilding market has slowly migrated towards countries with lower build costs, Britain has been able to maintain an industry with a warship focus. Unfortunately, much like other nations, without the support of the government, the industry is doomed. Seeing this, the UK

[18] Richard Scott, "UK Set for Shipbuilding Strategy Refresh," *Jane's Navy International* 126, no. 3 (2021).

government is attempting to ensure the survival of the industry through a concerted effort.

This concerted effort comes in the form of the British government taking on risk. This risk is taken on in the form of lesser capability within its navy. The introduction of the Type-31 comes with less capability for the Royal Navy. The intent, however, is that this model of frigate will be more marketable to the world.[19] The marketability of the design is hoped to ensure business for the UK shipyards through foreign contracts. Interestingly, at this point, there appears to be more sales of the more capable Type-26 than of the Type-31.

Overall, readings suggest that to sustain a shipbuilding industry in the UK, the British government has taken on risk within the capability of the Royal Navy. The hope is that the capability developed at a reasonable price will attract other nations. Nations seeking an economical general-purpose frigate are being sought to support the British shipbuilding industry. The United Kingdom is ensuring the sustainment of their shipbuilding industry by providing products that are attractive to customers.

Australia

Australia is currently undergoing a fleet renewal. During this renewal, Australia has decided, like the UK, to ensure domestic production capability exists. As such, Australia has developed its own National Shipbuilding Plan (NSP). This plan focuses on the domestic production of ships for the Royal Australian Navy.

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[19] "Type 26 Global Combat Ship (GCS) – Capabilities," last modified October 24, accessed Mar 11, 2021, https://www.thinkdefence.co.uk/the-type-26-frigate/type-26-global-combat-ship-gcs-capabilities/.

Ian Mack worked within the Australian shipbuilding field. His writing points out several advantages that the Australian defence procurement process has. These advantages have allowed Australia to begin delivering products to the Australian government.[20] Unfortunately, Australia has encountered ballooning costs associated with projects, as is typical with most countries trying to build a domestic industry focused on high-end warships from scratch.[21]

These cost overruns are associated with reinvigorating an industry that has suffered from a boom and bust cycle. The boom and bust cycle is common in shipbuilding. This cycle occurs when the industry develops during the production of ships and slowly dies following neglect due to insufficient commercial business to sustain the industry. The NSP strategy addresses this specific issue. The intent is to take a long-term view of ship procurement. The hope is that this approach allows the industry to thrive with constant demand rather than surge during high demand times and atrophied during times of low demand.

Overall, Australia is attempting to sustain a domestic shipbuilding industry through the use of domestic demand. The hope is that a long-term view will be in line with the sustainment needs of the industry.

Canada

Canada is taking on a similar approach to Australia, with similar pitfalls. Canada is attempting to address the sustainment of an industry, an industry that has been

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[20] Ian Mack, *Emerging Lessons from the National Shipbuilding Procurement Strategy* Canadian Global Affairs Institute, 2019.

[21] Collins, *Overcoming 'Boom and Bust'? Analyzing National Shipbuilding Plans in Canada and Australia*.

repeatedly plagued with a boom and bust cycle. As a result of this boom and bust cycle, the estimates and financial commitments for projects have grown.[22] Canada has realized that, while combating the boom and bust cycle would be beneficial, there are other values associated with the industry. The industry promises to bring jobs to the economy, along with savings. Canada is also considering the needs of the Canadian fleet beyond the build cycle. Canada is aware of the need for an industry to conduct the necessary work on vessels throughout their life. As such, Canada is planning the sustainment of an industry with a vision of future needs.

Canada built simple warships domestically during and following the Second World War.[23] Despite multiple interventions by the federal government, Canada is still plagued with a boom and bust shipbuilding industry.[24] The federal government has taken a close interest in the shipbuilding industry since the 1960s. This is when the first government subsidies were extended.[25] This continued until the reductions and rationalization of the industry in 1986 when the government ended subsidies. The Canadian government effectively bought out the Quebec and Ontario portions of the industry by generous unemployment insurance benefits extended to workers leaving shipbuilding. Without the long-term support of the government, the industry has been unable to self-sustain. This has manifested itself in the ballooning budgets seen in recent ship procurements in Canada. Most recently, this has been evident in the budget of the

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[22] Jeffrey F. Collins, *Overcoming 'Boom and Bust'? Analyzing National Shipbuilding Plans in Canada and Australia* Canadian Global Affairs Institute, 2019, p. 7.

[23] Marc Milner, *Canada's Navy: The First Century* (Toronto: University of Toronto Press, 1999). Chap. 5-7.

[24] Collins, *Overcoming 'Boom and Bust'? Analyzing National Shipbuilding Plans in Canada and Australia*, p. 5.

[25] "Federal Subsidy on Shipbuilding Aids Burrard." *The Globe and Mail (1936-2017)*1962, http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Canadian Surface Combatant (CSC). The initial budget forecasts were in the order of $27 billion. This budget forecast has now jumped to $77 billion and is still expected to climb.[26] This is a result of the need to reinvest in an industry that has suffered a slow death due to neglect, in conjunction with the escalating cost of materials and labour.

The NSS represents a commitment to purchase ships from selected and favoured shipyards on each coast, and no more. The expectation is that with a long-term approach to procurement, Canadian shipbuilders can more effectively plan their building phases into the future. The hope is that this predictability of demand will allow the industry to be sustained.

NSS also provides economic benefits. These include domestic jobs and the development of skills. A bonus is a reduction in the cost of ships to Canada. The cost reduction is the return of funds to Canada through taxation. While no direct values have been determined, PricewaterhouseCoopers indicates that, due to taxation, ships built in Canada would be between 16-39% cheaper than competitors, which offsets the higher cost of building in Canada.[27]

Overall, Canada is struggling to sustain shipbuilding in the face of fierce competition. With the help of the Canadian government, there is a chance that Canada can break the cycle of boom and bust and establish a sustainable shipbuilding industry. It is unlikely that Canada could ever establish an industry to the level of other major competitors, but some level of sustainment is likely possible.

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[26] Naval Association of Canada, *The National Shipbuilding Strategy and the Canadian Surface Combatant,* 2021.

[27] LLP PricewaterhouseCoopers, *Value for Canada the Cost Versus Benefit to Canadians of the National Shipbuilding Strategy,* 2017, p. 6.

Many countries are struggling with establishing or maintaining a shipbuilding industry. While Canada has encountered problems in the past, NSS is one strategy that Canada is trying. Unfortunately, the success of NSS rests with the government of Canada. Should funds become unavailable and budgets reduced, NSS will be unable to proceed. If NSS executes as expected, there is potential that Canada will have a lengthened period of sustained shipbuilding for the industry.

Canadian shipbuilding history is plagued with disappointment and failure. Canada has proved that the injection of projects can sustain an industry, but it can only do so for the period injections exist. The NSS provides Canadian shipbuilding with a long-term framework.[28] This framework intends to allow for the longer-term sustainment of the Canadian shipbuilding industry. The longer sustainment of the shipbuilding industry will let Canada take on a more holistic approach to government fleets, from cradle to grave. This approach will ensure the maintainability of the new fleet into the future.

Should Canada invest in a domestic shipbuilding industry, Canada benefits from having the capacity to build ships in the country. Domestic shipbuilding avoids the reliance on foreign suppliers, even though the overall cost may be more. Building ships in Canada is a conscious choice. It promotes regional employment and economic development in key maritime industries. The value of shipbuilding is the ability of the industry to sustain the fleet in the future. While there is a benefit to the domestic production of ships in Canada and a savings associated, the real value is the ability to repair and maintain future fleets.

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[28] *National Shipbuilding Strategy* Government of Canada, 2021.

Shipbuilding also provides significant tertiary benefits to both the economy and the nation. These benefits focus on the sustainment of the industry. The NSS strategy uses Industrial Technological Benefits (ITBs) to inject a level of sustainment, but shipbuilding in itself can also bring sustainment. While ITBs help the government guide investments, direct requirements for investment have proven to be more effective in stimulating the industry.[29] In addition to ITBs and direct investment, the effective leveraging of the Intellectual Property (IP) developed during shipbuilding can be of significant economic advantage and benefit aspects of industry sustainment. The most significant tertiary benefit to shipbuilding maintenance requirements stems from the presence of a Canadian fleet. These tertiary benefits ensure that the Canadian shipbuilding industry can support Canadian vessels throughout their life, and not just focus on the construction of ships.

One option for the sustainment of the industry is the sale of ships to nations other than Canada. In practice, this supports the basic need of the shipbuilding industry. It would supply the necessary demand to ensure the sustainability of the industry. Unfortunately, international sales of warships have met little success in the past and few prospects in the future. Canada has little chance of gaining any market share in a highly competitive global arms trade, dominated by countries with deeper pockets and established industries. It would take time for Canada to develop the necessary industry base for Canada to be competitive. Even then, Canada's competitiveness would be uncertain.

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[29] LLP PricewaterhouseCoopers, *Value for Canada the Cost Versus Benefit to Canadians of the National Shipbuilding Strategy,* 2017.

The sustainment of the shipbuilding industry is a complex process with several influences. Canada's desire to take on a holistic approach to shipbuilding may be impacted by other factors. The investments of Canada in shipbuilding, tertiary benefits of shipbuilding, and the international sales of warships all influence Canada's ability to take on a holistic approach to the Canadian fleet. The decisions Canada has already made could limit available options. These decisions include the structure of the NSS. Overall, the objective is for Canada to maintain a holistic approach to shipbuilding. Can it be done is the question?

CHAPTER 1: WHY SHOULD CANADA INVEST IN SHIPBUILDING?

For Canada to take on a more holistic approach to shipbuilding, Canada must have a sound approach to the domestic shipbuilding industry. The holistic approach that Canada seeks to obtain is dependent on the availability of Canadian industry. If Canada can sustain shipyards and produce vessels at a comparable cost to competitors, Canada can ensure that it takes a holistic approach to shipbuilding. Without these two things, it will not be possible. Even with the sustainment of shipyards and a reasonably costed product, Canada must ensure the choices it makes towards shipbuilding are in line with a holistic view of the Canadian fleet. Canada could make a decision that negatively impacts the sustainability of the industry by allowing factors unrelated to shipbuilding to influence decisions.

Canadian Shipyards

The boom and bust cycle of shipbuilding is equivalent to a feast or famine mentality. This cycle highlights that the shipbuilding industry thrives when demand is good but quickly dies as demand goes away. After consultation with industry partners, including domestic shipbuilders, Canada realized that to avoid the historic cyclical nature of shipbuilding, long-term predictability is essential.[30] There is a need to introduce long-term steady-state demand. Previous attempts to thwart the cycle through the strategic injection of funds or projects proved to sustain the industry for a short period.[31] The federal government kept the shipbuilding industry going with subsidies for nearly three

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[30] "About the National Shipbuilding Strategy – National Shipbuilding Strategy – Sea – Defence Procurement – Buying and Selling – PSPC," last modified -04-13, accessed Mar 7, 2021, https://www.tpsgc-pwgsc.gc.ca/app-acq/amd-dp/mer-sea/sncn-nss/apropos-about-eng.html.

[31] Collins, *Overcoming 'Boom and Bust'? Analyzing National Shipbuilding Plans in Canada and Australia*

decades, from 1960 to 1986. Direct subsidization ceased when the federal government decided that it was not of value to continue propping up the industry. They did not account for the longer-term plan. NSS is attempting to changes this. The plan within NSS allows both industry and the government to develop a long term plan that should allow for some level of long-term sustainment of the industry.[32] Projects will replace previous subsidies. This will depend on the funding of the government of the day. Government long-term funding for the NSS initiative is a determining factor in the future success of NSS. But is the current approach of NSS the one needed to sustain the industry into the future, or are there other more viable approaches?

There are three possible courses of action to sustain the shipbuilding industry. NSS is currently taking one of these approaches, which is the sustainment of three shipyards. Other possibilities include investment in two shipyards, one for each coast, a plan similar to the original NSS plan with only two shipyards. A third option is to implement a single shipyard where all the government fleet capability is developed. Each option provides specific advantages and disadvantages, which will be evaluated. But why has the government chosen the three shipyard option? After all, the goals of the strategy is to ensure there is a sufficient industrial base to support both the building of ships and the sustainment of the vessels throughout the life of a ship, is it not?[33] If Canada wishes to ensure the fleet of tomorrow has a shipbuilding industry available to support it throughout the life of the fleet, Canada must focus its sustainment efforts on one shipyard

[32] "About the National Shipbuilding Strategy – National Shipbuilding Strategy – Sea – Defence Procurement – Buying and Selling – PSPC," last modified -04-13, accessed Mar 7, 2021, https://www.tpsgc-pwgsc.gc.ca/app-acq/amd-dp/mer-sea/sncn-nss/apropos-about-eng.html.

[33] John Birkler et al., *AUSTRALIA'S NAVAL SHIPBUILDING ENTERPRISE Preparing for the 21st Century* (Santa Monica, California: RAND Corporation, 2015).

