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Human Capital and the NSPS

MSPO No. 18

Human Capital and the National Shipbuilding Procurement Strategy

Maritime Security Occasional Paper No. 18

Edited by
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Centre for Foreign Policy Studies
Dalhousie University

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National Shipbuilding Procurement Strategy: Human Capital and the NSPS

Proceedings of the Maritime Security Program Workshop
Dalhousie University
14 November 2014

Edited by
Ian Wood

Prepared by
Tim Dunne

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List of Acronyms

ACOA	Atlantic Canada Opportunities Agency
AOPS	Arctic Offshore Patrol Ship
AOR	Auxiliary Oiler and Replenishment (Ship)
AWP	Association of Women Professionals
CBI	Computer-based instruction
CBRN	Chemical, biological, radiological and nuclear weapons
CBT	Computer-based training
CFITES	Canadian Forces Individual Training and Education System
CFTS	Contracted Flying Training and Support
CIC	Combat Information Centre
CM	Corrective maintenance
CO	Commanding Officer
CODELAG	Combined diesel electric and gas
COTS	Commercial off-the-shelf
CSC	Canadian Surface Combatant
DLN	Defence Learning Network
DRDC	Defence Research and Development Canada
ECDIS	Electronic Chart Display and Information System Trainers
EI	Employment Insurance
EPSS	Electronic performance support systems
ERDT	Educational Resource Development Trust
FREMM	Frégate Européenne Multi-mission
EW	Electronic warfare
FELEX	Frigate Life Extension

GED	General Educational Development
HCM	Halifax-class Modernization Program
HELO	Helicopter
HMCS	Her Majesty's Canadian Ship
HR	Human resources
IE	Industrial Engineering
ILT	Instructor-led training
ISI	Irving Shipbuilding Inc.
ITAR	International Trade in Arms Regulations
JSS	Joint Support Ship
LAE	Department of Labour and Advanced Education
LMDA	Labour market development agreements
LMI	Labour market information
MCDV	Maritime Coastal Defence Vessel
MEOPAR	Marine Environmental Observation Prediction and Response Network
MOSID	Military Occupational Structure Identification
MPIO	Major Initiatives and Project Office
MTOGS	Maritime Tactical and Operational Gaming System
MUN	Memorial University of Newfoundland
NBC	Nuclear, biological and chemical weapons
NSAA	Nova Scotia Apprenticeship Agency
NSBI	Nova Scotia Business Inc.
NSCC	Nova Scotia Community College
NSPS	National Shipbuilding Procurement Strategy
NSSAL	Nova Scotia School for Adult Learning
NTS	Naval Training System
PM	Preventive maintenance
RAS	Replenishment at sea
RCN	Royal Canadian Navy
RHIB	Rigid-hull inflatable boat

RPLM	Recognition of Prior Learning and Labour Mobility
SAT	Systems Approach to Training
SCC	Security Control Centre
SCORE	Simulation for Crew Optimization and Risk Evaluation
SME	Small and medium size enterprise
SPT	Surrogate Partner Training
TIOW	Targeted Initiative for Older Workers
TUNS	Technical University of Nova Scotia
UBC	University of British Columbia
USN	United Stated Navy
USS	United States Ship
WBT	Web-based training
WIPSI	Workplace Innovation and Productivity Skills Incentive
XO	Executive Officer

Introduction

After a very successful National Shipbuilding Procurement Strategy (NSPS) workshop entitled "Charting the Course" held in June 2014, the Centre for Foreign Policy Studies (CFPS) at Dalhousie University undertook a second workshop. This workshop, "Human Capital and the NSPS," was held on 14 November 2014 and looked at the personnel considerations behind the NSPS.

Unlike other workshops that have examined NSPS from the policy, process and industrial perspectives, this workshop examined the human elements. It focused in particular on the need by government and industry to develop the human capital necessary to build the ships and to address future warship crewing concepts. Given that personnel costs are exceeding over 50% of the budgets of most military organizations, it is vital that we take a more comprehensive look at the human resource issues associated with the NSPS. Research to date on this issue suggests that there is significant risk associated with the personnel aspects of the NSPS, particularly given the planned shift to a long-term and virtually continuous building approach to national shipbuilding. Much time has passed since Canada last built ships for the navy, and this means that the skilled personnel needed for the major construction envisioned under the NSPS will need to be carefully regenerated. The key challenge will be to ensure that the right quality and quantity of personnel will be available over the next 30+ years to meet the needs of the NSPS.

In addition to recapitalizing the navy, the NSPS is designed to eliminate the boom-and-bust cycles of shipbuilding that have been characteristic in Canada. And because we are coming out of a bust cycle, both the shipbuilding infrastructure and the personnel need to be rebuilt. Irving and Seaspan are well along the process of updating their facilities, but what about the human dimension? The workshop examined how to ensure that there is a trained workforce and a proper design for the crewing of the ships before steel is cut.

The purpose of this workshop was to bring together representatives from industry, academia and government, including the Royal Canadian Navy and international navies, to discuss the potential challenges and issues concerning the human capital dimensions of the NSPS. Chatham House rules were in effect. Media were not invited but follow-on academic research and articles emanating from the discussions are anticipated, with non-attribution in effect per the Chatham House rules.

Executive Summary

This one-day workshop tackled the personnel issues related to all elements of the National Shipbuilding Procurement Strategy (NSPS). Three key themes can be drawn from the presentations. The first theme was developing the human capital to build the ships. This theme broke down into three elements: education and training; provincial government programs; and industry perspectives. The first group of presenters, who were from educational institutions, discussed the education and training opportunities that must be created to develop the shipbuilding workforce of the future. Following these presentations we heard from senior Nova Scotia provincial officials about the government plans that are being put in place to stimulate apprenticeships and long-term employment in the shipbuilding sector. The next group of speakers, from industry, discussed the planning that is underway to regenerate the necessary skills and labour for this important new sector.

It was refreshing to see that there has been inter-stakeholder discussion on both the East and West Coasts about the human resources necessary to build the ships. However, it was also clear that there needs to be greater national dialogue in Canada about broader labour issues beyond the nascent regional collaboration. Key NSPS human capital issues that arose during the workshop that require further investigation include enhancing labour mobility of skilled trades personnel within Canada, using temporary foreign workers to close the gap while a Canadian labour force

is developed, and revitalizing and expanding the worker base in the shipbuilding sector from its traditional demographic.

The second theme drawn from the presentations was the novel crewing concepts that must be considered as part of the design and construction of the future fleets. The speakers in this group contained both Canadian and international experts. They spoke about some of the research tools that are being used for crewing designs and shared some valuable international shipbuilding expertise that Canada should consider as it prepares the crews for the new NSPS fleets.

The third and last theme that came out of the workshop was the need to sustain the shipbuilding workforce once it has been created. This is a vital topic as the NSPS is envisaged to stimulate over 30 years of shipbuilding work.

Given the fact that shipbuilding in Nova Scotia is also a core component of the future economic development and prosperity for the province, there is a need for greater co-development of shipbuilding training initiatives among the various private, public and government stakeholders. Labour-focused governance structures will need to be defined in order to institutionalize these early examples of collaboration.

Clearly one of the main challenges will be to transform Canada's marine workforce from a ship-*repair* to a ship-*building* capacity by comparing Canadian industry best practices against those of global leaders in the shipbuilding industry. This will involve updating and/or expanding the training and design courses for the trades and professions necessary to build ships. Many of Canada's training methods and systems are out of date, and industry must incorporate the advances in web-based training, distance learning and simulation in order to prepare the human capital that the navy will need in the future.

Theme 1: Building Human Capital

What is involved in building the human capital necessary to make the NSPS successful? The following is a summary of panel presentations in the three elements from this first theme – education and training, provincial government programs and industry perspectives.

Education and Training

In his presentation, "An Overview of Select Technical Capabilities and Activities," Dr Ronald Pelot a professor at Dalhousie University, gave a thorough description of the Faculty of Engineering at Dalhousie and in particular the industrial engineering discipline. Industrial engineers design, create and manage systems that integrate people, materials, information and technology. This could include maintenance systems, production systems, scheduling systems, distribution systems, and supply chain management. It is not hard to see how this could relate to major projects such as shipbuilding. With the development of the NSPS, Dalhousie University industrial engineering students should be well positioned both geographically and educationally to participate in the construction of these new fleets of ships. But at the same time Canadian universities such as Dalhousie should continue to develop the attributes of their programs, and continue with the program of cooperative education in the private sector, so as to take full advantage of these professional opportunities

Rosaline Penfound, Vice-President Academic at Nova Scotia Community College (NSCC), in her presentation entitled "Transforming the Labour Force to Meet the Demands of an Emerging Ship-building Industry," outlined how the college is participating in the transformation of the labour force in Nova Scotia to meet the demands of the shipbuilding industry. She described the existing programs of study at NSCC and how the

graduates of these programs will be well suited to contribute to the work that lies ahead in the NSPS. Given the decreasing population of young people in Nova Scotia, it is important that all youth are given the right skills to participate fully in the labour market – and this includes encouraging under-represented groups to take technical/industrial courses and apprenticeships. Community colleges such as NSCC are very keen to adapt and extend their curriculum to provide the graduates necessary to take full advantage of the opportunities and employment that are offered by shipbuilding. In order for community colleges to take advantage of the future they need to engage in strategic partnerships with government and industry. NSCC is already working with the Nova Scotia Apprenticeship Agency to make sure the training and certification system is working, and partnering with private sector stakeholders. Penfound cautioned, however, that there is much work that remains to be done to make sure that a skilled workforce has been trained and is in place when the NSPS begins in earnest.