The current implementation is three shipyards distributed across the country. One shipyard, located in Halifax, Nova Scotia, Irving Shipbuilding, a second shipyard, located in Levi, Quebec, Chantier Davies Canada, and a third shipyard, located in Vancouver British Columbia, Seaspan's Vancouver Shipyards. The distribution alone of this three shipyard option provides a benefit of distributed benefits throughout the nation. The latest reports indicate that six provinces have benefitted from the NSS, but there is little evidence to suggest that this will lead to a sustainable industrial base.[34] By supporting three separate shipyards, Canada ensures the necessary employment for each shipyard is supported, rather than only one. This implies that direct employment to shipyards is roughly three times higher with the sustainment of three shipyards versus one. Unfortunately, the benefit of this option stops there.

The current distribution of NSS amongst three shipyards provides significant challenges, including the implications of experience gained, cost investment requirements, the lack of pooled resources, and possible competition amongst shipyards for both resources and work. The distribution of shipyards results in the reduction of lessons learned through the build phase. It indicates that, while possible for shipyards to share experience, it will not be effective. Indications from Docking Work Periods (DWPs) conducted in two different shipyards indicate that each shipyard will make similar mistakes before improving.

Cost investment requirements are another negative aspect of the distribution of shipbuilding into three shipyards. While the government of Canada is not investing in

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[34] Government of Canada, *Canada's National Shipbuilding Strategy - 2019 Annual Report,* Government of Canada, 2019.

shipbuilding, it does require private investments in the industry to succeed. These investments will be a result of the expected work each shipyard will receive. As such, there are investment requirements in all three locations. The current NSS plan has taken this approach. It has succeeded in obtaining the necessary investments to ensure the viability of each of these yards. Interestingly, no study currently exists that addresses the possible impact on the long-term opportunity cost of this approach.[35] As such, perhaps the increased investment requirements is not truly an issue. Regardless, three shipyards ensure that the investment requirement is three times higher than with a single yard.

While the investment requirements may not be a significant issue, the lack of pooled resources is. It places a significant burden on the procurement and build management of the shipbuilding industry. With government shipbuilding distributed across three shipyards, there is a need to provide individual project teams to interact at each location. The current NSS model indicates that each class of ships will be constructed in different locations. This removes the need for any duplication of personnel. The counter-argument is that this ensures that no efficiencies are discovered between project teams. One example of this is the size of project detachments for AOPS and CSC. Both project teams are co-located in Halifax compared to the project detachment for JSS located in Vancouver. The combined AOPS and CSC detachment is not twice the size of the JSS detachment. There are certainly efficiencies gained if the JSS detachment was collocated with the AOPS and CSC detachments. The recent decision of the federal government to build two Polar icebreakers in two different

[35] J. Craig Stone, *The Demise of the National Shipbuilding Strategy* Canadian Global Affairs Institute, 2019, p. 6.

shipyards further exacerbates the problem.[36] This will required the duplication of personnel performing the exact same tasks in two different locations.

Competition amongst shipyards is another problem associated with the implementation of three shipyards. While resources are limited, each shipyard will be expected to maintain a schedule for ship delivery. The standard contracts issued by the government of Canada will link the delivery of vessels to a milestone payment. While there can be modifications to this approach, shipbuilding projects in the recent past have included this. As such, a limit of resources will result in each shipyard vying for the same resources. The introduction of the third shipyard spurred a level of competition between yards forcing the shipyards to drive business into the domestic economy.[37] Before the award of the Polar icebreaker contract to Chantier Davie Canada, in a bid to ensure that Seaspan could meet expected timelines, Seaspan entered into a strategic partnership with Heddle Shipyards of Ontario. This partnership intended to demonstrate that there was no requirement for another shipyard.[38] Seaspan wanted to demonstrate that it could meet expected schedules. This could go as far as artificially inflating the price of resources as three shipyards, all working on similar government contracts, compete. This competition will drive the cost of ships up. It will result in the government paying inflated prices due to self-imposed competition. While the government could intervene to avoid this, there is

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[36] "Trudeau Government Promises Coast Guard Two New Icebreakers, Splits Work between Seaspan and Davie | CBC News," last modified -05-06, accessed May 6, 2021, https://www.cbc.ca/news/politics/coast-guard-heavy-icebreaker-1.6016127.

[37] "Seaspan Shipyards and Heddle Shipyards Join Forces in Bid to Deliver the Polar Icebreaker to the Canadian Coast Guard," last modified -06-09T06:25:47-07:00, accessed Feb 22, 2021, https://www.seaspan.com/seaspan-shipyards-heddle-shipyards-join-forces-bid-deliver-polar-icebreaker-canadian-coast-guard.

[38] Peter Kitchen, "Why Canada must Stay the Course on its NSS Commitment," (Dec 17, 2020). http://www.canadiandefencereview.com/featured_content?blog/219.

a possibility that some of this competition will go unnoticed and result in an artificially inflated cost for Canadian ships.

It should be noted that the distribution of work accounts for an even distribution amongst shipyards. The current NSS plan does not distribute work evenly among the three shipyards. As a result, this introduces other variables not considered in this analysis.

The initial distribution of work within the NSS plan was amongst two shipyards.[39] The NSS attempted to divide the work demand relatively evenly. Work was divided among Irving Shipbuilding in Halifax, NS and Seaspan in Vancouver, BC. Once again, the approach of supporting two shipyards provides both advantages and disadvantages. While this option is similar to the three shipyard options, it demonstrates some advantages when compared to the three shipyard option. There are similar implications of experience and cost investment requirements. The reduction to two shipyards does not address the lack of pooled resources and possible competition amongst shipyards, which both remain present.

As stated, the two shipyard option provides similar problems as the three shipyards option. One significant advantage this option has is an increased length of sustainment. While both the two and three shipyard options seek to build the same number of vessels, it stands to reason that with fewer shipyards conducting the work, the work will take more time to complete. Simply by reducing one shipyard, the government of Canada could increase the duration of the shipbuilding program and therefore increase the availability of the industry for future fleet sustainment.

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[39] Ian Mack, *A Third NSS Shipyard* Canadian Global Affairs Institute, (2019), p. 1.

Among other advantages, the option of a single shipyard would be most effective at increasing the sustainment of the industry. It would ensure that experience is localized in one location. It provides the advantage of pooled resources. In addition, this option avoids any competition within the industry. It is, however, limited by the slower delivery pace, localized jobs and economic investment, and an increase in risk.

There is no question that a single shipyard would be better suited to sustain the shipbuilding industry. With a surplus of work for a single shipyard, that single shipyard could output vessels constantly. This would have a direct impact on the expected delivery schedules. A single shipyard would only have the resources to conduct work sequentially. It is unlikely that multiple ships would be at the same stage of production concurrently within a single shipyard. Multiple shipyards would output more ships in a shorter time. However, as the goal is the sustainment of the industry, a prolonged delivery schedule favours sustainment.

The schedule also has a direct link to the process of gaining experience. With a single shipyard, all experience would be gained on the first platform. A continuous improvement cycle would begin on the first platform. Subsequent platforms would benefit from the experience of the previous platform. Quality and skill would gradually improve. This is a lesson known within the NSS strategy. In fact, to develop the necessary skill sets through experience, the AOPS was intentionally placed prior to CSC in the build cycle. This decision was taken, despite the impact, it would have on the CSC delivery schedule.[40] This highlights the value of the experience, regardless of the

[40] *Canada's National Shipbuilding Strategy 2018 Annual Report*, p. 17.

platform they it is learned on. It is, therefore, reasonable to assume that the most logical course of action is for all learning to take place in a single location. The option of a single shipyard allows this.

A single shipyard also allows Canada to take advantage of an opportunity to pool resources. This opportunity translates to a requirement for fewer people in detachments across the country. It also provides the benefit of Subject Matter Experts (SMEs) being co-located, ensuring that the necessary experts are more readily available rather than distributed amongst multiple shipyards. In essence, the pooling of resources translates to savings for the government. The savings is in the form of personnel and ensures that the correct people are always available at the shipyard.

The option of a single shipyard does come with a level of negative consequences, one of which is the subject of perspective, and that is the build schedule. As previously mentioned, a single shipyard would have a limited output capacity and will be unable to increase this without significant investment. As such, the production schedule will be a slave to the capacity of the shipyard. This can be seen as a negative if the intent is about the production rate. However, as the focus of the government is the sustainment of the industry, this could be seen as a positive. By reducing the production rate of the NSS, a single shipyard effectively prolongs the sustainment period of NSS.

Not all negative aspects of investing in a single shipyard can be seen as both a positive and a negative. The impact of localized economic investment is negative, though one outside the direct scope of shipbuilding. By investing in one shipyard, Canada does not distribute any economic advantage across the country. Canada only invests in a single location. While tertiary benefits may spread beyond the localized area, an investment in

shipbuilding is a local investment. It will bring jobs to the location of the shipyard conducting the work. Work within the marine industry will bring a higher level of trade capability as the marine industry has a higher percentage of STEM requirements than other manufacturing.[41] The issue remains that this trade capability will solely exist within the area of investment. While there may be political implication to this, from a shipbuilding perspective, there is no impact.

Investing in one shipyard brings a significant level of risk to shipbuilding. With production taking place at a single shipyard, Canada is not providing any level of diversification to its plan. As a result, any impacts on the shipyard will impact Canadian shipbuilding completely. A labour dispute or strike is but one example. Through the use of shipyards in multiple locations throughout the country, Canada limits the impact of a local labour dispute. By building ships in only one shipyard, Canadian ship production remains at the mercy of the local labour unions. The same also holds for the risk of insolvency. If the shipyard producing ships is dissolved, so too are the prospects of the future support of the Canadian fleet. Diversification helps temper this risk.

The number of shipyards Canada selects for the production and sustainment of the future fleet has a direct impact on the viability of the sustainment plan. It is clear that with three shipyards, Canada has the greatest opportunity to diversify, but this comes with a higher level of investment requirements. In contrast, the investment in a single shipyard provides a substantial sustainment ability for the shipbuilding plan. Unfortunately, it increases the risk that is beyond the control of Canada. If the approach

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[41] *Canada's National Shipbuilding Strategy 2018 Annual Report,* p. 11.

to shipbuilding intends to ensure the sustainment of the future fleet, it stands to reason that the option with the longest sustainment possibility should be chosen. If this is the case, NSS should be based on a single shipyard and not the current three. The fact that NSS is based on three shipyards suggests that there is more than the future sustainment of the fleet to consider when evaluating the approach of the Canadian government.

Building Ships in Canada

While investment in the correct sustainment strategy is a fundamental step in ensuring the future sustainment of the fleet, Canada must ensure it has a future fleet. The cost of current projects appears to be climbing, and market competitors are indicating that they can produce cheaper ships than those chosen by Canada.[42] Is this true? Are Canadian ships simply that much more expensive than foreign ships? The reality is no. While domestic vessels have proven to be more costly, the increased cost is nowhere near what is being advertised. It should also be noted that foreign ship values were not compared to values from Chantier Davies Canada. Chantier Davies Canada has proven to deliver under budget and ahead of schedule repeatedly, even with complex vessels.[43] These quoted costs do not account for the complete cost associated with a Canadian ship, including all necessary equipment and armament, the integration of equipment, spares and In-Service Support (ISS). The advertised prices also do not include the cost of the procurement of the vessel, which can be significant. In addition, pricing does not consider the return of revenue to Canada due to taxation. Overall, the cost associated with foreign

[42] Naval Association of Canada, *The National Shipbuilding Strategy and the Canadian Surface Combatant,* p. 8-9.

[43] "Quebec Shipbuilder Delivers North America's First LNG-Powered Ferry," last modified July 13, accessed Mar 28, 2021, https://www.jwnenergy.com/article/2018/7/13/quebec-shipbuilder-delivers-north-americas-first-l/.

ships is lacking a great deal in their *advertised price*. As a result, Canada is better suited to buy Canadian and ensure that Canada can maintain the fleet of tomorrow.

The Canadian fleet of tomorrow is expected to have 15 Canadian Surface Combatants (CSC) as part of the fleet. The initial cost for the CSC was estimated at approximately $28 billion for all 15 ships.[44] Latest reports indicate that CSC will cost $77 billion and may even exceed $82 billion.[45] Price estimates for the FREMM (French), Type 31 (British), and the Constellation class (US) are $30 billion for 15 ships, $435 million per ship, and $1.1 billion, respectively.[46] Comparing these values against the current estimates for the CSC project of 15 vessels, the CSC numbers appear to be excessively high. One must consider what is included in the values presented by other countries and how accurate they are.

Unfortunately, quoted prices by shipbuilders are base costs. They do not account for the costs of performing necessary modifications to meet the needs of Canada.[47] This means that if Canada requires an additional evacuation route to meet necessary safety standards, Canada must pay for this change. This is also true for the weapons systems. If the Canadian radar, as an example, is heavier than the radar originally designed for the ship, there will be a requirement for Canada to pay for the necessary modifications. These modifications could include excessive hull redesign. This implies that the entire detailed design phase of ship design will need to be completed and will result in cost increases.

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[44] Collins, *Overcoming 'Boom and Bust'? Analyzing National Shipbuilding Plans in Canada and Australia*.

[45] Scott Gilmore, "It's Time to Ban the Buying of made-in-Canada Warships," *Macleans.Ca,* Feb 25, 2021.

[46] Naval Association of Canada, *The National Shipbuilding Strategy and the Canadian Surface Combatant,* 2021, p. 8.

[47] Birkler, *Australia's Naval Shipbuilding Enterprise Preparing for the 21st Century,* p. 32-36.

As an additional complication, Canada can not necessarily purchase the radar that the ship was designed with. It simply may not be included in the price. Not all equipment is factored into the price. For example, in the case of the Type-31, several armaments will be reused from previous vessels.[48] This equipment is therefore not included in the "base price" quoted. This implies that, in addition to the purchase of ships, Canada must purchase the necessary armaments for the vessels as a separate purchase. While this cost is not included in the advertised price, it is a cost that Canada will incur due to the purchase of these vessels.

When the necessary equipment is procured to add to the purchased ship, Canada must also pay for the necessary integration of the equipment into the vessel. Rough costing for the necessary middleware is in the order of 1.5 times the cost of the equipment and software.[49] Middleware is the software purpose-built to allow for the interaction between equipment software and the system. By omitting the cost of the equipment for the quoted cost, companies are also avoiding a significant integration cost that will further escalate the price of the ships being purchased.

Additionally, Canadian vessels are costed for an all-in cost. This includes the procurement team cost, life cycle costing of the ships, ammunition, and spares for the life of the vessel.[50] Specifically for the life cycle costing of the ships, Canada uses an In-Service Support Contracts (ISSC). These include a certain level of maintenance costs. As

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[48] "Type 31 Frigate Capabilities," last modified Aug 27, accessed Mar 11, 2021, https://www.thinkdefence.co.uk/type-31-general-purpose-frigate-gpff/type-31-frigate-capabilities/.

[49] Connecting software, -10-20, 2015, https://www.connecting-software.com/blog/infographics-why-are-it-system-integration-costs-so-high/.

[50] Naval Association of Canada, *The National Shipbuilding Strategy and the Canadian Surface Combatant, p. 8*.

a result, Canadian costing tends to be higher due to all of the inclusions beyond the base price of ship. It is estimated that costs beyond those quoted by foreign shipbuilders' accounts for 40 – 50 percent of project costs.[51] This is a tremendous addition to the quoted advertised prices.

The cost of the ships is only one portion of the cost. Another cost is associated with the procurement of the vessel, a significant consideration. Any advertised price for ships does not account for the costs associated with the Government of Canada procurement system. Procurement within the Government of Canada is a complicated process and involves several departments. There is a need for projects staff to manage and supervise the construction of the vessel. Additionally, there is the requirement for the salaries of sailors and the lifetime equipment costs not normally considered. Once the ship is ready for delivery, there is the need for specific vessel training to ensure that Canada can operate the vessel as expected. None of these costs are associated with the advertised prices indicated by shipbuilders.

In contrast, the cost quoted by the government of Canada for CSC, as an example, does include these additional costs. As a result, the cost of the CSC appears exceptionally high when compared to competitors. In reality, there is a significant premium that must be added to the advertised price to account for fixed procurement cost to make it comparable to the values proposed by CSC. These costing metric can also be applied to

[51] "Update on the Canadian Surface Combatant Request for Proposals," last modified -12-05, accessed Mar 3, 2021, https://www.canada.ca/en/public-services-procurement/news/2017/12/update_on_the_canadiansurfacecombatantrequestforproposals.html.

other major shipbuilding projects, including the Joint Support Ship (JSS) and the Arctic Offshore Patrol Ships (AOPS).

Eric Lerhe, a retired Commodore, conducted a study evaluating the costing associated with the Halifax Class procurement. In the CDA Institute's Vimy Paper, Lerhe indicates that actual ship purchase cost account for 47% of project costs. He further points out that the remaining 53% of project costs are made up of project management cost, generous sparing, contingencies, taxes, insurance, training, facilities, and salaries, to name a few.[52] These numbers highlight that the majority of project costs are not a direct result of the purchase of ships but associated costs. As such, these costs would be borne regardless of the vessel purchased, including a foreign-built ship. One might suggest that the numbers used by Commodore (Ret'd) Lerhe are dated and reflective of past projects. Coincidently, a recent RAND report, conducted in Australia on recent fleets, suggest similar numbers and points to significant costing that is not directly related to shipbuilding.[53]

Domestic shipbuilding also has the benefit of providing returns on the investments of the Government of Canada. It does this through taxation and the establishment of jobs, jobs with revenue that are taxed. These points are not factored in when considering the price of the vessels purchased. If these values were accounted for, Canada would find that the actual cost of Canadian vessels is significantly lower than advertised.

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[52] Eric Lerhe, *FLEET-REPLACEMENT AND THE 'BUILD AT HOME' PREMIUM: Is it Too Expensive to Build Warships in Canada?* CDA Institute, 2016, p. 8-9.

[53] Birkler, *Australia's Naval Shipbuilding Enterprise Preparing for the 21st Century,* p. 146.

The advertised price does not account for the return the government will receive from the investment in the form of taxes. In some cases, the revenue generated from taxes could be significant. As taxes will apply to all areas of the build, from material purchased, when purchased within Canada, to income tax paid by all earners within the Canadian labour force. This would result in significant revenue. PricewaterhouseCoopers LLP conducted a study to determine the value of a built-in Canada strategy. Within the final report, PricewaterhouseCoopers LLP indicates that, based on the revenue to the Government of Canada, taxation alone would result in Canadian ships being between 16-39% cheaper than a comparable ship built in Europe.[54] Additionally, Irving shipbuilding calculates that approximately one-third of labour costs will return to the government in the form of taxes.[55] One must consider the validity of the report from Irving shipbuilding, as they are a significant beneficiary of government funding for shipbuilding. Even if only a portion of what is indicated is true, it is a tremendous saving for the government of Canada. The taxation of Canadian companies while building Canadian ships provide a significant reduction in the actual cost of vessels built in Canada, despite the initial cost of the purchase. While this does not account for the capital tax allowances provided to the organization, all supplies and equipment will provide savings. Of interest is that the revenue generated from taxation was not considered by the RAND Corporation when conducting a study of shipbuilding in Australia.[56]

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[54] PricewaterhouseCoopers, *Value for Canada the Cost Versus Benefit to Canadians of the National Shipbuilding Strategy, p. 6*.

[55] Naval Association of Canada, *The National Shipbuilding Strategy and the Canadian Surface Combatant, p. 4*.

[56] Birkler, *Australia's Naval Shipbuilding Enterprise Preparing for the 21st Century*

One final factor that should be considered when evaluating the cost of building ships in Canada is the impact of building new ships. As with most things, when new designs are built, there is a learning curve that the production facility must go through. This cost is not considered in any of the base prices that are being touted as cheaper options to building in Canada. While it is common for naval vessels to have cost overruns, a United States Government Accountability Office study indicates that first of class ships normally exceed expected budgets by eighty percent or more.[57] In addition, the United States Government Accountability Office also found that the lead ships resulted in significant schedule delays. Of the eight lead ships studied, more than half saw delays of over two years.[58] These are clear indications of the difference between advertised pricing for lead ships and their actual costs. While this does not indicate that additional ships will be on budget, it does suggest another factor that is overlooked when considering building ships domestically.

It does appear that the Canadian cost of ships is significantly higher than competitors. In reality, this is not the case. Advertised prices by competitors have neglected to include some significant pricing aspects. This includes some major equipment and the necessary cost to integrate the equipment into the ships, as well as fundamental things like project costs. In some cases oversights may be unavoidable, but they result in a significantly underpriced vessel. While Canadian vessels may not be cheaper, when omissions are considered, it suggests that Canadian ships are likely comparable in price to their competitors. When this is considered, in conjunction with the

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[57] United States Government Accountability Office, *Navy Shipbuilding Past Performance Provides Valuable Lessons for Future Investment GAO-18-238SP*, 2018, p. 8.

[58] United States Government Accountability Office, *Navy Shipbuilding Past Performance Provides Valuable Lessons for Future Investment GAO-18-238SP*, 2018, p. 9.

fact that building in Canada would allow Canada to take a holistic approach to ship maintenance, there is no doubt. Canada must build ships in Canada. It will allow the future fleet to be maintained in Canada.

While foreign industry is advertising that Canadian ships are overpriced, the reality is that they are comparable in cost to major competitors. This fact, in conjunction with the ability of Canada to sustain a shipyard, will allow the sustainment of the future fleet. Canada must simply decide if sustainment is the priority. If this is the case, it is clear that the production of cost comparable Canadian ships in a single shipyard will provide Canada with the greatest likelihood to ensure the sustainment of the future fleet. The choice to build ships in Canada, and to invest in three shipyards, suggest that sustainment may not be the only priority of the government. NSS is providing a significant demand on shipbuilding, perhaps this demand can sustain three shipyards, but the selection of one shipyard would provide the most sustainable option. Maybe the government so risk-averse that it is seeking to diversify the built in Canada strategy to provide some assurances for the future fleet?

CHAPTER 2: THE TERTIARY BENEFITS

A holistic approach to shipbuilding must include some level of investment to support the industrial base. In turn, this approach ensures that the industry is available throughout the life of the Canadian fleet to provide required services. The current approach has favoured the use of Industrial and Technological Benefits (ITBs) and Intellectual Property (IP). The prolonged maintenance of the vessels has been a bonus. While these options do provide value for the future support based, are they being implemented effectively? Can Canada take on a holistic approach without these approaches? While ITBs guide the investment of industry, they by no means dictate where investments must occur. IP can bring tremendous value to the support base and could even spark significant innovation. Without the necessary initial investment, key aspects of IP may be unobtainable. For example, the maintenance requirements may not be sufficient to aid in sustainment of the industry. The steps to sustain the fleet of tomorrow are established in NSS, but are these steps the right ones to ensure a holistic approach for the Canadian fleet?

Industrial Technological Benefits (ITBs)

ITBs are the backbone of the reinvestment plan as laid out in NSS. ITBs are the Industrial and Technological Benefits that are associated with a product. The Canadian government uses these incentives to ensure some level of reinvestment into the Canadian economy. ITBs are contractual obligations that ensure indicated reinvestments take place. Normal requirements for ITBs stipulate a 100 percent reinvestment into the Canadian

economy.[59] It has been reported that some contractors have committed up to 200 percent of contract value for the CSC project to win bids.[60] But why would contractors over-commit to ITB requirements? The answer is that ITBs, while useful, are used at the discretion of the contractor. ITBs can stimulate significant innovation and development within the Canadian industry. However, the limitations are that ITBs are not under the control of the Canadian government and that ITBs are only related to existing Canadian industry.

Through the use of ITBs, the NSS has been successful in establishing the only Naval Architecture master's program in Canada at the University of British Columbia. While the NSS does not specifically establish the need for development of naval architects, it has successfully leveraged the contracts expected within the program. Leveraging has provided a necessary skill to ensure a future for shipbuilding in Canada. Of course, this was likely influenced by the incentivization of ITBs. Development and innovation are incentivized through the ITB process at a rate of 9:1. This implies that one dollar of investment in innovation and research counts as nine dollars of investment. This highlights that when effectively incentivized, ITBs can accomplish the goals set by Canada. It should also be noted that the use of Value Proposition (VP), a component within ITBs, as a 10 percent portion of the bid evaluation, has aided in providing Canada with some level of control of required investments. VP ensure that ITBs are not used as simple offsets. They ensure that proposed ITBs provide value to Canada through the evaluation of five factors. These factors include possible export generation, long-term

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[59] Innovation, Science and Economic Development Canada, *Industrial and Technological Benefits Policy: Value Proposition Guide*, 2018.

[60] Naval Association of Canada, *The National Shipbuilding Strategy and the Canadian Surface Combatant, p.* 4.

support to the Canadian defence industry, the enhancement of innovation through research and development in Canada, supporting the growth of Small and Medium Businesses (SMB) in Canada, and skills and training development.[61] The use of the incentivization and VP control measures aid in ensuring that some level of control over investments related to Canadian contracts rests with Canada.

This is limited by the desires of the contactor and the presence of industry in Canada. While there is incentivization for use of ITBs in emerging industry, this is completely at the discretion of the supplier.[62] Ideally, this would indicate that ITBs are used to augment a capability required by a contractor for the primary contract. This does not have to be the case. Contractors could choose to invest in any area of the Canadian industry to fulfil the necessary contractual obligation. ITB policies specifically use the word *encourage* indicating that there is a choice.[63] This is further magnified by the fact that ITBs are intended for use in existing industry. It implies that ITBs cannot be used to develop a new capability within Canada. This limits the ability of Canadian contracts to develop new areas of the industry.

One approach to return control of investment to Canada and allow creation of new industry is purchase of Canadian equipment rather than use of ITBs. There is a fundamental difference in the certainty of value when Canadian equipment is purchased compared to the imposition of ITBs.[64] While ITBs have been demonstrated to provide a

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[61] "Industrial and Technological Benefits Policy - Home," last modified April 3, accessed May 5, 2021, https://www.ic.gc.ca/eic/site/086.nsf/eng/home.