Nova Scotia Provincial Programs and Perspectives

John Somers, Senior Executive Director, Department of Labour and Advanced Education for Nova Scotia, was invited to the workshop to provide an overview of the efforts that the province of Nova Scotia is undertaking to assist individuals and groups in the region to enter and to excel in the workplace. His comments, "Building Human Capital: Skills Development," were focused on some of the particular programs of interest in the shipbuilding and maritime security sector. He mentioned several provincial programs, including: Apprenticeship Training, which administers certification and harmonizes skills in the province; Employment Nova Scotia, which tries to match employers with employees; and Skill Development, which supports and enables the creation of a skilled workforce that matches the labour needs in the

province. Somers also noted that there are labour market agreements with the federal government that are designed to help unemployed people find work and to match workers with the right skills to employers who need them. All of these programs will be helpful to ensure that the NSPS has the workforce it needs.

To conclude his presentation, Somers raised some interesting questions that will need to be answered if the human capital issues of the NSPS are to be solved. As Somers noted, one persistent issue is how governments, both federal and provincial, and industry create a long-term sustainable workforce. This has been a problem in the shipbuilding industry which has experienced boom-and-bust cycles in the past. As well, he asked how to attract a new labour force when competing with higher paying industries outside the region. Can government and industry raise the bar for salaries to retain a skilled force? What other incentives can be offered to achieve these ambitions? Clearly there is more work that lies ahead

It was a privilege to have Duff Montgomerie, Deputy Minister, Department of Labour and Advanced Education, join in on this workshop. As the Deputy Minister, Montgomerie possesses a broad level of experience allowing him to look across the many programs that have been set in place to enhance the employment and skills development for Nova Scotian workers. In his presentation, "Human Capital," the Deputy Minister gave a thorough review of the many strategic partnerships and programs that are being undertaken across Nova Scotia to position the province's workforce under the leadership of the Educational Resource Development Trust (ERDT), the Department of Labour and Advanced Education (LAE) for future engagement in the shipbuilding industry. He made it clear that in addition to provincial programs, most initiatives will also require regional and national cooperation and multi-level stakeholder engagement

to develop shared objectives and align priorities, resources and support. He explained that the provincial government has created the Major Initiative and Project Office (MIPO) with the objective to maximize economic opportunities provided by the NSPS and other major projects. MIPO focuses on labour and workforce development, supplier development, investment and innovation. He highlighted that private sector engagement – with major players like Irving Shipbuilding – will be essential to developing the full employment potential of the province's human capital under the NSPS.

Industry Perspectives

In his presentation, "Advancing Human Potential," Dr. Roddy Warnock, Senior Instructional Designer at Bluedrop Performance Learning, introduced some of the new methods that can be applied when training members of the Canadian Armed Forces to operate existing equipment, and new equipment that will come through the NSPS. He suggested that future training might be delivered more effectively and affordably if the customer (i.e., the navy in this example) shared the training load with professional companies such as Bluedrop, which already has a great deal of experience working with Canada's military. In this way the customer could use its own military subject matter experts to establish high training standards and ensure that they are met, while delegating the actual instruction and training equipment maintenance and overhead expenses to private companies. Warnock suggested that training for new equipment could be undertaken in a variety of ways, from in-person courses to online material and 3-D gaming. Future work in this area will need to be undertaken to determine if this is an effective method of training and whether it is in fact less expensive over the lifecycle of the equipment involved in the training. Warnock's presentation pointed to some of the benefits of this approach given the

numerous new types of equipment that will be introduced during the NSPS fleet modernization.

In his presentation, "A Workforce Plan," the Irving Shipbuilding Inc. (ISI) Vice-president for Human Resources, Brian McCarthy, gave a detailed account of how ISI intends to manage its existing labour capacity and also how it intends to find new staff to meet the needs of shipbuilding in the yard over the coming decades. The lack of shipbuilding talent has been recognized during the NSPS process, the objective of which is to support marine industry and revitalize Canadian shipyards so ships can be built in Canada. McCarthy discussed ISI's approach to recruiting employees, in particular the effort to convince skilled Nova Scotians who have moved out of the province for work-related reasons to return home. Building the ships will require attracting, recruiting and retaining shipbuilding talent, and this includes work with Nova Scotia Community College to train the appropriate trades, attract skilled workers back to the shipbuilding industry, and possibly use foreign workers until Canadians can be trained. He also highlighted that it is critical that the construction of the Arctic Offshore Patrol Ships and the Canadian Surface Combatant (CSC) begin on time. The Irving workforce plan is predicated on having the right people on site when they are needed. Should the CSC program begin late, the people working on ship construction will begin to drift away to other regions – and ISI will have to start over again to find a skilled workforce.

This presentation was the last on the theme of developing the shipbuilding workforce of the future. The presentations were wide ranging and we heard from experts in academia, government and industry. Despite the breadth of the presentations, what seems clear from all of the presentations is that there is very encouraging early work underway. However, while government, industry and the academic world seem to be on the same page

about what is needed to make sure the human capital element of the NSPS is satisfied, cooperation will need to be undertaken in a more open and collaborative way for the individual efforts to compound their effect. As well, the cooperation will need to extend outside the province of Nova Scotia. This is the view from the Atlantic coast – Nova Scotia in particular as one slice of the coast – and in future workshops we might want to consider the work that is going on in parallel on the Pacific Coast. In the end the regional opportunities offered by the NSPS to build the workforce of the future will have to be joined up nationally so that the strategy can benefit all of Canada and throughout numerous different industry sectors.

Theme 2: New Trends in Maritime Crewing

The second theme that became clear during the day was the novel crewing concepts that must be considered as part of the design and construction of the future fleets. The speakers in this group contained both Canadian and international experts. They discussed some of the research tools that are being used for crewing designs and shared some valuable international shipbuilding expertise that Canada should consider as it prepares the crews for the new NSPS ships.

The presentations in this theme highlighted that in future warships crew size and skills composition must be looked at as key contributors to the overall operational effectiveness of naval platforms. Early research on optimized crewing focused too much on minimum manning and the effectiveness of this strategy is now being questioned. In the French and German cases the reduced manning levels were mandated by the government early in the design phase, but it has since been discovered that the reduced crews may have led to reduced effectiveness and

endurance of the ships. After a period of trial, these navies had to increase the crews to achieve the mission capabilities for which the ships had been built.

The RCN has begun to take delivery of the ships coming out of the *Halifax*-class Modernization (HCM) program. This program will enhance and extend the viability of the *Halifax*-class frigates for decades. While the RCN waits for the next classes of ships to be delivered, it has a good opportunity to study the effects that the advanced automation and enhanced weapons systems in the HCM ships may offer in terms of future crewing strategies. In the presentations here, RCN staff and defence research scientists explain how they have collaborated to ensure that modern research techniques have been incorporated into the crewing studies for the *Harry DeWolf*-class Arctic Offshore Patrol Ships.

This section includes a summary of the presentations from the second theme.

The first two presentations were valuable because they included the perspectives of both a Canadian scientist and an experienced Royal Canadian Navy officer on the question of how to ensure that the new classes of ships have the 'right' number and type of personnel. This type of collaborative operations research will be essential as the new ships are introduced under the NSPS.

In her presentation, "Decision Support for RCN Crewing," Dr. Renée Chow from Defence Research and Development Canada (DRDC) discussed the importance of getting the crew size right for a ship. She made it clear that the problem is determining what exactly 'right' is. And as the NSPS proceeds, it will be essential to make sure the crews are the right size for the new classes of ships. If the crews are too big or too small, the ships will not be as operationally effective as they could be. She outlined a decision-support process that has been developed for

the RCN by defence scientists – Simulation for Crew Optimization and Risk Evaluation (SCORE). SCORE is designed as decision support for direct use by RCN personnel. Through SCORE DRDC is conducting multiple phases of crewing analysis, as ship acquisition projects evolve. The analysis has included assessments – done at sea in some cases to make sure they are as accurate as possible – of watchkeeping demands and maintenance demands, etc., to identify the personnel needs. It is also exploring how technology has replaced personnel and the effect of this on operations. The RCN used SCORE to re-evaluate baseline crew for the Canadian Patrol Frigate and it is being applied across multiple ship projects, most notably the Arctic Offshore Patrol Ship.

Dr. Chow's presentation was supplemented by a presentation entitled "A Practitioner's View," by Lieutenant-Commander Ramona Burke, Director Naval Personnel and Training 5-3: Future Fleet. In her presentation she continued the discussion about how to ensure that the crews for the new RCN ships are the 'right' size. She discussed the existing RCN regulations and ships' standing orders, as well as international regulatory regimes, that affect crew sizes. She also discussed the SCORE analysis that has been undertaken to develop and validate the crew for the new AOPS. Using the analysis capability in SCORE has reduced the research time and effort, and reduced the trial and error that was characteristic in the past to find the right sized crew for a new class of ships.

In order to broaden the discussion beyond Canada's national considerations, two European experts were invited to discuss the topic of crewing concepts. Both individuals have been involved in crewing research and operations for decades and the lessons that they shared from their national experience should be very relevant to Canada's NSPS efforts in the future.

Bernd Kulmus from ThyssenKrupp Marine Systems of Ger-

many, made the first of two international presentations, entitled "Reduced Crewing: Design Considerations." In this presentation, he discussed how the lessons of new design methods put in place for the F124 Air Defence Ships have been useful in the German Navy's new F125 frigates. The crewing considerations for the F125 Global Deployment Ship were considered at the very beginning of the class design. The frigates all have two crews of 105-120 people, which are changed every four months. This is a 50% reduction in crew from the previous generation of frigates. Examples of this approach can be seen in areas such as the selection of the construction materials that are easy to maintain and clean with a small crew all the way to using simple engineering configurations that will ease maintenance routines and allow for the most efficient operations over a protracted period of time. It is clear that the German designers have paid close attention to the crewing issues – although there are still questions to be answered about how the two-crew system can be made most effective.