[62] Innovation, Science and Economic Development Canada, *Industrial and Technological Benefits Policy: Value Proposition Guide.*

[63] Innovation, Science and Economic Development Canada, *Industrial and Technological Benefits Policy: Value Proposition Guide*, 2018.

[64] Naval Association of Canada, *The National Shipbuilding Strategy and the Canadian Surface Combatant, p.4.*

level of value, especially when incentivized, they also have limitations and do not necessarily produce the effects expected. The purchase of Canadian equipment ensures that investment is made in Canada in the desired sector. This allows growth of the given industrial sector. It also provides a level of assurance related to the future sustainability of the industry.

ITBs provides both benefits and drawbacks. They appear to achieve the goal of ensuring some level of investment in Canada. Through the use of incentivization, ITBs have proven to be very effective. Unfortunately, their ability is limited. While checks and balances such as Value Proposition are in place to ensure value to Canada, the use of the word *encourage* throughout the ITB documentation points to the fact that ITBs occur at the discretion of the contractor. The use of direct purchasing would be much more effective at providing Canada with the necessary control to ensure the correct investments are made to allow the sustainability of the industry for the fleet of tomorrow. The only way Canada can better control reinvestment into the industry to ensure a holistic approach to the Canadian fleet is by abandoning the use of ITBs and shifting policy towards investment through direct purchasing. This will allow Canada to ensure that reinvestments are aligned with the investments needed to support the fleet of the future.

Intellectual Property (IP)

While ITBs can provide investment towards the holistic fleet maintenance perspective that Canada is seeking, Intellectual Property (IP) can also help in this area. IP represents not only an investment in Canada but the repeated possibility of reinvestment in Canada. IP are the rights associated with intellectual creations, including such things as

patents, processes and ideas.[65] The development of IP in Canada provides the country with a resource that can be reused in the future for sustainment of the industry. This represents a cyclical reinvestment, if the initial investment in IP is successful. In addition, the resource allows development through foreign investment in Canadian IP. Both aspects aid in sustainment of the industry and help Canada advance its current capability for the future fleet. But, has Canada done everything it can to ensure that the most IP is available to Canada and the fleet of tomorrow?

The future fleet is dependent on Canada's ability to create IP. During the building of ships, a tremendous amount of capability is developed for the platform. When this work is done in Canada, there is an opportunity for Canada to sell this capability overseas. This, in turn, generates revenue for the Canadian economy and a taxation revenue stream for the government. Additionally, the IP developed provides additional repair opportunities for companies within Canada. This reinvestment drives companies to continue the development of new capabilities and allows sustainment of the industry. Through this approach, Canada would avoid the need to invest in training personnel to repair systems as that training takes place during development of the equipment. Canada cannot forgo the cost of IP related work but, as the IP resides in Canada, it could be treated as an injection of funds into the Canadian economy rather than a cost. In turn, this would lead to a sustainable industry in Canada. The development of the correct IP could result in tremendous innovative developments within the industry due to the reinvestment of sales.

[65] European Union, *Intellectual, Industrial and Commercial Property*, (2021), p. 1.

One simple example is the investment that Canada made in CAE during the development of the Halifax Class vessels. CAE developed the Integrated Machinery Control System (IMCS) used on Halifax Class ships. This system revolutionized the remote capabilities within a ship. Personnel were no longer required in engine spaces to turn valves. This can now be done remotely. CAE branched off into L3 who now develops state of the art control systems for ships around the world. Canada has further invested in L3 by upgrading the previous IMCS system to the latest Integrated Platform Management System (IPMS). This is a prime example of the sustainment generated through IP if the initial investment is made in the correct area.

The value of IP is clear as it relates to the benefits to the future sustainment of the industry. Unfortunately, Canada has decided to overlook the portion of shipbuilding that would generate the most IP for Canada, the design phase of shipbuilding. A tremendous amount of work goes into development of a ship. While one might suggest the building of warships is innovative in itself, it must be noted that many of the innovations that take place within the design process take place in other countries. While Canada is building ships, it is not designing ships. The Canadian Surface Combatant is one such example. CSC is a British Type-26 design that will be Canadianized in a Canadian shipyard. While possible to innovate in areas of the ship, such as emissions, propeller design, rudder design, and even paint, these types of modifications would be costly and are contrary to the intent of purchasing a ship with a proven design. The innovation associated with simple reductions in drag can be significant.[66] Essentially, the need for a proven design

[66] Bao-Ji Zhang and Zhu-Xin Zhang, "Research on Theoretical Optimization and Experimental Verification of Minimum Resistance Hull Form Based on Rankine Source Method," *International Journal of Naval Architecture and Ocean Engineering* 7, no. 5 (2015), p. 785-794. doi:10.1515/ijnaoe-2015-0055. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

prevents Canada from gaining any innovative capabilities from the ship design process. In addition, by not designing the ship, Canada is using the IP of another nation. Canada is simply fabricating an existing design. While the process of ship construction is complex and involved, it pales in comparison to designing a vessel. Canada sought a proven design to avoid risk in the shipbuilding process. This choice also came with an associated choice. That associated choice was to forgo any IP associated with the ship design phase.

While the shipyards will not gain all the benefits, innovation, and IP associated with the design process, they will advance production techniques. This is an advantage for the industry within Canada, but without the design capabilities, it is limiting the abilities of the industry. Canada is making significant investments to modernize the shipyards within the NSS, but why is Canada only investing in half of the shipbuilding cycle? Surely this is a tremendous opportunity to develop an entire industry rather than simply modernizing an assembly plant? The short answer is that Canada is not developing an industry to compete on the international stage. It is doing what is necessary to meet the needs of the Government of Canada. A proven design, the Type-26, was chosen to ensure that a predictable schedule will be maintained. While this decision does not completely remove the ability of Canada to develop IP to compete with other major shipbuilding nations, it does have an impact.

Canada is taking significant steps to ensure that IP related to the investment in shipbuilding is created. Canada is doing this by simply building ships. Canada has also limited the IP development available by forgoing the design phase of shipbuilding. In an attempt to forgo some of the risk associated with shipbuilding, Canada has lost some of its ability to develop valuable IP that could aid in sustainment of the industry through

reinvestment. Simply put, Canada has not done everything it can to maximize the IP developed during acquisition of new ships.

Maintenance Requirements

While ITBs and IP both provide some level of sustainment to the shipbuilding industry, the reason for sustainment is maintenance of the fleet. Refit costs associated with maintenance of a fleet could provide sufficient value to ensure some level of industry sustainment on its own. Refit values do not currently exist for the future fleet. As such, estimates will be conducted using figures for the current fleet. Are the values of refits sufficient to maintain an industry? These refits are costly. When the size of the fleet is considered, the numbers only grow.

With an expected RCN fleet of 23 major Canadian warships, numerous minor war vessels, plus the Canadian Coast guard fleet, there will be a tremendous requirement for refit facilities to ensure that these fleets are serviceable to the expected 30 years of service and likely beyond. Currently, standard Halifax Class refits cost in the order of $70 – 95 million.[67] These are values for standard refits and not mid-life refits. The value of complete mid-life refits is significantly higher. Without the investment in shipyards during the build phase, there would be a need to conduct refits overseas. This would represent billions of Canadian taxpayer dollars directed to other nations rather than Canada.

Using the current Halifax class frigates as an example, Docking Work Periods (DWPs) are currently scheduled on a five-year cycle. That is to say, every five years,

[67] Info taken from DGMEPM – RCN IRMC Winter 2020 brief.

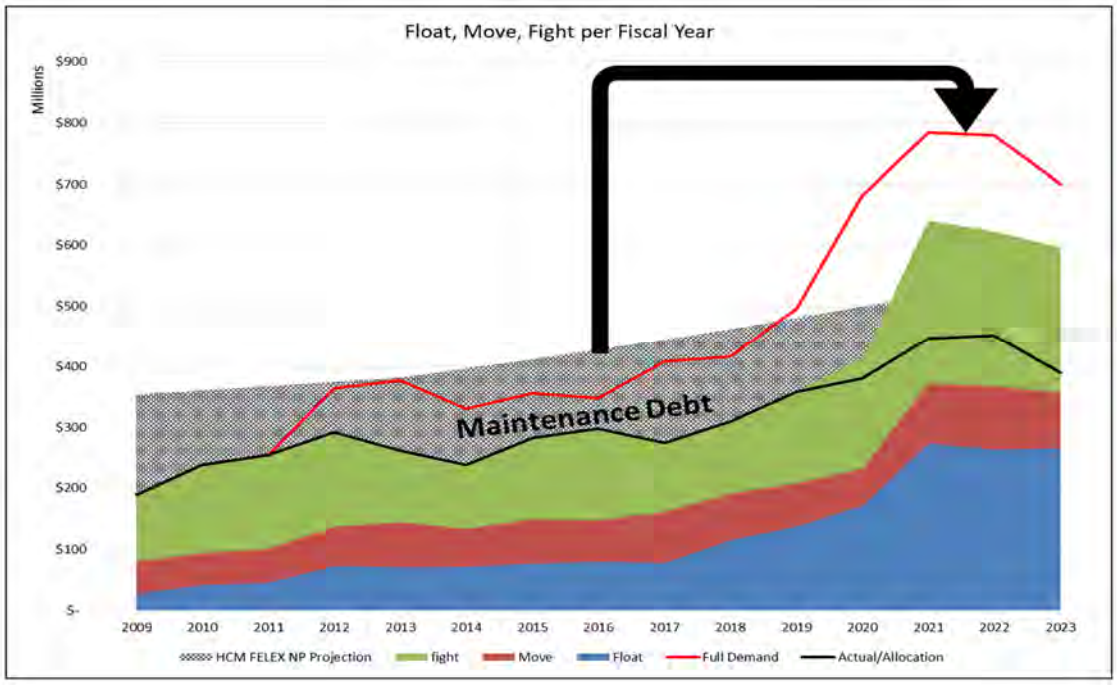
each frigate goes through a docking work period. Each docking work period may have different maintenance requirements for each ship. Work requirements could range from hull and steelwork to complex radar installations and repairs. With each DWP costing in the order of $70-95 million and taking place every five years, the overall costs can easily be estimated.[68] Using a 30 year expected life of vessels, as is the case for the current Halifax class, each ship would go through 6 DWPs during their life, resulting in a life cost per vessel of $400-$500 million. Applying this value to all twelve frigates, the values range from $5-$6.8 billion. Therefore total DWP costs for the Halifax class frigates would be approximately $5-$6.8 billion.

Chart 1 highlights the maintenance cost and projected cost for the Halifax Class frigates between 2009 and 2023, including DWPs. Chart 1 breaks down executable demand for the Halifax Class per year and full demand. Full demand is the value of interest. The chart also highlights a maintenance debt that is currently being carried by the fleet. Note, the DWP values indicated above do not include the maintenance debt tracked on the graph. Ideally, when considering ship maintenance, no maintenance debt would exist. As such, estimates of $70-95 million per DWP, while accurate according to payments, are not reflective of the true cost required of a DWP. There is an argument that could be made that highlights that these maintenance debt costs are simply overruns for previous maintenance not conducted. The reality is that regardless of where the cost lies, it remains a cost that must be paid. An alternative could be the decommissioning of the vessels but this would place undue pressure on the Canadian fleet and reduce Canadian

[68] Info taken from DGMEPM – RCN IRMC Winter 2020 brief.

capability. Fundamentally, the estimates made with $70-95 million are optimistic values and could easily be escalated given the information in the chart below.

Chart 1: Halifax Class Maintenance Projections[69]



While these figures are for vessels nearing end of life, they are also for fewer vessels. These values also do not include work that might occur between DWPs due to urgent requirements. It also does not include the cost related to mid-life refits, which is expected for all vessels. Using similar assumptions and applying these values to the expected major warship fleet of 23 ships, DWP costs will range from approximately $10-$13 billion. Of note, the coast guard fleet is expecting up to 23 vessels as well. The provided DWP values can therefore be doubled, resulting in DWP costs of $20-26 billion dollars for regularly planned DWPs alone. These values do not account for inflation. Once again, this only accounts for planned DWP work and does not account for mid-life

[69] Slide taken from DGMEPM – RCN IRMC Winter 2020 brief.

refits. It also assumes a 5-year maintenance cycle. In reality, the number would be significantly higher.

With this level of investment, repair and maintenance cannot be overlooked. Maintenance and repair is an essential part of the overall cost associated with ships. A total value of approximately $26 billion is a substantial investment into the shipbuilding industry. With this value distributed amongst 46 vessels, this could easily sustain at least a portion of the industry. It will ensure that maintenance of the fleet will provide some level of sustainment beyond the build phase.

The Government of Canada has already determined that ITBs will be used within the NSS contract. It has also decided that Canada must reduce risk during builds by constructing proven designs of ships. Both of these choices by the government of Canada limit the reinvestment into the shipbuilding industry. The options chosen may prove to have been implemented reasonably and may allow the industry to be sustained. By taking on more risk during builds, Canada could have capitalized on more IP development opportunities available during the ship design phase. The use of ITBs has limited the control of the government and will force Canada to hope that contractors make the right choices for reinvestment of ITBs within Canada. Luckily, it appears that the maintenance requirements of the expected fleet will be sufficient to ensure that a holistic approach to shipbuilding for the Canadian fleet can be achieved. Overall, the tertiary benefits of shipbuilding may well allow Canada to sustain the fleet of tomorrow. Unfortunately, the industry would be better positioned had Canada been willing to take on more risk with ship design and ITBs. From a long-term sustainment perspective, the choice made by Canada regarding the use of a proven design was not the right choice.

CHAPTER 3: THE REALITY OF SELLING WARSHIP INTERNATIONALLY

A holistic approach to shipbuilding requires sustainment of the shipbuilding industry until the end of life of the new fleet. The tertiary effects guide the government towards actions that may aid in sustainment of the industry. Sustainment can also be achieved through a steady demand on the shipbuilding industry. The NSS plans to provide the necessary demand for the industry to ensure the required sustainment. Unfortunately, the NSS is dependent on the availability of funds to sustain the program. A lack of government funds at any point could result in the loss of the shipbuilding industry. The international sale of warships provides an alternative to the NSS plan. Through international sales, Canada could provide the necessary demand and ensure the sustainment of the industry.

International sales are complex and dependent on the Canadian defence market, the warships sales options, and the global defence market. All these factors provide different aspects that encompass Canada's ability to sell warships internationally. The Canadian defence market encompasses the ability of Canada to trade-off values and the sales of military equipment. It provides some insight into the details associated and some of the limitations. The warship sales highlights the intricacies of ensuring the produced warships can meet market needs. The global defence market dictates the market share available to Canada and the realities of the competition that Canada faces. Overall, the question is, can Canada sustain the future fleet through a holistic approach to shipbuilding by placing the necessary demand for ships on the international community?

Canadian Military Exports

The success of Canada as a warship exporter is highly dependent on Canada's ability to conduct Canadian military exports. In 2019, Canadian military non-US exports totaled almost $3.8 billion Canadian.[70] These exports were highly influenced by three factors. These factors include the benefits Canada obtained from the export, Canadian policies related to the export of military goods, and recent adoption of the Arms Trade Treaty (ATT) by Canada.[71] These three factors contributed significantly to the value of non-US military exports. The benefits of exports for Canada could be tremendous. They could provide investment opportunities within Canada and allow for sustainment of an industry without direct dependence on the government of Canada. Policies related to the export of goods has a significant impact. Flexible policies may allow for greater trade of arms, while more rigid policies would do the opposite. The recent adoption of the ATT adds a very specific dimension to export of military equipment. It could reduce the probability of the export of military goods. All these factors influence the trade of arms for Canada. In turn, these factors will influence Canada's ability to export warships in the future. Perhaps these factors are already too rigid to allow the foreign sale of warships to take place?

The US has been specifically excluded from this analysis as there are specific arrangements between Canada and the US regarding trade that could alter an evaluation

[70] Government of Canada, *Export of Military Goods 2019* Global Affairs Canada, (2020), p. 22.

[71] "Arms Trade Treaty Regulatory Implementation Package," last modified -11-14, accessed April 6, 2021, https://www.international.gc.ca/trade-commerce/consultations/export_controls-controle_exportations/arms_trade-reg-commerce_armes.aspx?lang=eng.

of military exports. Of note, the US is Canada's largest trading partner. This is true for military goods as well.

While tremendous benefits to the Canadian government for foreign sales of warships might be possible, the industry also benefits. While preservation comes to mind, it is a result of the diversification that is possible through access to other customers. There are benefits of economies of scale that will help preserve supporting industries, one of the primary interests of the Canadian government. The preservation of supporting industries will help maintain the supply chain for spares, spares required in the future to sustain the Canadian fleet. An added benefit is the further investment in innovation and technology attributed to foreign sales. Current raw production costs per ship are estimated to be in the order of $3.5 billion.[72] While this number will decrease as demand increases due to economies of scale, the sale of one ship alone would have a tremendous impact on the sustainment possibilities of the industry. It supports the idea that international sales could aid in the sustainment of the shipbuilding industry and allow Canada to have a holistic perspective of the Canadian fleet.

Fundamentally, the sale of warships in the international market provides sustainment to Canada and the Canadian shipbuilding industry through short-term and long-term investment. Without these, the idea of long-term sustainment would not be possible. It is therefore vital for Canada to ensure that the international market remains available to Canadian industry.

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[72] "Estimated Costs for the Canadian Surface Combatants (Csc)," last modified Oct 20, accessed Mar 13, 2021, http://espritdecorps.ca/eye-on-industry/estimated-costs-for-the-canadian-surface-combatants-csc.

That said, it should also be noted that while sustainment of the industry is valuable to Canada, so too are the principles that Canada stands for. As such, Canada must ensure that, while sustainment is the goal, policies are in place to encourage sales while maintaining Canadian principles. Canadian policies are very clear in that their purpose, among other things, is to "ensure that … Canadian goods and technology are not used in a manner that is prejudicial to human rights, peace, security or stability."[73] Canadian policies regarding the export of military goods are among the strictest in the world and align with the policies of international partners.

While all countries do not adhere to the same set of values and principles that Canada does, there are some similarities among allied countries. In general, allies and members of common organizations tend to have similar mentalities. NATO is one example. NATO was established to counter a Cold War threat, as such members share some level of commonality regarding culture or values.[74] This is not true for countries outside these spheres. There is, therefore, a need to establish a robust regulatory system that ensures established policies are followed uniformly, regardless of where these exports are going. As such, Canada tracks the export to aid in the regulation of trade. This tracking also helps ensure enforcement of the necessary policies. In 2019, export to countries included on Canada's Automatic Firearms Country Control List (AFCCL) that are not NATO members was tracked. The AFCCL is a list of states to which Canadian weapons manufactures are permitted to export.[75] Table 1 demonstrates that 80% of

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[73] Government of Canada, *Export of Military Goods 2019,* p. 6.

[74] Ruud van Dijk and Stanley R. Sloan, "NATO's Inherent Dilemma: Strategic Imperatives Vs. Value Foundations," *Journal of Strategic Studies* 43, no. 6-7 (2020), p. 1014-1038.

[75] Paul Esau, "Customers Or Allies? the Dilemma of Canada's Automatic Firearms Country Control List," *Ploughshares Monitor (2001)* 39, no. 3 (2018), p. 11.

military trade took place with non-NATO AFCCL countries. This highlights that high levels of military trade are taking place with countries that may adhere to a different set of values than those of Canada.

Table 1: 2019 – Total Value ($CAD) of Exports for Military Goods and Technology by NATO and AFCCL Destinations[76]

Destination	Value	Percentage
NATO Members	$571,304,847.55	15.20%
Non-NATO AFCCL countries	$2,994,031,596.85	79.67%
Other countries	$191,721,239.62	5.12%
Total Non-U.S. Exports of Military Goods and Technology	**$3,757,057,684.02**	**100.00%**

While growth in these markets is excellent for sales and the economy, it presents a possible issue. Sales within these markets will be dependent on adherence to policies and processes. As such, careful regulation must take place in this area to ensure that Canadian values are upheld to the expected standard. The complication is that with the introduction of more regulation, the execution of exports becomes more difficult. At present, this is satisfied through the permit process that Canada uses, as outlined in the Export and Import Permit Act.[77] Canada's policies and processes must balance the need for military exports with the desire to uphold Canadian values. There is the possibility that, without effective policies to ensure foreign sales are possible, investment in shipbuilding as a net contributor, rather than a drag on the economy of Canada, could result in no international sales due to regulatory limitations.

[76] Government of Canada, *Export of Military Goods 2019,* p. 4.

[77] Government of Canada, *Export and Import Permits Act* (Canada: Government of Canada, (1985).

In contrast, authoritarian regimes seem set to demonstrate their unwillingness to tolerate the imposition of ideals that Canada expects.[78] As such, Canada must carefully navigate its military export policy and its development. The overall impact on the industry due to policy decisions could be tremendous. Procurement within Canada is too small to absorb the possible ramifications that political ideals could have on the industry as the military exports to Non-US states account for about 0.2% of the total Canadian Gross Domestic Product (GDP).[79]

In addition to existing regulations regarding the trade of arms with other nations, Canada has become a state party to the Arms Trade Treaty (ATT).[80] The ATT is a treaty introduced by the UN to "regulate the transfer of conventional arms … because of its close linkage with the concern of national security."[81] This introduces further regulatory requirements regarding the trade of arms. As a result, Canada has further reinforced trade policies making it more difficult for states with ill intent to obtain weapons from Canada. Conversely, the sale of arms will become more difficult, and available qualified buyers will be reduced. This brings to mind the question as to the value of investing in shipbuilding with a stringent set of international trade limitations in place.

Canada has established itself on the international stage as a country based on principles. This is supported by the various alliances and treaties that Canada is a part of, including the ATT. This stance has afforded Canada a great deal of soft power. Canada

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[78] Roland Paris, "Alone in the World?: Making Sense of Canada's Disputes with Saudi Arabia and China," *International Journal (Toronto)* 74, no. 1 (2019), p. 151-161.

[79] "Canada GDP | 1960-2019 Data | 2020-2022 Forecast | Historical | Chart | News," accessed Nov 4, 2020, https://tradingeconomics.com/canada/gdp.

[80] "Arms Trade Treaty Regulatory Implementation Package,"

[81] Yasuhito Fukui, "The Arms Trade Treaty: Pursuit for the Effective Control of Arms Transfer," *Journal of Conflict & Security Law* 20, no. 2 (2015), p. 302.

uses this soft power in all aspects of international politics. As such, the ideals that Canada clings to are critical aspects of Canadian international politics. Unfortunately, this positions Canada in an awkward situation regarding international trade, especially related to arms. To continue to be a principle-based country, Canada cannot conduct arms deals with countries that do not adhere to similar fundamental principles that Canada does.

The limitation here is that the Canadian defence industry cannot be as selective as the nation. While a principle-based approach to international trade allows Canada to wield significant soft power, it limits the economic prosperity of the defence industry. Furthermore, once deals are established, the Canadian defence industry could suffer tremendously if Canada cancels deals. This same concept holds for the Canadian shipbuilding industry. As indicated, the success of shipbuilding is strongly based on the predictability of demand. The idealistic approach to defence trade that Canada has limits how successful the industry can be. One contract cancellation could cost billions of dollars for the industry. It would effectively negate any value that Canada may gain from the industry and any level of sustainability of the future fleet.

While the value of Canadian military exports is a reasonable number, it is small when compared to the overall GDP of Canada. Canada's small military exports are heavily influenced by Canadian values and the policies implemented to uphold these values. While the idea of exploiting military exports to leverage the Canadian shipbuilding industry is one that would aid in the sustainment and holistic approach to shipbuilding, it may not be possible. The small and complex environment of military exports may prove difficult to exploit for the benefit of Canada.

Warship Sales

One thing that may aid Canada to market Canadian warships as part of military exports is the vessels themselves. While perhaps not the first thought in defence procurement, one option that could aid in ensuring sustainment of the shipbuilding industry into the future is the foreign sales of designed warships. To be effective, Canada must consider the cost, the product, the product diversity, and the product design. These factors will allow Canada to leverage opportunities. While Canada has demonstrated an ability to leverage some shipbuilding capability with the ANZAC modernization, it has yet to do this with a complete ship.[82] Even with these considerations in mind, can Canada affect them? If so, is the current approach sufficient to attract the necessary market share?

The CSC is a multi-role frigate based on the British Type 26 design. This ship is intended to be multirole capable. It will therefore be able to engage all aspects of threats from submarines to aircraft. To engage such a range of threats, it will be equipped with all manner of sensors. As a result of the range of capabilities, the cost of each platform is estimated to be in the order of $3.5 billion, as previously indicated.[83] It should be noted that the price per ship is based on an average determined for 15 vessels. In reality, the average cost per ship would be reduced as more vessels are constructed. This implies that a greater number of international sales would aid in lowering the costs of the CSC. The reduction in the average cost per ship is further supported by the first of class overruns

[82] "New Zealand ANZAC Frigate Systems Upgrade Project," accessed Mar 11, 2021, https://www.lockheedmartin.com/en-ca/anzac.html.

[83] "Estimated Costs for the Canadian Surface Combatants (CSC)."

determined by the United States Government Accountability Office.[84] This report indicates that initial builds of classes tend to result in cost overruns due to the inexperience of the shipyards with the design. As experience is gained, costs are decreased. The same report highlights that cost continue to decline as more ships are produced. There is, however, a limit to the cost reductions as there is a link between ship capability and cost.

To combat a similar cost issue with a highly capable ship, the British took a very innovative approach. A report conducted by the UK treasury indicated that "Naval Ships are not designed to be export friendly."[85] To address this aspiration, the United Kingdom established two frigate designs, the Type-26 and the Type-31. The latter of these two ships designs is to be cost-effective and generic. The former is designed for high tempo operations against a peer enemy. Admiral Sir Philip Jones clearly stated that "the Type-26 is a high-end anti-submarine warfare frigate, and it is deliberately designed to be so. Its design enables it to provide high-end protection both to our continuous at-sea deterrent forces and to our future carrier strike groups."[86] While both will be employed by the Royal Navy, the demand is for eight Type-26 and five Type-31.[87] To further ensure the placement of the Type-31 was at a price point that would attract buyers, the Royal Navy assured that the price point would reside below that of a Type-26.[88]

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[84] United States Government Accountability Office, *Navy Shipbuilding Past Performance Provides Valuable Lessons for Future Investment GAO-18-238SP* p.8

[85] "Royal Navy Stuck with Ships 'Well Beyond Sell-by Date'," last modified -11-29, accessed Mar 11, 2021, http://www.theguardian.com/uk-news/2016/nov/29/royal-navy-fleet-faces-depletion-review-finds.