The final presentation in this section, "Exploring New Trends in the Crewing of Modern Warships," was made by Nelly Chouvy, a defence scientist at the Directorate General of Armaments in France. She was presenting information about the French Navy's new *Aquitaine*-class FREMM frigate which has adopted a new approach to crewing. Its immediate predecessor, the *De Grasse*-class, employed a crew of 240, and the FREMM frigate has a crew of 108.

As Chouvy noted, five years of research was conducted even before the contract was signed, and for seven years after the design was improved during building. The French designers utilized Human Factors Engineering Processes and crew optimization modeling tools when designing the ship. They developed simulators to test bridge and combat information centre designs, and preliminary studies enabled statements of requirements to fit

the design to an optimized crew. This included provision for use of a specified 'optimal' crew for all sea trials, so as to test the ship as it would be used in real life with this reduced crew. The FREMMs also employ a support concept referred to as 'reach-back.' This means that the ship is supported during its deployments by a dedicated group of staff who remain ashore and are available at all times to assist the at-sea operations of the ship, and are available to replace crew members at short notice.

There are a number of questions that come up when examining the theme of determining an optimal crew size for the new classes of Canadian ships. Is there really a cost saving overall by employing reduced crew sizes? If the crew size at sea is small then you must develop additional shore maintenance support structures in order to compensate for the lightly manned crews. It would be helpful to take a closer look at the reachback method of operations that the French Navy has adopted for the FREMM ships. How expensive is it to sustain a highly trained manning pool ashore waiting to deploy? What would be the cost of producing a supply chain that could be responsive enough to replace damaged equipment on these ships at short notice from shore facilities? And how would this cost compare to having the crew strength already embarked in the ships to fix the systems that are degraded and/or damaged?

Key questions arise about the nature of savings that can be accrued and about how long you can sustain high-tempo operations with reduced crews. The answers to these questions might have an important impact on the design options to be made for the ships to be produced under the NSPS.

Theme 3: Sustaining Human Capital

In the third theme of the workshop presenters considered the long-term human capital issues that will affect the ability of industry and government to sustain the workforce necessary to meet the demands of the NSPS. There are challenges of trying to bring the experienced workforce back into the shipbuilding sector from other parts of the country at the same time as the next generation of apprentices is trained to fill in behind the experienced labour force as it ages. As we have seen in the discussion of developing the human capital, there have been programs developed through educational institutions and government. Some initiatives that are being considered include establishing shipbuilding apprenticeship agencies to support individuals as they proceed through their training, and more effective alignment of personnel training programs with labour market information to ensure that the correct type and number of apprentices are being generated. There was also discussion of the need for Centres of Excellence in Shipbuilding and the importance of having qualified Canadians to fill all the jobs.

It is clear that there will be many challenges ahead to build and retain the 30+ year workforce necessary to complete the shipbuilding envisaged in the NSPS. However, given that it has been a long time since Canadian shipyards have operated at full employment, the concerns about retaining a workforce for generations have not been comprehensively examined and addressed. These last two presenters provided some helpful context to this topic but clearly much more research will need to be undertaken to get a better appreciation of how to sustain the NSPS workforce through the life of the shipbuilding program. This section includes a summary of the panel presentations from this third theme.

In his presentation entitled "A Strong Workforce," Vice-

Admiral (Retired) Peter Cairns, of the Shipbuilding Association of Canada, argued that we must keep the two key strategies of the NSPS foremost in mind. First, the NSPS is based on the idea of creating a continuous build program that will eliminate the traditional boom-and-bust cycle in the Canadian shipbuilding industry. Second, NSPS is predicated on a 'build in Canada' policy and the policy doesn't work if the shipbuilding is done anywhere else. The NSPS allows Canadian firms to create Canadian equipment that will be put in Canadian ships. If Canadian firms are not seen as supporting their own navy, it will be more difficult for them to market their materials to other countries. Cairns was quite adamant that there is no benefit to Canadian industry, and Canada generally, to build NSPS ships offshore. This is why the strategy was adopted to build at home. But, in his opinion, the policy to utilize only proven technology in the ships is wrong because Canadians should be allowed to explore and develop new technology as they have done so successfully in the past.

In his presentation, "Shipbuilding Research: A Systems Approach," Ken Hansen from the Centre for Foreign Policy Studies at Dalhousie University, argued that if we look at shipbuilding and the NSPS, we can see that the program faces a challenge that other programs/organizations may not. Shipbuilding is one of the most complex industrial activities known to humanity – warships are extremely complex. In some cases, the large organizations that produce ships are so intricate and delicately balanced that the prospect of change is difficult to understand and manage. But in any new program such as the NSPS there will be change, and inherent in that is risk. As Hansen pointed out, risk must be recognized as a major factor and it must be managed. In his discussion he looked at examples of shipbuilding best practices in two international shipbuilding associations, the Danish Maritime Authority and the National Shipbuilding Research

Program in the United States. He argued that we would be well served to create a similar organization in Canada because in institutions such as these collaboration is an essential way to preserve continuous innovation. He concluded that the Canadian national shipbuilding industry would benefit from a dedicated industrial association as marine industries and suppliers begin to grow in response to the NSPS.

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Beyond the individual presentations, some other themes emerged during the day's activities. Some of the participants observed that the NSPS has put in place a system that is more transparent than earlier procurement processes, and ironically this may mean that expectations will actually be higher than in the past. These expectations may be disappointed as much risk still lies in the fundamental uncertainty of political commitment and budgetary stability over the long term. Given the froth that has been seen in the media, there will need to be better management of expectations of all parties, including those of the public as the NSPS slowly proceeds. The government and the prime contractors will need to be more frank with the public and members of the defence industry to sustain a sense of goodwill in the industry, particularly given the significant amounts of public and private funding involved in this endeavour. The NSPS must open opportunities for companies at all levels of capitalization so that the benefits of this national program can be spread across the entire marine sector in Canada.

Many participants voiced the concern that they have not seen a clear indication of what exactly is being done under the NSPS to avoid the traditional boom-and-bust cycle of Canadian naval procurement. As eliminating the boom-and-bust cycle via a plan for long-term building of ships was supposedly one of the

underlying motives of the NSPS, this is a big concern. It will be extremely important to avoid any overall delays in the full construction plans envisaged for the NSPS. Any setbacks in the building schedule might force labour away from shipbuilding work during the very period that was supposed to be guided by a continuous build philosophy for 30 years of NSPS construction. If the price of oil remains low, it will be easier to lure skilled tradespeople back to the Maritimes from Alberta to work in shipbuilding. However, any labour that might have left the oilpatch for shipbuilding could return to that industry if a turnaround in the price of oil renews growth in the extraction industry.

There were concerns expressed about the points of transition from one NSPS project to the next – i.e., AOPS to CSC in Nova Scotia and JSS to Canadian Coast Guard icebreaker in British Columbia. Getting these points of transition wrong could create a gap between projects and create the kind of doubt that will prevent skilled people from leaving one employment situation for another in shipbuilding. As a result, it is critically important both for the success of the NSPS and for the employment prospects of people hoping for quality job opportunities in this industrial sector that the program be managed skillfully to avoid gaps – and a return to the boom-and-bust cycle. In the event of unforeseen political, economic or other negative developments, it is essential that 'bridging' plans be developed that mitigate the detrimental effects and continue the progress toward the strategic goal of developing the Canadian national industrial base.

The NSPS represents the opportunity to undertake a recapitalization of the ageing fleets in the Royal Canadian Navy and other government departments. It is an opportunity to rejuvenate the Canadian shipbuilding industry, boost the capacity of Canadian business and provide jobs to people, in particular in British Columbia and Nova Scotia but also across the country.

The NSPS also means an opportunity to reconsider the crewing aspects of the new ships in recognition of new technology and smaller military organizations. But these opportunities will not just materialize out of nowhere – the shipbuilding industry needs skilled workers and new ships need trained crews. The human capital elements are, therefore, absolutely essential to making the NSPS succeed.

Summaries of Panel Presentations

Theme 1: Building Human Capital

Education and Training Programs

- "An Overview of Select Technical Capabilities and Activities," Dr. Ronald Pelot, Professor Dalhousie University, Industrial Engineering, Assistant Dean, Engineering Co-op Associate Scientific Director, MEOPAR NCE
  - In this presentation Dr. Pelot described the Faculty of Engineering in general and the industrial engineering program in particular at Dalhousie University and the ways that these engineers could contribute to the design and building envisaged in the NSPS.
- "Transforming the Labour Force to Meet the Demands of an Emerging Shipbuilding Industry," Rosaline Penfound, Vice-President, Academic, Nova Scotia Community College
  - In her presentation, Vice-President Penfound described the current programs at Nova Scotia Community College and new programs that are in the works to ensure that NSCC graduates are well suited to contribute to shipbuilding and the NSPS.

An Overview of Select Technical Capabilities and Activities

Ronald Pelot

What is currently the Faculty of Engineering at Dalhousie University began as Nova Scotia Technical College on 25 April 1907. On 3 June 1980, the government of Nova Scotia changed the name of the institution to the Technical University of Nova Scotia (TUNS). Its mission was to "contribute to the development of Nova Scotia by providing high quality education, research and community and industry collaboration in architecture, computer science and engineering." TUNS merged into Dalhousie University on 1 April 1997 as the Faculty of Engineering.

Dalhousie University, as part of an associated university system, allows students to start at the university or any of five other universities within the system, and graduate with a Bachelor of Engineering degree. Students who do not start at Dalhousie can do two years at one of the associated universities and transition seamlessly into third year at Dalhousie.

The Faculty of Engineering currently has 1,783 Bachelor of Engineering students and 540 graduate students, including 125 PhD candidates. There are 628 international students (298 undergraduate and 330 graduate students). The faculty has five departments and eight undergraduate programs, including Master of Science, Master of Engineering and Doctor of Philosophy degrees in all programs. There are 98 faculty members, 43 staff

members and approximately $13 million annual research funding.