[86] "Type 26 Global Combat Ship (GCS) – Capabilities,"

[87] "Type 31 Frigate Capabilities," and "Type 26 Global Combat Ship (GCS) – Capabilities,"

[88] "Type 31 Frigate Capabilities,"

The desire for the British to maintain a shipbuilding industry forces decisions within their fleet that support the idea of the export of warships. To do this, Britain was forced to reduce capability. This was done to assure that the warships produced by British shipbuilders were marketable to a wider variety of customers. If Canada has a desire to sustain the shipbuilding industry, one option could be to cater to the desires of a variety of future customers by ensuring product diversity. Production of one fully capable class of frigates within Canadian shipyards does not appear to support the exportability of the design. While variants of the CSC design are expected, it does not appear that these variants will take the steps that the British have taken to ensure the exportability of the vessels.[89]

The United Kingdom managed the expectation of its fleet around the desire to support the exportability of their ships. If Canada determines that the exportability of warships is a viable option, Canada will be forced to do the same if it expects to compete on the international stage. The practicality of the issue is that the capabilities and the price point of CSC will result in it being over capable and expensive. This is not desirable for the vast majority of nations to which Canada would seek to sell. Consider that, of the top four countries that Canada exports military capability to, only one does not currently build frigates.[90] While Saudi Arabia would be a prime country for the export of Canadian frigates, the reality is that Canada would seek to ensure that it can export warships to countries that are lower on the export list.

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[89] AMI INTERNATIONAL INC., "Canadian Surface Combatant Proposal Deadline Extended," *Sea Power (1971)* 60, no. 10 (2017). http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org. p. 44.

[90] Government of Canada, *Export of Military Goods 2019*

The major complication associated with this approach is the actual marketability of the design. Canada has opted to use a proven design as the basis for the CSC. The limitation is whether or not Canada can sell a ship designed in Britain as a Canadian ship. In fact, in all likelihood, a consumer would likely prefer to go directly to Britain rather than receive a Type-26 frigate from a secondary source.

In addition, as is the case for Constellation Class vessels expected from US shipyards, ships purchased will require modification to suit the needs of the purchasing country. In the case of the Constellation class, the FREMM design was selected, and the designing firm, Fincantieri, was hired to make the necessary modification to the FREMM design.[91] The Canadian team constructing the CSC consists of BAE Systems, CAE, Lockheed Martin Canada, L3 Technologies, MDA and Ultra Electronics. This team, with BAE at the helm, will be working with Irving shipbuilding. Irving will be the fabricator and the prime contractor to the government of Canada, and BAE will be the designer.[92] As such, any country seeking to buy the CSC design and modify it would be buying the Type-26, designed by BAE. As such, this would be a British design, not a Canadian. While it may be possible to sell a fully Canadianized version of the BAE design, it is much more likely that the base design, the Type-26, would be selected. This results in a very small possibility that Canada could sell a Canadian warship based on the design of the CSC. If Canada seeks to sell ships internationally, it must invest in design capability. Without this, there is no certainty that Canada can even sell warships. Unfortunately, the

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[91] Congressional Research Service, *Navy Constellation (FFG-62) Class Frigate (Previously FFG[X]) Program: Background and Issues for Congress. CRS Report*, (2020). p. 14.

[92] "Canada's Combat Ship Team: BAE Systems, CAE, Lockheed Martin Canada, L3 Technologies, MDA and Ultra Electronics Join Forces to Deliver Canadian Surface Combatant Proposal." *SP's Naval Forces* (2017a). http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

investment requirements for such an endeavour would outweigh the objective of ensuring the sustainability of the fleet of tomorrow.

While it may be possible for Canada to adjust the design of the CSC to suit a more diverse customer base, the fundamental issue is that Canada does not own the design of the Type-26. Without this, it is more likely that consumers would seek to purchase the Type-26 rather than a CSC. Canada has significantly impacted its ability to ensure the sustainment of the shipbuilding industry through the sales of warships by not designing the CSC in Canada. Canada will have to leverage skills such as the modernization work Lockheed Martin is conducting on the ANZAC class if there is any hope that foreign money will aid in sustainment of the shipbuilding industry.

Global Defence Market

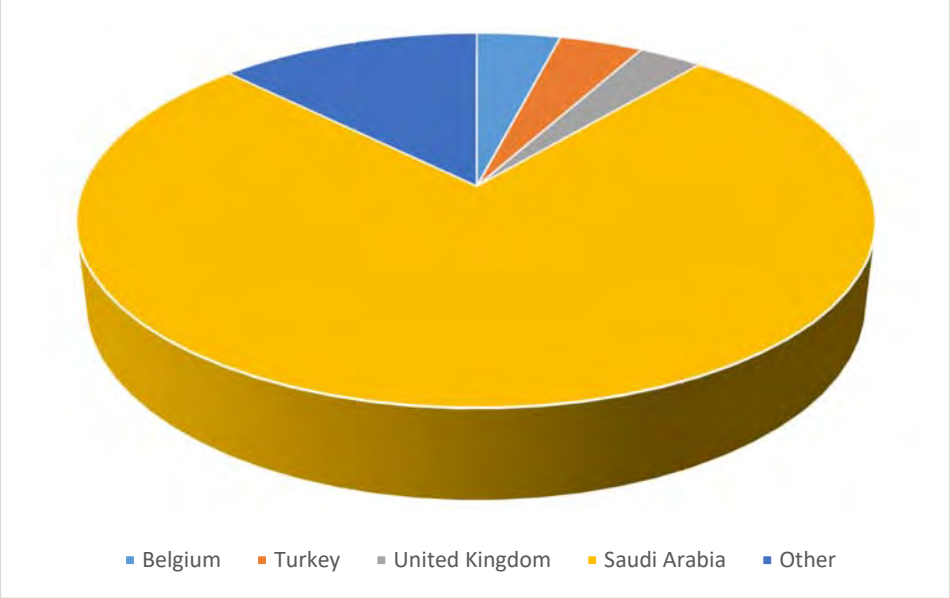
The global defence market is a significant value. Many countries take part in the industry with a significant impact. Canada is reported to be in the top 10 defence exporters between 2010 and 2019 but is significantly behind the leaders.[93] As such, it will be difficult for Canada to compete with majors players for market share. Canada may seek to leverage existing relationships to obtain sales, but it is still very competitive. Canada is also limited by the lack of established shipbuilding industry. While it may be possible for Canada to develop an established shipbuilding industry, competitors already have them established. This is further complicated by the already saturated frigate market in which Canada would compete. To sustain the shipbuilding industry for the future fleet,

[93] "UK Defence and Security Export Statistics for 2019," last modified October 6, accessed Mar 11, 2021, https://www.gov.uk/government/statistics/uk-defence-and-security-export-statistics-for-2019.

it is in Canada's best interest to gain market share to sell warships. Unfortunately, with fierce competition and a lack of experience, Canada may be forced to do without.

According to the latest UK defence and security export statistics, as of 2019, the global defence export market was estimated to be $89 billion.[94] Of this, Canada was able to obtain nearly $3.8 billion of that market. Chart 1, below, highlights defence trade that Canada has had globally during 2019.

Chart 2: Canadian Military Exports by Country in 2019[95]



Note that this chart includes exports greater than $100 million. Countries with exports of less than $100 million were included in the category of other.

Of particular interest in the chart is the significant military exports to Saudi Arabia. The overall value of military trade with Saudi Arabia totaled nearly $2.9 billion

[94] "UK Defence and Security Export Statistics for 2019," last modified October 6, accessed Mar 11, 2021, https://www.gov.uk/government/statistics/uk-defence-and-security-export-statistics-for-2019.

[95] "UK Defence and Security Export Statistics for 2019," last modified October 6, accessed Mar 11, 2021, https://www.gov.uk/government/statistics/uk-defence-and-security-export-statistics-for-2019.

in 2019.[96] Initial evaluation of this data suggests opportunities for Canada to pursue additional defence trade deals with Saudi Arabia. It is, however, a distorted perspective. The reality is that Saudi Arabia has begun to import a significant amount of defence capability. This is related to concerns with Iran and the involvement of Iran in Syria.[97] In an attempt to ensure that the demand is met, Saudi Arabia has established significant trade deals with major defence exporters. These trade deals include a trade deal with the US in the amount of $110 billion, with an additional $350 billion deal over the next ten years with Saudi Arabia and other Gulf states.[98] The trade deal with the US allows Saudi Arabia to enjoy a special relationship with the US that Canada cannot compete with.

That said, between 2016 and 2020, Saudi Arabia has imported 11% of the global arms imports.[99] This could imply that Canada may not be in competition with the US for the business of Saudi Arabia. This suggests that should Canada be able to developing a capably designed frigate of good quality Saudi Arabia may have purchased it. The limitation is that Saudi Arabian frigate purchases appear to have come from well-established frigate industries, the US and Spain.[100] Canada cannot develop a well-established shipbuilding industry overnight. As such, it is unlikely, despite Saudi Arabia's willingness to do business with Canada, that Canada could sell warships to Saudi Arabia.

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[96] Government of Canada, *Export of Military Goods 2019*. p. 22.

[97] Line Khatib, "Syria, Saudi Arabia, the U.A.E. and Qatar: The 'Sectarianization' of the Syrian Conflict and Undermining of Democratization in the Region," *British Journal of Middle Eastern Studies* 46, no. 3 (2019), p. 385

[98] Mary Kay Linge, "Trump Signs Off on $110B Arms Deal in Saudi Arabia," *New York Post*-05-20, 2017. https://nypost.com/2017/05/20/trump-signs-off-on-110b-arms-deal-in-saudi-arabia/.

[99] Pieter D. Wezeman, Alexandra Kuimova and Siemon T. Wezeman, *Trends in International Arms Transfers, 2020* (Solna, Sweden: Stockholm International Peace Research Institute, (2021). p. 11.

[100] Pieter D. Wezeman, Alexandra Kuimova and Siemon T. Wezeman, *Trends in International Arms Transfers, 2020* (Solna, Sweden: Stockholm International Peace Research Institute, (2021). p. 10

The saturated frigate market is another complication to the ability of Canada to enter into the global sales of warships. Many countries, ranging from the UK and the US to countries like India and Iran, build frigates. Not all these are of the same standard expected of a Canadian product, but many are. When the British Type-26 design was selected as the base of the future Canadian Surface Combatant, there were a total of three potential bids that Canada evaluated.[101] This suggests strong competition for the market space that the CSC will occupy. While the overall idea of international sales would prove beneficial to the Canadian shipbuilding industry, Canada is not well-positioned to compete in a saturated frigate market. To compete in the market, Canada would require experience and a reputation. Both will take Canadian shipbuilders decades to build. As the goal is to ensure the fleet can be sustained in the future, the idea of the international sales of warships may be a bridge too far.

Canadian defence exports are minor when compared to the leaders in the industry, specifically the US. The fact that a single deal between the US and Saudi Arabia is over 30 times greater than the total defence exports of Canada in 2019 highlights this.[102] It makes it difficult for Canada to obtain a reasonable segment of the industry. When compounded with a saturated frigate market and the realities of selling ships internationally, it is unlikely that international sales are a good course of action for Canada. If Canada is to ensure the sustainment of the shipbuilding industry for the fleet of tomorrow, Canada will have to seek other avenues to ensure this success.

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[101] Beatrice Paez, "Feds Closing in on Winning Bidder for $60-Billion Warship Project," *The Hill Times,* Aug 24, 2018.

[102] "Saudi Arabia, United States: US Govt. Announces $110 Billion Arms Deal with Saudi." *MENA Report* (2017b). http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

It appears that Canada is not well suited for the international sales of warships. Canada has limited its ability to compete on the international stage based on choices made. Canadian ideals place significant pressure on the ability to conduct exports. While these are likely reasonable choices for Canada, they do not aid in warship sales. In addition, Canada's choice to build a proven design of frigate has impacted Canada two-fold. It would force Canada to compete in an already saturated market, and it prevents true sales as the design belongs to the UK. Market share is the final hurdle that limits Canada in the sale of warships. Canada is simply not well positioned to compete with major players in the defence industry. Canada's choices have prevented it from sustaining the fleet of tomorrow through international sales. Without a major change in the choice made by Canada, international sales are simply not an option, even if it means a lack of sustainment for the shipbuilding industry

CONCLUSION

Canada has a long history of shipbuilding starting in the Second World War. Since then Canada has been struggling to maintain a shipbuilding industry and consistently repeating the boom and bust cycle. The National Shipbuilding Strategy has been advertised as the strategy to change this. The intent of the strategy is to sustain an industry to allow the government of Canada to take on a more holistic approach to shipbuilding. In reality the NSS is simply a long-term procurement plan that extends government investment, in the form of demand, to shipyards.