The Faculty of Engineering produces practical engineers with excellent problem-solving skills, and a strong natural sciences background. The emphasis on real-world problems has created a high demand for the university's graduates and has made Dalhousie the preferred school for many major industrial companies, including GM, Shell, Teck, Vale, Fluor, Imperial, Goldcorp and Michelin. The Faculty has $12 million in research projected for 2013-2014, and has worked with over 200 different companies and agencies over the past three years, with most of these continuing. There are seven externally funded research chairs, with major contracts, with Boeing, Pratt and Whitney, Raytheon, Ultra Marine Systems, Nunavut, Halifax Water Commission and Intel.

Among the programs offered by the Faculty of Engineering is industrial engineering (IE), established in 1965. It is the oldest program of its kind in Canada and is associated with the University of Toronto. Forty to 50 industrial engineering students graduate per year from Dalhousie. The department has a faculty of 10 full-time and two part-time professors.

Industrial engineers design, create and manage systems that integrate people, materials, information and technology in productive ways. This could include maintenance systems for airlines, distribution systems for online retailers, scheduling systems for hospitals, layouts and control systems for factories, individual workstations, work and workspaces, warehouses and inventory systems, production systems, and global supply chains. IE design systems for many sectors, including:

- manufacturing;
- transportation and distribution;
- health care;

- environmental;
- government;
- utilities (phone, electricity, gas);
- communications; and
- natural resources (forestry, mines).

Master of Business Administration (MBA) and industrial engineering students provide a good mix for supply chain management. It is easy to imagine how these engineers could make a big impact on shipbuilding. It would be essential to have engineers designing and monitoring the processes to ensure efficiency of construction and supply management.

In their final year, student teams are partnered with a local 'client.' Students, acting as consultants, analyse and design solutions to the client's problem. Some examples include:

> *Project in Industry 2003-2004. Irving Shipbuilding Ltd.:* Students of the class of 2004 redesigned the factory layout and developed a new system for production planning. They reduced time to produce product by nearly 40%.
> *Project in Industry 2010-2011. Air Canada Jazz:* The students of the class of 2011 designed a virtual centralized inventory system for the portable spare parts used in the Dash-8 aircrafts.

There are a number of major research themes in the Industrial Engineering Department, including:

- maritime risk and safety (Pelot);
- maintenance and scheduling (Diallo, Ghasemi, and Gunn);
- engineering design and methodology (Johnston);
- manufacturing, warehousing and process industry design, planning and operations (Gunn, MacDonald, Tajbakhsh and

Venkatadri);
- health service systems optimization (Blake and Vanberkel);
- forest resource optimization (Gunn, MacDonald);
- ergonomics (Das); and,
- decision analysis (Barzilai).

Engineering Cooperative Education

In 2014 there are 398 engineering students participating in the cooperative education program, in a total of 535 total work terms, consisting of four months on the job and four months in the classroom. There are also 46 international students. The students are in eight disciplines: Chemical, Civil, Electrical, Environmental, Industrial, Materials, Mechanical and Mineral Resources.

Our top three provinces for cooperative education work terms are: Nova Scotia, in the construction, electronics, communications, transportation, energy, sustainability/efficiency and research sectors; Alberta in the energy, oil, gas, mining and construction sectors; and Ontario in automotive, transportation and energy sectors..

The benefits of cooperative education for students are:

- apply academics to real work and vice versa;
- try different career paths before graduation;
- enter the job market with experience;
- network and make connections; and
- earn competitive wages.

The benefits for employers are:

- boost operations;

- test young talent for long-term recruitment;
- gain new knowledge and fresh perspectives;
- develop leadership skills among staff;
- build brand on campus; and
- provide feedback on curricula.

Changing Use of the Ocean

Increased exploitation, coupled with the declining health of oceans, has led to an increased scale and frequency of marine emergencies as well as fundamentally new marine hazards. Canada is particularly vulnerable to the new emerging patterns with its vast coastline, dispersed emergency response assets and economic dependence on the oceans and coastal environment. This has been an incentive to focus more on oceans at Dalhousie. The university recognizes that there needs to be more investment in marine engineering educational resources.

Dalhousie's Faculty of Engineering does not have a major maritime focus as, for example, there is at Memorial University Newfoundland. But Dalhousie does engage in ocean and marine research and activities, including marine communications and ship modeling, among other things. Ocean and offshore research projects in the Faculty of Engineering include:

- clean water, including ballast water treatment;
- autonomous underwater vehicles;
- offshore risk and safety;
- marine communications;
- underwater communications;
- advanced materials including corrosion and anti-corrosion coatings;
- ship traffic modeling.

Dalhousie's Ocean Sciences program of courses was established in 2012 as one of the Network of Centres of Excellence, a federal government initiative. The Centre of Excellence is headquartered at Dalhousie University. There are 28 research projects underway by 52 researchers from 13 Canadian universities and four federal government departments.

An example of the work that is being undertaken at Dalhousie is the Marine Environmental Observation Prediction and Response Network (MEOPAR) which is a multi-disciplinary, multi-purpose, multi-sectoral department. Its mission is to enhance resilience and economic opportunity through an informed relationship with the changing marine environment. Programs intend to inspire and enable Canadian leadership in marine environmental observation, prediction and response. Some programs include Ocean Viewer which provides real-time ocean data (from temperatures to waves to animal sightings) from a wide variety of sources, Automatic Identification System, which is satellite monitoring of ships, and modeling for ice and ocean spills, etc.

Conclusion

As at universities across Canada, there are concerns in the Faculty of Engineering at Dalhousie as well. The university is facing the possibility of its student capacity reaching its maximum and needs additional infrastructure, labs and resources. *However*, Dalhousie University Faculty of Engineering provides the professional environment that encourages interaction between engineering students and students of various other disciplines. Dalhousie students are competitive within Canada's workforce of the future.

Perhaps of most relevance to the NSPS is the industrial

engineering program in the Faculty of Engineering. There are six industrial engineering programs in Canada, and 165 in the United States. The department has a co-op education program that has included student work at airlines, distribution systems and online retailers. The industrial engineers have also produced scheduling systems for hospitals, layout systems for plants and factories, individual workspaces, warehouse and inventory systems, and production systems – all of these systems might be of interest to a shipbuilding project in the NSPS.

With the development of the NSPS program, Dalhousie University industrial engineering graduates should be ready to participate in the construction of these new fleets of ships. Universities such as Dalhousie must continue to develop the attributes of their programs so as to take full advantage of the exciting professional opportunities in the NSPS.

Transforming the Labour Force to Meet the Demands of an Emerging Shipbuilding Industry

Rosaline Penfound

Nova Scotia Community College (NSCC) is one college distributed over 13 campuses across the length and breadth of the province. Many of these learning centres are full-service campuses with cafeterias, fitness facilities and specialized classrooms and equipment, while others provide courses designed to fit the needs of specific groups of learners and the communities in which they live.

Within the college's mission of "Building Nova Scotia's economy and quality of life through education and innovation," the institute's goal in relation to the National Shipbuilding Procurement Strategy (NSPS) is to assist in the transformation of the labour force to meet the demands of the emerging shipbuilding industry.

There are future workforce challenges that we can predict as we see the decrease in the youth population entering schools in Nova Scotia. The decreasing enrolment constitutes a real challenge for the region to provide able young workers to take advantage of future opportunities like the NSPS.

What NSCC hopes to do is to make sure that the looming demographic problem does not have too large a negative impact

on the economy by making sure that Nova Scotians are productive and have training for the careers of the future.

NSCC delivers over 100 certificate, diploma and advanced diploma programs across the province within five program areas:

- Trades and Technology;
- Business;
- Applied Arts and New Media;
- Health and Human Services; and
- Access. For students with developing academic potential.

In addition, NSCC also delivers apprenticeship training for 26 trades, in both face-to-face and online courses. Furthermore, it conducts bridging and outreach programming for Women Unlimited, the Black Business Initiative and community outreach. It also offers customized solutions to industries that require specialized workers, part-time studies that lead to licensing and certification, and applied research. The college maximizes and leverages its program offerings through flexible delivery.

It has become apparent that community colleges will play an increasingly crucial role in a changing economy. Colleges are under more pressure than ever before to innovate and transform. Students need relevant and realistic occupational programs to give them the greatest opportunities to find work after graduation, requiring sustained and focused employer engagement. Advisory committees at colleges are no longer sufficient, and the trend now is to develop ongoing strategic partnerships with employers to align college programs with the needs of industry and business.

Community colleges have generally accepted a greater role in expanding their relationships with industry to develop industry-validated, competency-based credentials to complement existing academic degrees. They work with industry to define

relevant certifications and to expand the integration of prior university learning to complement community college programs. This has changed the nature of the role that community colleges play in Canada. This means that contrary to earlier years, in certain cases, a university under-graduate degree is a prerequisite for admission into some college programs.

Colleges are adopting the position that fundamental changes to their business models and strategies are necessary to increase the credentials of students and thus contribute to their subsequent employment. These institutions are developing flexible approaches to enhance and accelerate learning through online resources, and competency-based instruction.

Technical educational programs need to be relevant to the local labour market to meet current, near and mid-term future employment for NSCC graduates. If the local and regional economies are to thrive, the business, industrial, educational and occupational training communities must collaborate and co-operate to define the credentials and skill sets the current and future workforces must possess. NSCC has undertaken reforms to its programs to make sure that it better prepares its students to enter the workforce and be trained for the jobs that exist.

There are challenges on the road ahead.

- Demographic: In the previous 10 years we have seen a reduction of 30,000 students in the school system in Nova Scotia. This has not yet affected the post-secondary system level, but it is apparent that there will be a net reduction in the community college student population in the coming years.
- Economic: As students who have already received a university education opt to enroll in a community college program, they will, first of all, face the additional expenses associated with the NSCC occupational programs. And, secondly, they will have several more years of occupational training before they can enter the workforce, with the resulting lag in earnings that could be used for savings and pensions, and perhaps, delaying retirement.

To meet the requirements of the labour force necessary to construct the Arctic Offshore Patrol Ships (AOPS) and the Canadian Surface Combatants (CSC), the college is partnering with the province's shipbuilding companies and related sectors to co-develop an integrated strategy – the Marine Manufacturing Initiative (MMI). The plan is to build and maintain a skilled team to make the transition from ship repair to ship building and tie this to Nova Scotia's labour market needs. However, the college needs a broader understanding of the trades and roles in the shipbuilding worlds.

NSCC has embarked on a workforce training strategy of 'grow at home/keep them at home/bring them home.' The college is working closely with the Nova Scotia Apprenticeship Agency to support the apprentice to journeyman progression.

The Nova Scotia Apprenticeship Agency (NSAA), established on 1 July 2014 as an agent of the Crown, is operated under the authority of the *Apprenticeship and Trades Qualifications Act*, the Operating Charter and the General Regulations, and is authorized to manage the trades training and certification system in Nova Scotia. NSAA comprises the Apprenticeship Board, committees, agency staff and the Chief Executive Officer. It:

- engages Nova Scotia employers and industry;
- designates trades for apprenticeship training and certification;
- registers and monitors apprenticeship agreements;
- assesses, counsels and certifies apprentices and skilled tradespersons;

- sets standards for apprenticeship technical and workplace training;
- recognizes credentials and supports labour mobility issues;
- regulates and enforces trades designated under the *Apprenticeship and Trades Qualifications Act*; and
- participates in the national Red Seal program to provide greater mobility across Canada for skilled tradespeople.

The Operating Charter mandates NSAA to steward and operate a relevant, accessible and responsive industry-led trades training and certification system, and to improve access to and participation in the system by Aboriginal persons, African Nova Scotians, differently-abled persons, immigrants, women and members of other under-represented groups.

The agency works closely with employers and industry to put this program into effect, to align program planning with labour market information, develop customized information for upgrading skills and certification, and to create awareness and pathways for apprentices to learn, develop and advance. NSCC accomplishes this through customized training for the trades such as welder, metal fabricator, blueprinter, pipe fitter, sheet metal worker, tack welder and electrician that are oriented to the needs of the employers and the province's labour market. This will take the approach of 'Shipbuilding 101' which will have a specific focus on marine development and construction trades.

These programs are aligned with labour market information, creating awareness and pathways for all Nova Scotians to participate in the development of Nova Scotia as a centre of excellence in shipbuilding. While Irving Shipbuilding Inc. is the principal beneficiary of these initiatives, this is not only for Irving. This is about the value proposition for the benefit of Canada and for the economy of Nova Scotia to ensure that the province is prepared to take advantage of available skill sets to

reactivate the shipbuilding industries of Canada and of Nova Scotia.

The mandate is to provide all Nova Scotians, with particular focus on under-represented groups, with applicable programs and training to optimize opportunities to work in the marine sector. Irving Shipbuilding has made a funding commitment of $250,000 per year throughout life of the NSPS program.

Irving Shipbuilding Inc. is developing a Shipbuilding Centre of Excellence that will focus on pathways and create capacity for people to participate in any opportunities stemming from shipbuilding activities. A formal agreement with NSCC is signed and the first programs are under development. This agreement will maximize the impact of these programs on the industry throughout Nova Scotia. NSCC is incorporating values that include elements for respectful and inclusive environments as our workforce becomes more diverse.

Questions Remain

What incentives will government and industry provide to attract and retain skill sets within the maritime development and construction workforce, including tuition bursaries, scholarships, higher pay and job guarantees?

How are we addressing the bottom line? How will the province attract and retain the skilled labour force? How will the Nova Scotian governmental and industrial principals create opportunities for advancement that offer job satisfaction and rewards for those involved in these trades?

We do not know the answers to these fundamental questions. There is a great deal of excitement about construction of warships for the Royal Canadian Navy being concentrated in Nova Scotia, but there does not seem to be a comparable focus

on the basic need of having a skilled labour force to build the ships.

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It is clear from the presentations in this section that both Dalhousie University and Nova Scotia Community College are cognisant of the challenges of building the workforce necessary to undertake the work of the NSPS. Both institutions are attempting to adopt programs and policies that produce students with the skills that can be applied to shipbuilding.

Community colleges such as NSCC are very keen to adapt and supplement their curriculum to provide the necessary number of trained graduates to take advantage of the opportunities and employment that are offered by the NSPS. However, in order for community colleges and universities to take full advantage of the NSPS program, they will need to engage in strategic partnerships with government and industry. This will be a continuing and long-term project.

Theme 1: Building Human Capital

Nova Scotia Provincial Programs and Perspectives

- "Building Human Capital: Skills Development," John Somers, Senior Executive Director, Labour and Advanced Education, Province of Nova Scotia
  - John Somers provided an overview of the efforts that the province of Nova Scotia, and in particular the Department of Labour and Advanced Education, is undertaking to assist individuals in the province to enter and excel in the workplace. His comments point to some of the particular programs of interest in the shipbuilding and maritime security sector.
- "Human Capital," Duff Montgomerie, Deputy Minister, Labour and Advanced Education Province of Nova Scotia
  - As the Deputy Minister of the Nova Scotia Department of Labour and Advanced Education Mr. Montgomerie possesses a broad level of experience allowing him to look across the many programs that have been set in place to enhance the employment and skills development for Nova Scotian workers.

Building Human Capital: Skills Development

John Somers

The Skills and Learning Branch is a branch of the Nova Scotia School for Adult Learning (NSSAL) that offers programs for adult Nova Scotians who want to improve their skills. Other programs include:

- Apprenticeship Training, which administers the apprenticeship and trades certification system in Nova Scotia. The province is leading the country in efforts to harmonize the skills and learning efforts to the needs of the employers throughout the province.
- Employment Nova Scotia, which helps Nova Scotians meet their full employment potential, and helps employers find the employees they need to prosper. Nova Scotia Business Inc. (NSBI) has initiated an effort to visit 100 businesses to ensure government programs meet employer needs.
- Skill Development promotes learning at work and supports the development of a skilled and adaptable workforce. The Skills online program offers 800 online courses for free, and there are 17,000 Nova Scotians registered. This is an effort to instill a learning and training culture within the workforce and the businesses of Nova Scotia.

With an annual budget of $126 million, the Skills and Learning Branch has 166 staff members throughout the province. It provides employment services, adult education, workplace initiatives and youth initiatives. It manages hundreds of agreements with third-party service providers and individuals, and is responsible for two major labour market agreements, plus the Targeted Initiative for Older Workers (TIOW). As well, the branch occupies a unique and influential position in the labour market continuum, as it straddles the demand and supply sides of the continuum.

In short, the Skills and Learning Branch is working to address the related problems of 'people without jobs, jobs without people.' Market forces do not always favour individual jurisdictions, such as a province or the communities within it. The Nova Scotia Labour Market strives to be a self-reinforcing cycle, marrying together economic, population and workforce growth and development, and improve productivity through employer-focused training, workplace education, and the use of 'sector councils.' The sector council program supports an industry-led approach to human resource development through funding/agreements with sector councils and like organizations.

Nova Scotia's workforce challenges and opportunities are similar to those in other mature economies. What is required is a self-reinforcing cycle, with economic growth, population growth and workforce growth. There are many people, many layers and many avenues involved, with young workers, immigrants and the province's particular demographic factors of a large older workforce and fast-growing Aboriginal workforce. The term 'attachment' describes the process of connecting people with jobs.

The Skills and Learning Branch endeavours to develop interventions to be put in place to help Nova Scotians get the jobs that are aligned with the skills that employers need in the

province. While, as noted, market forces do not always favour individual jurisdictions, the Skills and Labour Branch works to facilitate greater market participation by Nova Scotian workers. It supports workforce attachment through assessment, job search, adult education, teaching new skills and advanced education. The provincial Department of Labour and Advanced Education has developed a series of online tools – including ideas and tips, practical guides, checklists, downloadable templates and links to relevant resources – that will help businesses discover and keep valued employees.

In the case of government interventions, funds generally come from Employment Insurance and not from general tax revenues. But the province also undertakes labour market agreements, which includes funding from labour market funding agreements with industry stakeholders.

Labour market development agreements (LMDA), for example, are agreements between the federal government and the provinces and territories to help the unemployed quickly find suitable employment and return to work, and develop a skilled labour force to meet current and emerging needs of employers.

Labour market development agreements are complemented by labour market agreements (LMA), which provide funding for provincial and territorial labour market programs and services, particularly for low-skilled workers and unemployed persons who are not eligible for Employment Insurance (EI) benefits.

Labour market agreements increase labour market participation of groups that are under-represented in Canada's labour force and enhance the employability and skills of the labour force. The government of Canada has entered into these agreements with provinces and territories, through which the government provides funding for provincial and territorial labour market programs and services for:

- unemployed persons who are not eligible for Employment Insurance (EI) benefits; and
- employed persons who do not have a high school diploma or recognized certification, or have low levels of literacy and essential skills.

Through these agreements, provinces and territories determine the priorities for funding and decide how the funding is allocated in order to meet the needs of their particular labour markets. In addition, government of Canada funding enables provinces and territories to design, deliver and manage skills and employment programs for unemployed Canadians, particularly for those who are eligible for Employment Insurance benefits.