If the NSS was truly the strategy that is claimed, there is no doubt that a single shipyard would have been chosen rather than the three currently in contract with the government of Canada. A single shipyard would prolong the sustainment of the industry and would ensure that the industry is available to maintain the fleet in the future. There are likely other factors that have persuaded the government to opt for three shipyards within the NSS structure but it likely was not related to the future sustainment of the industry or the fleet.

The tertiary benefits of the shipbuilding industry have also been limited based on choices made within the NSS. The decision to use ITBs and to use a proven design have limited the benefit of the reinvestment that takes place as a result of the shipbuilding industry. That said, the approach chosen has demonstrated success. ITBs appear to be effectively implemented and are directing reinvestment into the industry thanks to the incentivization applied. The same can be said for IP. While the decision to use a proven design has limited the IP developed during the design phase, Canada remains the beneficiary of the IP related to any other stage of ship construction. As such both the

ITBs and IP could be considered positive steps towards sustainment of the fleet of tomorrow.

The sustainment of the industry through the use of international sales, will not be viable. While Canada could develop the experience required, it will take years to develop and will not be a viable solution for the fleet of tomorrow. In addition, Canada faces strong competition and a saturated market for frigate sales. While these are significant issues alone they are only compounded by Canadian policies related to military trade. With all these factors against Canada, international sales are not a viable option.

Canada does appear to be taking steps towards a holistic approach to shipbuilding, but it is not taking the most viable steps. There are options available to Canada that may make the holistic approach to shipbuilding a more viable than the choices being made. That said, there is sufficient evidence to suggest that despite some errors, Canada is trying to ensure a holistic approach to shipbuilding. It simply seems like Canada is making compromises.

BIBLIOGRAPHY

AMI International I N C. "Canadian Surface Combatant Proposal Deadline Extended," *Sea power* (1971) 60, no. 10 (2017). http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Axworthy, Lloyd. "Why `Soft Power' Is the Right Policy for Canada: Final Edition." *The Ottawa Citizen* (1986). 1998. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Birkler, John, John F Schank, Edward G Keating, Joel B Predd, James Black, Dan Jenkins, James G Kallimani, et al. "Australia's Naval Shipbuilding Enterprise Preparing for the 21st Century." RAND. Santa Monica, California: RAND Corporation, 2015.

Bland, Douglas L., Ont.). Defence Management Studies Program Queen's University (Kingston, and Ont.). School of Policy Studies Queen's University (Kingston. *National Approaches to Shipbuilding and Ship Procurement*. Vol. 11. 11. Kingston, Ont: Defence Management Studies Program, School of Policy Studies, Queen's University, 2010. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

"Bound to 'Bust'? Part 2: The Myth of NSS Exports," *Canadian Naval Review*, June 17, 2020. https://www.navalreview.ca/2020/06/bound-to-bust-part-2-the-myth-of-nss-exports/.

Brewster, Murray. "Trudeau Government Promises Coast Guard Two New Icebreakers, Splits Work between Seaspan and Davie | CBC News." CBC, May 6, 2021. https://www.cbc.ca/news/politics/coast-guard-heavy-icebreaker-1.6016127.

Brooks, Mary R. *The Jones Act under NAFTA and Its Effects on the Canadian Shipbuilding Industry*. Atlantic Instutute for Market Studies, 2006. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

"Canada : Davie Polar Icebreaker Program Confirms GE as Strategic Partner," MENA Report, 2021. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

"Canada GDP | 1960-2019 Data | 2020-2022 Forecast | Historical | Chart | News." Accessed November 4, 2020. https://tradingeconomics.com/canada/gdp.

Canada, Global Affairs. "About Canada," August 30, 2018. https://www.educanada.ca/study-plan-etudes/before-avant/about-canada-a-propos.aspx?lang=eng.

Canada, Global Affairs. "Arms Trade Treaty Regulatory Implementation Package." GAC, November 14, 2018. https://www.international.gc.ca/trade-commerce/consultations/export_controls-controle_exportations/arms_trade-reg-commerce_armes.aspx?lang=eng.

Canada, Government of. “Canada’s National Shipbuilding Strategy - 2019 Annual Report.” Government of Canada, 2019. https://www.tpsgc-pwgsc.gc.ca/app-acq/amd-dp/mer-sea/sncn-nss/rapport-report-2019-eng.html.

Canada, Government of. “Export and Import Permits Act.” Government of Canada. Canada: Government of Canada, 1985.

Canada, Government of. “Export of Military Goods 2019.” Global Affairs Canada. Global Affairs Canada, May 2020. https://www.international.gc.ca/trade-commerce/controls-controles/reports-rapports/military-goods-2019-marchandises-militaries.aspx?lang=eng.

Canada, Industry. “A New Policy Framework for the Canadian Shipbuilding and Industrial Marine Industry Focusing on Opportunities 2001.” Government of Canada, 2001.

Canada, Lockheed Martine. “New Zealand ANZAC Frigate Systems Upgrade Project.” Lockheed Martin, 2021. https://www.lockheedmartin.com/en-ca/anzac.html.

“Canada Military Expenditure | 1950-2018 Data | 2019-2020 Forecast | Historical | Chart.” Trading Economics. Accessed September 17, 2020. https://tradingeconomics.com/canada/military-expenditure.

Canada, Naval Association of. “The National Shipbuilding Strategy and the Canadian Surface Combatant,” February 4, 2021.

Canada, Public Services and Procurement. “Canada Announces next Step toward Adding Third Strategic Partner under National Shipbuilding Strategy.” Accessed December 31, 2020. https://www.newswire.ca/news-releases/canada-announces-next-step-toward-adding-third-strategic-partner-under-national-shipbuilding-strategy-828527180.html.

Canada, Public Services and Procurement. “Update on the Canadian Surface Combatant Request for Proposals.” *GC News,* December 5, 2017. https://www.canada.ca/en/public-services-procurement/news/2017/12/update_on_the_canadiansurfacecombatantrequestforproposals.html.

Canada, Statistics. “Highlights of Canada’s Geography,” October 7, 2016. https://www150.statcan.gc.ca/n1/pub/11-402-x/2012000/chap/geo/geo-eng.htm.

“Canada’s Combat Ship Team: BAE Systems, CAE, Lockheed Martin Canada, L3 Technologies, MDA and Ultra Electronics Join Forces to Deliver Canadian Surface Combatant Proposal,” SP’s Naval Forces, 2017. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

“Canada’s National Shipbuilding Strategy 2018 Annual Report,” 28 Apr 21.

Chair, Stephen Fuhr. “The Readiness of Canada’s Naval Forces Report of the Standing Committee on National Defence,” June 1, 2017.

Chapman, Bert. “The Geopolitics of Canadian Defense White Papers: Lofty Rhetoric and Limited Results,” Geopolitics, history, and international relations 11, 11, no. 1 (2019): 7–40. https://doi.org/10.22381/GHIR11120191.

Chase, Steven. “Canada Now the Second Biggest Arms Exporter to Middle East, Data Show.” Globe and Mail, June 14, 2016. https://www.theglobeandmail.com/news/politics/canada-now-the-second-biggest-arms-exporter-to-middle-east-data-show/article30459788/.

Chuter, Andrew. “Britain’s Shipbuilding Strategy Has Not Gone According to Plan — and Industry Is Noticing.” Defense News, 2019. https://www.defensenews.com/global/europe/2019/09/08/britains-shipbuilding-strategy-has-not-gone-according-to-plan-and-industry-is-noticing/.

Collins, Jeffery. “Overcoming ‘Boom and Bust’? Analyzing National Shipbuilding Plans in Canada and Australia.” Canadian Global Affairs Institute, January 2019. https://www.cgai.ca/overcoming_boom_and_bust_analyzing_national_shipbuilding_plans_in_canada_and_australia.

Collins, Jeffrey F. *Overcoming ‘Boom and Bust’? Analyzing National Shipbuilding Plans in Canada and Australia*. Canadian Global Affairs Institute, 2019. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Defence, National. “Assistant Deputy Minister (Review Services).” Aem, March 11, 2021. https://www.canada.ca/en/department-national-defence/corporate/reports-publications/transition-materials/defence-101/2020/03/defence-101/adm-rs.html.

Defence, National. “Strong, Secure, Engaged: Canada’s Defence Policy.” Aem, September 22, 2017. https://www.canada.ca/en/department-national-defence/corporate/policies-standards/canada-defence-policy.html.

“Defence Procurement Canada — Defence Procurement in the 43rd Parliament.” Canadian Global Affairs Institute, 2019. https://www.cgai.ca/defence_procurement_canada_defence_procurement_in_the_43rd_parliament.

Defence, Think. “Type 26 Global Combat Ship (GCS) – Capabilities.” Think Defence, October 24, 2015. https://www.thinkdefence.co.uk/the-type-26-frigate/type-26-global-combat-ship-gcs-capabilities/.

Defence, Think. “Type 31 Frigate Capabilities.” Think Defence, August 27, 2016. https://www.thinkdefence.co.uk/type-31-general-purpose-frigate-gpff/type-31-frigate-capabilities/.

Dijk, Ruud van, and Stanley R. Sloan. “NATO’s Inherent Dilemma: Strategic Imperatives vs. Value Foundations,” *Journal of Strategic Studies*, 43, no. 6–7 (2020): 1014–38. https://doi.org/10.1080/01402390.2020.1824869.

Donaghy, Greg, and Michael Kiernan Carroll. *In the National Interest: Canadian Foreign Policy and the Department of Foreign Affairs and International Trade, 1909-2009*. Edited by Greg Donaghy, Greg Donaghy, Michael K. Carroll, and

Michael K. Carroll. Vol. 3. 3. Calgary: University of Calgary Press, 2011. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

ERICKSON, JENNIFER L. "Saint or Sinner? Human Rights and U.S. Support for the Arms Trade Treaty," *Political Science Quarterly* 130, no. 3 (2015): 449–74. https://doi.org/10.1002/polq.12361.

Esau, Paul. "Customers or Allies? The Dilemma of Canada's Automatic Firearms Country Control List," *Ploughshares Monitor* (2001), 39, no. 3 (2018): 11. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Exports, UK Department of International Trade and UK Defence and Security. "UK Defence and Security Export Statistics for 2019." GOV.UK, October 6, 2020. https://www.gov.uk/government/statistics/uk-defence-and-security-export-statistics-for-2019.

"Federal Subsidy On Shipbuilding Aids Burrard." The Globe and Mail (1936-2017). 1962. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Forbes, Gordon. "Forbes: Here's Why We Can't Buy Our Warships from Foreign Companies." Ottawacitizen, 2018. https://ottawacitizen.com/opinion/columnists/forbes-heres-why-we-cant-buy-our-warships-from-foreign-companies.

Forbes, R. A., and Canadian Forces College. "Government Shipbuilding: The Chase for the Elusive Economic Benefit." Toronto, Ont: Canadian Forces College, 2014. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Fukui, Yasuhito. "The Arms Trade Treaty: Pursuit for the Effective Control of Arms Transfer," *Journal of Conflict & Security Law,* 20, no. 2 (2015): 301–21. https://doi.org/10.1093/jcsl/krv003.

Gallagher, Kelsey. "Analyzing Canada's 2019 Exports of Military Goods Report," *Project Ploughshares*, 41, no. 3 (2020). https://ploughshares.ca/pl_publications/analyzing-canadas-2019-exports-of-military-goods-report/.

"Geography-Geographie-Eng," n.d.

Gereffi, Gary, Lukas Brun, and Shawn Stokes. *The NSPS Shipbuilding Value Chains*. Nova Scotia Department of Economic and Rural Development and Tourism, 2013. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Gilmore, Scott. "It's Time to Ban the Buying of Made-in-Canada Warships." *Macleans.Ca*, February 25, 2021. https://www.macleans.ca/opinion/its-time-to-ban-the-buying-of-made-in-canada-warships/.

Government of Canada, Innovation. "Industrial and Technological Benefits Policy - Home." Industrial and Technological Benefits, April 3, 2020. https://www.ic.gc.ca/eic/site/086.nsf/eng/home.

Government of Canada, Innovation. “State of Canada’s Defence Industry 2018 - Canadian Aerospace and Defence Industry.” Innovation, Science and Economic Development Canada. Accessed March 12, 2021. https://www.ic.gc.ca/eic/site/ad-ad.nsf/eng/h_ad03978.html#p6.

Government of Canada, Public Services and Procurement Canada. “About the National Shipbuilding Strategy – National Shipbuilding Strategy – Sea – Defence Procurement – Buying and Selling – PSPC,” April 13, 2016. https://www.tpsgc-pwgsc.gc.ca/app-acq/amd-dp/mer-sea/sncn-nss/apropos-about-eng.html.

Hossain, Khandakar Akhter, and N.M.G Zakaria. “A Study on Global Shipbuilding Growth, Trend and Future Forecast,” Procedia engineering 194, 194 (2017): 247–53. https://doi.org/10.1016/j.proeng.2017.08.142.