Federally-funded worker programs include:

- Canada Job Fund helps Canadians to acquire the skills and training to undertake available jobs. The government of Canada is renewing and transforming the labour market agreements with provinces and territories into new Canada Job Fund agreements, including the Canada Job Grant. The program provides employers with workers who have the latest skills training. It provides up to $15,000 per person for training costs, tuition and training materials, and up to $10,000 in federal contributions. Employers contribute approximately one-third of the total training costs.
- Targeted Initiative for Older Workers is a federal-provincial/territorial employment program that provides a range of employment activities for unemployed older workers living in smaller vulnerable communities with populations of 250,000 or less to help them stay in the workforce in their region. Created in 2006 to assist unemployed older workers in communities affected by significant downsizing or closures and/or high unemployment, this initiative supports the

reintegration of participants into the workforce.

Provincially funded initiatives include:

- Apprenticeship Training: With the selection of Irving Shipbuilding Inc. as the builder of warships for the Royal Canadian Navy and the continued development of other sectors of the provincial economy, there will be a new demand for skilled tradespeople to meet newly created jobs and to replace those retiring over the next five years. Nova Scotia's education and occupational apprenticeship system can provide new entrants into the provincial job market with skills to become professional, skilled tradespeople.
- Advanced Education: Nova Scotia's Department of Labour and Advanced Education has a number of programs for adult and mature workers within the province. These include Nova Scotia School for Adult Learning which offers programs for adult Nova Scotians who want to improve their literacy skills, as well as labour market programs and services, high school diploma for adults and General Educational Development (GED) preparation and testing.
- Office of Immigration: According to Census Canada, immigrants are more than twice as likely to have a university education as non-immigrants, and more than 10 times as likely to hold a doctorate degree. The abilities, training and education of many internationally trained workers can help Canadian organizations compete on national and international levels by developing new markets, building international networks through their knowledge of other languages and understanding of other corporate cultures. Furthermore, many immigrants have linkages to international networks of potential candidates, business partners, and global opportunities. They can, in addition, bring fresh perspectives on work

processes, management styles and human relationships that increase efficiency and act as a catalyst for new and improved ways of thinking.
- Adult Education: The Adult Education Division improves the education and employment prospects of adults by promoting, developing and funding the province's adult literacy, essential skills and upgrading programs. The division administers the:
  - Nova Scotia School for Adult Learning which offers tuition-free programs for adult Nova Scotians to improve their literacy skills at more than 150 sites across the province.
  - The Adult Education Division administers the General Educational Development (GED) program which has been offered in Nova Scotia since 1968. This is an international high school equivalency testing program for adults, which consists of a series of five tests in the areas of social studies, science, mathematics and language skills (reading and writing).
  - Recognition of Prior Learning and Labour Mobility (RPLM) identifies, documents, assesses and recognizes a person's skills and knowledge. A key building block in supporting continuous learning and ensuring people in Nova Scotia are employed at the highest level of their ability, the Labour Mobility Unit administers programs that support RPLM in a variety of sectors, as well as international qualification recognition, fair registration practices by regulatory authorities and the free flow of labour across Canada.

The vision of the government of Nova Scotia is to create winning conditions for the economy and labour market, and seize new economic opportunity. Education and life-long learning at

all stages of life will maintain a strong workforce to support a prosperous, sustainable economy. The Skills and Learning Branch must have a strong policy development and research capacity to address these current and emerging needs. A number of key strategic issues and key challenges have been identified, including having a skilled and knowledgeable workforce and making sure there is cross-departmental and inter-provincial collaboration among government, industry and education/training institutions.

Some of the challenges that this province will confront are:

- Demographic: The issue of the changing demographics in Nova Scotia is incredibly significant to the Skills and Learning Branch. Changing demographics include low birth rates, an exodus of younger workers, and high retirement rates. These will affect the labour force and employment in the future, and will result in a shortage of workers of different skill levels across Nova Scotia's economy. Without some change in the demographic factors these issues are expected to continue to affect the Nova Scotia workforce into the future.
- The Changing Nature of Work: The type of work that happens in Canada in general, and in Nova Scotia in particular, is a consequence of new processes and technology, and the emergence of new forms of business within the economy. This new type of work demands new skills, and that means there are workers displaced from business closures who now need to learn new skills. As Nova Scotia shifts from a goods-based to a service-based economy, employers often find that many of the available workers don't have the skill sets they need for the new jobs.
- Literacy and Learning: Nova Scotians need opportunities to learn throughout their lives, and this requires a seamless and continuous learning system that meets individuals' needs regardless of stage of life. Learning begins at birth. Youth need realistic learning opportunities to prepare them for the workplace, and adults need continuous opportunities to meet the ever-changing skill demands of a changing society. Low literacy levels among working age people leads to a segment of the population who are less likely to vote, who have worse health, and who have a higher risk of unemployment and poverty.
- Productivity: a shortage of skilled workers requires additional productivity from the existing labour force to meet the needs of the economy. Current levels of productivity are inadequate to compete nationally or internationally.
- Employer Adaptation: as the nature and conditions of the labour force change, so too must the nature of employment. Employers need to reorient and reset the nature of the employment relationship and workplace culture throughout the province. Employers should continuously develop their workforce through training, competitive wages and flexible working conditions to assist in changing the employment relationship by making it easier to attract and retain workers and by creating an employer culture that is more accepting of non-traditional workers (e.g., immigrants, persons with disabilities, Aboriginals).[1]

Right now there is an unprecedented national dialogue on labour market issues, with a focus on employer engagement, labour market responsiveness, labour market information, and accountability. At the federal level, labour market agreements are being replaced by the Canada Job Fund, labour market development agreements are under review, and pre-employment and supply chain requirements are evolving to meet needs of new major projects such as shipbuilding.

One persistent issue is how do governments, both federal and provincial and industry create a long-term sustainable workforce without creating a boom-bust cycle? How do you attract a new labour force when competing with higher paying industries outside the region? Can government and industry raise the bar for salaries to retain a skilled force? What other incentives can be offered to achieve these ambitions? Clearly there is more work that lies ahead.

Notes

1. Adapted from Government of Nova Scotia, Department of Labour and Workforce Development Business Plan 2008-2009, pp. 12-14.

Human Capital

Duff Montgomerie

From a provincial government perspective, the impact of the National Shipbuilding Procurement Strategy (NSPS) is huge for Nova Scotia, and involves key programs, policies and best practices that support partnerships and help sustain workforce development in the marine industry.

Big oceans mean big business for Nova Scotia. The approach is to ensure that the right people are having the right discussions around key issues in an appropriate time-frame, to recognize that good information drives good decisions, and ensure that we have the proper interactions (achieved successfully with the Irving team and other key stakeholders).

Under the leadership of the Educational Resource Development Trust (ERDT), the Department of Labour and Advanced Education (LAE), Nova Scotia Business Inc. (NSBI) and Energy deputies, the Major Initiatives and Project Office (MIPO) was created in July 2012. Part of the office mandate is to help maximize economic and industrial benefit opportunities. The MIPO team was built around subject matter experts in the following key areas: workforce development (Jacques Pelletier); supplier development (Matthew Johnson); and investment and innovation (Jennifer Chiasson). Most initiatives require regional and national cooperation and multi-level stakeholder engagement to develop shared objectives and align priorities, resources and support.

Irving has been a very active partner in MIPO's activities.

A sample of MIPO'S activities include:

- Workforce Development
  - establish a provincial Labour Market Committee focused on addressing workforce issues and gaps;
  - develop a Labour and Workforce Development Framework for shipbuilding and ship repair within the province;
  - develop relevant research to look at the impact of major projects on small and medium size enterprises (SMEs);
  - establish a relationship with the marine industry in British Columbia; and
  - at the bottom line, there is a need to provide salaries that are competitive to the Alberta oilsands industry.

- Supplier Development
  - inform SMEs about the opportunities, timelines, procurement process and requirements needed to be part of the supply chain (i.e., certifications, quality standards and decision criteria);
  - collaboratively develop with industry ways to increase the competiveness of Nova Scotian companies through training, supplier essentials and workshops; and
  - work with provincial and federal partners help Nova Scotian companies position themselves in the various supply chains associated with NSPS (i.e., hosting supplier days with Tier 1 companies, leading industry trade missions, and establishing relationships with other jurisdictions).

- Investment
  - target specific areas of the NSPS value chain where Nova Scotia currently does not have capacity or specific companies that would complement our existing industry.

- Innovation and Excellence
  - foster collaboration within educational institutions, industry and project prime contractors, and identify unique opportunities for Nova Scotian companies to engage with key industry players (i.e., recent General Electric's Innovation Day, which was designed to stimulate interaction among all levels of innovation in the defence and security sector).

- Coordination
  - facilitate the coordination, collaboration and integration of NSPS activity, funding and support, provincially.

The province's approach is having the right people in order to have proper discussions. One example is MIPO's Labour Market Committee which has developed a Labour and Workforce Development Framework bringing together Irving's (ISI) Centre of Excellence, Marine People Partnership and the Association of Women Professionals (AWP).

Nova Scotia is leading the process. LAE, ERDT and ISI have created an executive committee, at the Minister and Deputy Minister level, that meets bi-annually to review progress and discuss issues. Also, as noted, the provincial government has created the Major Initiative and Project Office (MIPO), the objective of which is to maximize economic opportunities. Its focus is on labour and workforce development, supplier development, investment and innovation. Key working groups are being developed on an as-needed basis and most resources are being leveraged within existing departments.

Private sector engagement includes ISI's engagement with

our training institutions, including Nova Scotia Community College (NSCC). ISI is the biggest employer in apprenticeship training. It is developing approaches to support local suppliers as well as working with the marine industry on the West Coast.

Tier 2 suppliers have also been actively supporting supplier development through supplier development days and special initiatives such as GE Ventures Licensing. This program is designed so as to allow GE to partner with smaller companies to accelerate growth and commercialization of innovative ideas.

Partnerships

The NSPS has given rise to the development of multiple partnerships, resulting in joint research efforts between the federal and provincial governments. It has also resulted in the exchange of curriculum materials between jurisdictions, open discussion on industrial benefits, increased efforts in developing better access to NSPS for under-represented groups, and building relationships with the West Coast industry and government.

The key focus areas for the Department of Labour and Advanced Education are:

- the assessment of current and future state of the labour market;
- employer engagement;
- identifying gaps in skills, education and training;
- identifying current and potential sources of labour; and
- industrial and occupational forecasts.

The Department of Labour and Advanced Education (LAE) works with provincial and federal partners each year to produce labour market forecasts for Nova Scotia. This results in data on

over 30 industries and 500 occupations. The information supports planning and decision-making by various stakeholders within government, the education sector, industry and more. Furthermore, LAE has plans underway to strengthen its forecasting capacity through building a more comprehensive supply-demand occupational model. Shipbuilding labour requirements and assumptions can, to an extent, be incorporated into the department's model.

Job market conditions and prospects have led to work with partners to monitor labour market trends and assess occupational employment prospects in Nova Scotia, and support program decisions/investments and career choices made by youth, students, unemployed, etc. Careers.NovaScotia.ca provides the public with tools and information on occupations in demand, wages, education pathways, and other career planning resources. Labour market information (LMI) on employment prospects can help us understand broader conditions and pressures related to key shipbuilding occupations.

Through the work of the LMI Advisory Committee, LAE leads a provincial LMI strategy that aims to align and leverage LMI activity in the province. This is a collaborative approach to identifying priorities and responding to gaps in LMI, with the committee overseeing activities such as the forecasting model development, industry studies, surveys, joint data purchases, etc.

LMI is a priority area under the Atlantic Workforce Partnership program. Atlantic provincial LMI producers are collaborating on common priority areas including forecasting and improving data availability on post-secondary student pathways and outcomes. Irving and the province of Nova Scotia have been sharing such information and will continue to as the project moves forward. In collaboration with partners, Irving can identify workforce needs for its warship construction projects. But Irving also undertakes its own labour requirements planning and

forecasting, as the need for various skill sets will vary over the production cycle.

One principal challenge in meeting the needs of the shipbuilding industries in Nova Scotia is to identify current and potential sources of labour. These can include:

- supply and demand gap analysis (LMI);
- regional and local labour supply;
- work with under-represented groups (Centre of Excellence);
- international students (university); and
- youth.

Through the LMI provincial committee, work is currently underway to develop the proper data sets that will support a supply and demand forecasting model. The focus will be on beefing up data on the supply side.

The NS Department of Economic Regional Development and Tourism (ERDT) is presently implementing Regional Enterprise Networks across the province. Their work within the business community will be instrumental in helping to identify local labour supply. ERDT is working on the cooperative education program and incentives for employers who hire university grads.

ISI's Centre of Excellence is actually rolling out a pilot project to increase the number of women training and working in the marine industry as well as collaboratively design a gender diversity, inclusion and equity model. In addition, the Workforce of the Future initiative is looking at how we can better prepare Nova Scotian youth for today's jobs, and retain them, as well as international students. The Department of Education has focused its attention on connecting high school students to industry and, more especially, to trades and emerging sectors.

The province is aligning local training with industry,

creating an integrated approach to training and developing a joint partnership with British Columbia's shipbuilding industry. It is also working with the Nova Scotia Community College to develop an apprenticeship system, and establishing occupational trends for industry and a training program inventory (shipbuilding-related) and outcomes.

Current activities that are underway include:

- a list of core occupations related to shipbuilding and ship repair has been completed;
- discussions are underway with training institutions to identify if particular training programs exist and identify areas where there are gaps;
- discussions will be held with industry to ensure training satisfies industry's needs;
- partnerships with the West Coast will be pursued regarding curriculum content (apprenticeship trades, naval architecture);
- discussions are underway on alternate delivery mechanisms for training (mobile training, industry training); and
- supplier development programs are being developed; nine modules are being offered by LAE.

There are programs that support training, including:

- Canada Job Grant;
- Workplace Innovation and Productivity Skills Incentive (WIPSI);
- apprenticeships; and
- workplace initiatives.

Supplier development programs are another feature of the provincial government's plan, including industry days with Tier

1 business to business meetings, and a joint initiative with British Columbia to develop best practices related to supplier development, awareness, assessment, training, mentorship and audit. As well there is joint research with the Atlantic Canada Opportunities Agency (ACOA) on small/medium-size business best practices regarding human resources and business development.

The approach of the Department of Labour and Advanced Education has several incremental elements. The first element is to have the right people in order to have proper discussions in the right environment. The second element is to foster horizontal management using an integrated approach and subject matter experts to develop frameworks. One example is MIPO's Labour Market Committee which has developed a Labour and Workforce Development framework with ISI's Centre of Excellence, Marine People Partnership and the Association of Women Professionals (AWP).

The combined efforts of the major partners in this process have evolved to provide leadership in the area of shipbuilding in Nova Scotia. LAE, ERDT and ISI have created an executive committee, at the ministerial and deputy ministerial level, that meets to review progress and discuss issues. The provincial government has created MIPO and it is focused on maximizing economic opportunities. The centre of attention is on labour and workforce development, supplier development, investment and innovation. Key working groups are being developed on an as-needed basis and most resources are being leveraged within existing departments.

Private sector engagement has been equally dynamic. ISI has been working with training institutions, including NSCC. It is developing approaches to support local suppliers as well as working with the marine industry on the West Coast. And Tier 2 suppliers have also been supporting supplier development

through supplier development days and special initiatives such as General Electric's Ventures Licensing.

The net result of collaboration by these public sector, private sector and educational institutions is a joint effort, combining the energies and resources of the organizations, departments and institutions mentioned above. These efforts are also combined with Dalhousie University, University of British Columbia, trade unions, Aboriginal groups, the defence, aerospace and ocean sectors.

These multiple partnerships have evolved into joint research efforts between federal and provincial governments, an exchange of curriculum material between jurisdictions, and open discussions on industrial benefits. As well, these partnerships have led to efforts in developing better access to NSPS for under-represented groups, and developing relationships with the West Coast industry and government.

This file has an incredible number of moving parts and when the NSPS program is finished in 2030 we hope to look back and see that we have achieved the major initiatives which we identified at the beginning.

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The selection of Irving Shipbuilding Inc. as the builder of warships for the Royal Canadian Navy means that there will be demand in Nova Scotia for skilled tradespeople to fill the shipbuilding jobs and to replace those retiring over the next five years. What responsibility and/or role – if any – does the provincial government have in ensuring that the right labour is available in the province? In order for the jobs and personnel to match, is there a role for government to collect and provide labour market information? And is there a role for the federal government in ensuring that the NSPS has the human capital to

be successful?

It is clear from these presentations that, in Nova Scotia, the answer to these questions is yes, there is a role for government. Indeed, the provincial government has taken an active role. It has implemented programs in education, training and occupational apprenticeships that can provide new entrants into the provincial job market with the appropriate skills. The provincial programs are beginning to take shape and, like the presentations in the previous section, these presentations illustrate the need for strategic partnerships among educators, governments and industry.

Theme 1: Building Human Capital

Industry Perspectives

- "Advancing Human Potential," Roddy Warnock, Senior Instructional Designer, Bluedrop Performance Learning
  - Bluedrop Performance Learning focuses on training and learning. The company designs, develops and delivers courseware and simulation technologies for high-tech industries including defence, and works to train personnel on new equipment and platforms.
- "A Workforce Plan," Brian McCarthy, Vice-President Human Resources, Irving Shipbuilding Inc.
  - Vice-President McCarthy outlined how ISI intends to manage its existing labour capacity and also how it intends to find new staff to meet the needs of shipbuilding in the yard over the coming decades.

Advancing Human Potential

Roddy Warnock

Bluedrop is a publicly-held, Canadian-owned small business with more than 140 employees. The Canadian locations are Nova Scotia, Newfoundland and Labrador, New Brunswick and Manitoba. Its two business units are Training and Simulation and Learning Networks. Bluedrop is the largest provider of courseware in Canada, and the third largest in North America. It is ISO 9001.2008 certified and ITAR and Controlled Goods certified.

The resources which Bluedrop can bring to the table for the National Shipbuilding Procurement Strategy (NSPS) include:

- training needs analysis and design;
- courseware and technical documentation;
- training information management systems;
- training program delivery and support;
- simulators and support; and
- staff augmentation.

Bluedrop's experience in the defence market encompasses the three Department of National Defence operational environments:

Army
- Leopard 2 Tank Simulator Sub-Contractor; and

- Army Learning Support Centre, Training Program Support.

Air Force
- CH-147F Aircrew Training Program;
- CC-130J Training Program;
- CH-148 Maritime Helicopter Program;
- Contracted Flying Training and Support (CFTS);
- CF-18 Dedicated Weapons Load Trainer;
- CF-18 Integrated Maintenance Training System; and
- 30+ RCAF Virtual Maintenance Training Projects.

Navy
- Submarine Fire Control Trainer and Submarine Experimental Periscope Trainer;
- *Kingston*-class training;
- CF Maritime Warfare Centre, Maritime Tactical and Operational Gaming System (MTOGS);
- *Halifax*-class Modernization Program (HCM); and
- Arctic Offshore Patrol Ship Program.

Bluedrop provides state-of-the-art simulation technologies, training and simulation programs, and learning networks for high-tech clients. The company's military experience includes provision of a variety of simulation and training resources for the *Victoria*-class submarine and *Kingston*-class (MCDV) trainers. These services integrate analysis and development of training needs, courseware provision, provision of technical documentation, provision and training on simulators, as well as staff augmentation. The programs provide self-paced learning, group training, virtual reality, etc., as well as technician training programs (e.g., maintenance of emergency oxygen canisters). Bluedrop can also write content for programs, and manage the content, i.e., how to keep track and handle all the files, presentations,

programs, etc., that each 'package' requires. And finally, it has simulation capabilities, including 'tactile' and low-cost immersive virtual reality.