Industries, Canadian Association of Defence and Security, and Canadian Association of Defence and Security Industries. Marine Industries Working Group. *Sovereignty, security and prosperity: government ships - designed, built and supported by Canadian industry : the report of the CADSI Marine Industries Working Group*. Ottawa, ON: CADSI/AICDS, 2009. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Innovation, Science and Economic Development Canada. “Industrial and Technological Benefits Policy: Value Proposition Guide ,” May 31, 2018.

International, Radio Canada. “Ice-Capable Canadian Coast Guard Ships Could Be Both ‘a Blessing and a Curse’: Expert – RCI | English.” Radio Canada International, 2019. https://www.rcinet.ca/en/2019/05/11/aops-canadian-coast-guard/.

Ivus, Olena. *Does Canada’s Foreign Trade Policy Give Innovating Canadian Firms a Competitive Edge Internationally?* Centre for International Governance Innovation, 2019. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Jaramillo, Cesar, and Kenneth Epps. “Canada Joins the Arms Trade Treaty — but Will It Cancel the Saudi Deal?” Open Canada, October 1, 2019. https://opencanada.org/canada-joins-the-arms-trade-treaty-but-will-it-cancel-the-saudi-deal/.

Jean, Grace. “Canada to Commence Negotiations with Davie Shipyard for Interim Navy Supply Ship,” Jane’s Navy International, 120, no. 6 (2015). http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Jenkins, Tom, and Public Works and Government Services Canada. “Canada first: leveraging defence procurement through key industrial capacities : report of the Special Adviser to the Minister of Public Works and Government Services.” Ottawa, Ont: Government of Canada, 2013. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Jones, Robert. “Companies Still Made Largest Political Donations, Ahead of Ban | CBC News.” CBC, December 20, 2017. https://www.cbc.ca/news/canada/new-brunswick/new-brunswick-political-donations-ban-companies-2017-1.4457205.

Kenrick, Andrew. “Shipbuilding in Canada,” *Marine Technology and SNAME News*, 38, no. 4 (2001): 7. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Kerr, Julian. “Rand Report on Australian Shipbuilding Finds 30-40% Cost Premium,” *Jane’s Defence Industry*, 32, no. 5 (2015). http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Khatib, Line. “Syria, Saudi Arabia, the U.A.E. and Qatar: The ‘sectarianization’ of the Syrian Conflict and Undermining of Democratization in the Region,” *British Journal of Middle Eastern Studies*, 46, no. 3 (2019): 385–403. https://doi.org/10.1080/13530194.2017.1408456.

Kitchen, Peter. “WHY CANADA MUST STAY THE COURSE ON ITS NSS COMMITMENT,” December 17, 2020. http://www.canadiandefencereview.com/featured_content?blog/219.

Kukucha, Christopher J. “Neither Adapting nor Innovating: The Limited Transformation of Canadian Foreign Trade Policy since 1984,” *Canadian Foreign Policy Journal*, 24, no. 3 (2018): 301–15. https://doi.org/10.1080/11926422.2018.1463100.

Lee, Carol E., and Margherita Stancati. “Donald Trump, Saudi Arabia Sign Agreements in Move to Counterbalance Iran; Stop in Riyadh Begins Nine-Day Trip to Middle East and Europe, as Controversies Swirl at Home.” *The Wall Street Journal*. Eastern Edition. 2017. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Lerhe, Eric. “Fleet-Replacement and the ‘Build at Home’ Premium: Is It Too Expensive to Build Warships in Canada?” CDA Institute. CDA Institute, July 2016.

Lerhe, Eric. “The National Shipbuilding Procurement Strategy: An Update Strategic Studies Working Group Papers,” February 1, 2013.

Linge, Mary Kay. “Trump Signs off on $110B Arms Deal in Saudi Arabia.” New York Post. May 20, 2017. https://nypost.com/2017/05/20/trump-signs-off-on-110b-arms-deal-in-saudi-arabia/.

Lundquist, Edward. “Canada’s National Shipbuilding Strategy: It’s Not Just About Building Ships, It’s About Building an Industry,” *Naval Forces*, 40, no. 5 (2019). http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

MacAskill, Ewen. “Royal Navy Stuck with Ships ‘Well beyond Sell-by Date.’” *The Guardian*, 2016. http://www.theguardian.com/uk-news/2016/nov/29/royal-navy-fleet-faces-depletion-review-finds.

Mack, Ian. *A Third NSS Shipyard*. Canadian Global Affairs Institute, 2019. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Mack, Ian. *Emerging Lessons from the National Shipbuilding Procurement Strategy*. Canadian Global Affairs Institute, 2019. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Madsen, Chris. “Wages, Work, and Wartime Demands in British Columbia Shipbuilding, 1916-19,” *BC Studies*, no. 182 (2014): 73-111. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Markowski, Stefan, Peter Hall, Robert Wylie, EBSCO ebook, ProQuest ebook, EBSCOhost (Online service), and Ebook Library. *Defence Procurement and Industry Policy: A Small Country Perspective*. Vol. 11. 11. New York: Routledge, 2010. https://doi.org/10.4324/9780203013694.

McCarthy, Niall. “Infographic: The Countries With The Most Islands.” Statista Infographics, October 9, 2018. https://www.statista.com/chart/15364/the-estimated-number-of-islands-by-country/.

McKinnon, Judy. “Davie Yards Enters Creditor Protection; Will Eliminate 1,600 Jobs,” Daily Bankruptcy Review Small - Cap, 2010. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

McMenamin, Iain. “Party Identification, the Policy Space and Business Donations to Political Parties,” *Political Studies*, 68, no. 2 (2019): 003232171984124–310. https://doi.org/10.1177/0032321719841243.

Michalchuk, Brian. “Shifting From a Shipbuilding Strategy to a Ship Sustainment Strategy: Balancing Economic Prosperity and Technical Risk,” 2017.

Mickeviciene, Rima. *Global Shipbuilding Competition: Trends and Challenges for Europe*. IntechOpen, 2011. https://doi.org/10.5772/17215.

Milner, Marc. *Canada’s Navy: The First Century*. Toronto: University of Toronto Press, 1999. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Milner, Marc. “Launching The Service.” Legion Magazine, January 1, 2010. https://legionmagazine.com/en/2010/01/launching-the-service/.

MOON, SARAH. “A New Wild West: Opening the Northwest Passage,” *Harvard International Review*, 34, no. 3 (2013): 8–9. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

National Shipbuilding Strategy. Government of Canada, 2021. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Nossal, Kim Richard. *Charlie Foxtrot: Fixing Defence Procurement in Canada*. Toronto: A.J. Patrick Boyer Book, 2016. http://cfc.summon.serialssolutions.com.

Office, United States Government Accountability. “Navy Shipbuilding Past Performance Provides Valuable Lessons for Future Investment GAO-18-238SP,” June 1, 2018.

Paez, Beatrice. “Feds Closing in on Winning Bidder for $60-Billion Warship Project.” *The Hill Times*, August 24, 2018. https://www-hilltimes-com.cfc.idm.oclc.org/2018/09/24/feds-closing-winning-bidder-60-billion-warship-project/169844.

Paris, Roland. “Alone in the World?: Making Sense of Canada’s Disputes with Saudi Arabia and China,” *International Journal* (Toronto), 74, no. 1 (2019): 151–61. https://doi.org/10.1177/0020702019834652.

Portal, Funding. “Industrial and Regional Benefits Overhauled after 28 Years.” Grants101, February 18, 2014. https://fundingportal.com/grants101/industrial-and-regional-benefits-overhauled-after-28-years/.

PricewaterhouseCoopers, LLP. “Lockheed Martin of Economic Impact in Canada,” April 2018.

PricewaterhouseCoopers, LLP. “Value for Canada the Cost versus Benefit to Canadians of the National Strategy,” May 2017.

Pritchard, James S. *A Bridge of Ships: Canadian Shipbuilding during the Second World War*. Montreal: McGill-Queen’s University Press, 2011. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Pugliese, David. “$70 Billion Warship Project Promised Thousands of Jobs, but Who Knows How Many Will Be Delivered?” *Ottawa Citizen*, December 14, 2020. https://ottawacitizen.com/news/national/defence-watch/70-billion-warship-project-promised-thousands-of-jobs-but-who-knows-how-many-will-be-delivered.

Quigley, Aidan. “Navy: Lead Constellation-Class Frigate Ship Construction to Start This Fall,” *Inside the Pentagon’s Inside the Navy*, 34, no. 2 (2021). https://insidedefense.com/daily-news/navy-lead-constellation-class-frigate-ship-construction-set-start-fall.

Ring, Tom. *The National Shipbuilding Procurement Strategy*. Canadian Global Affairs Institute, 2016. https://www.cgai.ca/the_national_shipbuilding_procurement_strategy.

Rose, Andrew K. “Soft Power and Exports,” *Review of International Economics*, 27, no. 5 (2019): 1573–90. https://doi.org/10.1111/roie.12435.

“Saudi Arabia, United States : US Govt. Announces $110 Billion Arms Deal with Saudi,” MENA Report, 2017. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Scott, Richard. “UK Set for Shipbuilding Strategy Refresh,” *Jane’s Navy International*, 126, no. 3 (2021). http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Seaspan. “Seaspan Shipyards and Heddle Shipyards Join Forces in Bid to Deliver the Polar Icebreaker to the Canadian Coast Guard.” Seaspan, 2020. https://www.seaspan.com/seaspan-shipyards-heddle-shipyards-join-forces-bid-deliver-polar-icebreaker-canadian-coast-guard.

Service, Congressional Research. “Navy Constellation (FFG-62) Class Frigate (Previously FFG[X]) Program: Background and Issues for Congress. CRS Report,” 2021. https://fas.org/sgp/crs/weapons/R44972.pdf.

Sloan, Elinor. “Something Has to Give: Why Delays Are the New Reality of Canada’s Defence Procurement Strategy.” Canadian Global Affairs Institute, 2014. https://www.cgai.ca/something_has_to_give_why_delays_are_the_new_reality_of_canada_s_defence_procurement_strategy.

Sloan, Elinor C., and Canadian Defence and Foreign Affairs Institute. *Something Has to Give: Why Delays Are the New Reality of Canada’s Defence Procurement Strategy*. Calgary, Alta: Canadian Defence & Foreign Affairs Institute, 2014. http://cfc.summon.serialssolutions.com

Smith, Maurice. “Quebec Shipbuilder Delivers North America’s First LNG-Powered Ferry,” July 13, 2018. https://www.jwnenergy.com/article/2018/7/13/quebec-shipbuilder-delivers-north-americas-first-l/.

Stone, Craig. “Growing the Defence Budget: What Would Two Percent of GDP Look Like?” Canadian Global Affairs Institute, 2017. https://www.cgai.ca/growing_the_defence_budget_what_would_two_percent_of_gdp_look_like.

Stone, J. Craig. *The Demise of the National Shipbuilding Strategy*. Canadian Global Affairs Institute, 2019. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org.

Stone, J. Craig, and Binyam Solomon. “Canadian Defence Policy and Spending,” *Defence and Peace Economics*, 16, no. 3 (2005): 145–69. https://doi.org/10.1080/10242690500123414.

Stone, Mike. “U.S. Weapons Exports Rise 2.8% to $175 Billion in Fiscal 2020.” Reuters, December 4, 2020. https://www.reuters.com/article/us-usa-military-exports-idUSKBN28E2ZK.

Tibensky, Milan. “Infographics: Why Are IT System Integration Costs so High.” Connecting Software, 2015. https://www.connecting-software.com/blog/infographics-why-are-it-system-integration-costs-so-high/.

Tran, Pierre, Tom Kington, and David Pugliese. “Bold Move Backfires as Canada Declines Naval Group-Fincantieri Frigate Offering.” Defense News, 2017. https://www.defensenews.com/industry/2017/12/06/bold-move-backfires-as-canada-declines-naval-group-fincantieri-frigate-offering/.

Tucker, Gilbert Norman. *The Naval Service of Canada: Its Official History*. Ottawa: King’s Printer, 1952. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org

Union, European. “Intellectual, Industrial and Commercial Property,” 2021. www.europarl.europa.eu/factsheets/en.

Wasny, Garrett. “Canada’s Shipbuilding Industry,” *World Trade* (Irvine, Calif.), 11, no. 2 (1998): 44. http://cfc.summon.serialssolutions.com.cfc.idm.oclc.org

Wezeman, Pieter D., Alexandra Kuimova, and Siemon T. Wezeman. “Trends In International Arms Transfers, 2020.” Stockholm International Peace Research Institute (SIPRI). Solna, Sweden: Stockholm International Peace Research Institut, March 2021.

Williams, Alan. “Estimated Costs For the Canadian Surface Combatants (CSC).” *Esprit de Corps*, October 20, 2020. http://espritdecorps.ca/eye-on-industry/estimated-costs-for-the-canadian-surface-combatants-csc.

Zhang, Bao-Ji, and Zhu-Xin Zhang. “Research on Theoretical Optimization and Experimental Verification of Minimum Resistance Hull Form Based on Rankine Source Method,” *International Journal of Naval Architecture and Ocean Engineering*, 7, no. 5 (2015): 785–94. https://doi.org/10.1515/ijnaoe-2015-0055.