The experience that Bluedrop has in the Canadian defence market incorporates large and complex training programs that include operations and maintenance for the following classes of equipment:

- Maritime Helicopter Program courseware;
- C130J courseware;
- CH147F Chinook courseware;
- contracted flying training and support;
- NATO flying training in Canada;
- Arctic Offshore Patrol Ship;
- Maritime Coastal Defence Vessel.

There are many ways to train personnel. Bluedrop incorporates all types of training, including: instructor-led training (ILT); surrogate partner training (SPT); computer-based instruction (CAI); computer-based training (CBT); web-based training (WBT); electronic performance support systems (EPSS); and scenario- and team-based training. The training can include full integration of audio, video, animation and interactivity (IMI Levels 1-4). Training can be assisted greatly by utilizing simulation in two-dimensional (2D) and three-dimensional (3D) virtual environments using 3D gaming engines, virtual reality and augmented reality.

Bluedrop Performance Learning has achieved successful results through extensive use of content management technologies, including Learning Management Systems and Learning Content Management Systems. These include both traditional tactile approaches as well as low-cost immersive virtual reality training devices.

As a consequence, Bluedrop has developed and delivered a range of low- to high-fidelity training systems that include:

- cockpit procedures trainers;
- helicopter crew training systems;
- fixed-wing rear crew trainers;
- mission rehearsal training systems; and
- virtual maintenance trainers.

The Maritime Coastal Defence Vessel (MCDV) Training Program is an example. The 12 ships were constructed in the late 1990s. Bluedrop adopted the Systems Approach to Training (SAT) through the Canadian Forces Individual Training and Education System (CFITES), and developed the full crew initial and refresher training courseware, the courseware for the mission payload, under contract to SNC Lavalin. Bluedrop also trained the initial four MCDV crews and conducted course validation. Included in the package were 450-hours of computer-based training (CBT), with 26 CBT Labs installed across Canada. All courseware was bilingual. This turnkey solution was delivered for $32 million.

During the past several decades, the Royal Canadian Navy (RCN) has experienced a progressive technological change with introduction of:

- new ship classes;
- new sensor technologies;
- new weapon systems;
- new propulsion systems; and
- new damage control systems.

Today, the RCN is on the cusp of another major transformation occasioned by a number of new factors:

- the pending introduction of four new ship classes, the Arctic Offshore Patrol Ship (AOPS), the Joint Support Ship (JSS), the Canadian Surface Combatant 1 (CSC1), and the Canadian Surface Combatant 2 (CSC2);
- significant capability upgrades to the Canadian Patrol Frigates provided by the *Halifax*-class Modernization (HCM) and the Frigate Life Extension Program (FELEX);
- increasing operational demands that reflect a changing geopolitical landscape;
- the need to transform the existing training model to prepare RCN leaders to incorporate future technologies and meet future challenges;
- the Naval Training System (NTS) needs a complete reassessment and transformation in order to bring it in line with modern fiscal and technological realities; and
- Current NTS costs are unsupportable and budgets are likely to be further reduced in the wake of federal efforts to control spending.

In March 2014, Bluedrop delivered the results of a study examining delivery problems of existing NTS courses and training which recommended a blended approach, increased use of self-paced web-based training on the Defence Learning Network (DLN), with instructor-led training focused on practical skills and delivered by both uniformed and civilian staff.

Uniformed staff would continue to perform key functional roles, including divisional and administrative support, quality control, shared instructional duties as secondary instructors for any instructor-led training, and subject matter expertise. Contracted civilian staff would support the following functions:

- training needs analysis;
- instructional system design (analysis, design, development

of courseware);
- technology identification and insertion;
- training equipment analysis;
- support computer-based training;
- conduct instructor-led training as primary instructors; and,
- undertake responsibility for the recording of the training standards.

There are many exciting changes occurring in how training programs can be delivered. And as the new ships of the NSPS are built and delivered, there will be opportunities to capitalize on new technology and programs of learning such as those provided by Bluedrop.

A Workforce Plan

Brian McCarthy

Irving Shipbuilding Inc. (ISI) has built on past work to ensure that there is a comprehensive recruiting strategy to have the right people at the right place at the right time. ISI has adopted a quadripartite approach relating to employees and potential employees. This approach includes:

- keep them at home: remaining connected to displaced workers;
- grow at home: building the existing Atlantic Canada network;
- bring them home: bringing Atlantic Canadians home; and
- make it home: bringing the world's best shipbuilders to Nova Scotia.

Irving is keeping in touch with displaced workers, and is recalling employees from the existing seniority list. The company has created a 'keeping in touch' employee site that contains information updates and resources for employees on layoff, with the intention to lead up to the workforce growth through communication with laid-off employees. This communication initiative will be enhanced to ensure workers are aware of timelines and to monitor the effectiveness of the recall approach to recruiting.

The NSPS value proposition is a funding commitment by Irving Shipbuilding of $250,000 per year throughout the life of the NSPS programs to provide all Nova Scotians, with particular focus on under-represented groups, with applicable programs and training to optimize opportunities to work in the marine sector. It will focus on pathways and create capacity for these groups to participate in opportunities stemming from shipbuilding activities. The first $250,000 payment has been delivered.

Nova Scotia Community College Centre of Excellence

There is a well-known lack of shipbuilding talent in Canada. To address this problem, Irving Shipbuilding began working with Nova Scotia Community College to create a Shipbuilding Centre of Excellence. There are three areas of focus: Early Pathways; Moving to Learning; and Workplace Culture. The Steering Committee membership consists of ISI, province of Nova Scotia, NSCC, Canadian labour unions and members of communities which are traditionally under-represented in the labour market. ISI is also in a partnership with Women Unlimited to create a program in Spring of 2015 for direct entry to ISI employment in 2017.

ISI is one of largest employers of apprentices in Nova Scotia and has partnered with the province of Nova Scotia to make changes to apprentice programs, including participation on the board of the new Apprenticeship Agency. The company has committed to building programs to support the development of Canadian shipbuilding talent, including the Junior Engineer Program, under which eight people have already been hired, five of whom are Dalhousie graduates. Ten to 15 more are currently being recruited.

As one of the largest employers in the province of Nova

Scotia, ISI continues to expose young engineers to the business through its co-op program. Two Dalhousie co-op students are currently on site, and there are plans for two more in the Winter 2015 term. Two Interns from the University of British Columbia (UBC) were recently offered employment, and one from Dalhousie was offered an internship contingent on his graduation in 2015.

ISI is planning to undertake targeted job fairs in western Canada to promote opportunities in Nova Scotia, with a message to displaced Atlantic Canadians that it's 'time to come home.'

Canada has not built naval vessels in more than 20 years, and there is a need to bring in some specialized shipbuilding talent from abroad. Irving Shipbuilding uses this as one part of its broader strategy. So far in 2014, Irving Shipbuilding has hired nine temporary foreign workers, and three through NAFTA, and is currently supporting five employees in obtaining their permanent residency, with more expected to follow. There is an anticipated need to hire an additional 25 temporary foreign workers to support the growth of shipbuilding locally.

The NSPS offers people the opportunity to build expertise in the marine sector, to develop shipbuilding talent, and to hire young talent to build ships in the future.

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One of the elements of the NSPS is to ensure that Canada has a shipbuilding capacity, and that it is no longer subject to the boom-and-bust cycles of the past. This means that the shipbuilding industry has an incentive to make the NSPS a success in order to ensure its own long-term survival. As well, the NSPS plan includes support for related Canadian industry, so businesses are onboard to make the program work.

The presentations in this section illustrate that both Irving

and Bluedrop Performance Learning are not sitting idly by waiting for the human capital to appear. They are both being proactive. Irving has adopted a plan to find and train personnel for its facilities, and this includes working with community colleges such as Nova Scotia Community College, and universities such as Dalhousie. And Bluedrop, like other companies that do training, is making an effort to enhance its capabilities to ensure that there will be a trained body of personnel available when the ships are built.

Theme 2: New Trends in Maritime Crewing

- "Decision Support for RCN Crewing," Dr. Renée Chow, Defence Research and Development Canada
- "A Practitioner's View," Lieutenant-Commander Ramona Burke, Director Naval Personnel and Training 5-3: Future Fleet
  - These presentations were valuable in that they included the perspectives on crewing of both a Canadian scientist and an experienced RCN officer. This type of collaborative operations research will be essential as the new classes of ships are introduced under the NSPS.
- "Reduced Crewing: Design Considerations," Bernd Kulmus, Proposal Manager Canadian Surface Combatant, ThyssenKrupp Marine Systems of Germany
- "Exploring New Trends in the Crewing of Modern Warships," Nelly Chouvy, Defence Scientist, Directorate General of Armaments, France
  - In order to broaden the discussion beyond Canadian considerations two European experts were invited to discuss the topic of crewing concepts. Both individuals have been involved in crewing research and operations for decades and the lessons that they shared from their national experience should be very relevant to NSPS efforts in the future.

Decision Support for RCN Crewing

Renée Chow

One of the most important considerations that has been discussed in recent years is the notion of determining the right size crew. The US Navy (USN) Naval Research Advisory Committee (2000) reported that Total Ownership Cost (TOC) of naval ships is 30% procurement and 70% operations and support (O&S). Of O&S costs, 51% is personnel.

Crewing is one of the biggest issues in integrating new ship designs into fleet structures, and this includes both crew size and composition. Early research on optimized crewing focused on reduced or minimum manning. However, it has to be recognized that there are risks with too-large and too-small crew estimates, and allowances have to be made for design changes, policy and procedural changes, refits and operational impact.

The Royal Canadian Navy (RCN) is in the midst of several major capital acquisitions including the Joint Support Ship, Arctic Offshore Patrol Ship and Canadian Surface Combatant. So it is important to analyse the crewing requirements for the new generation of ships to be incorporated into the fleets. Work on this began in 2011 based on the understanding that crew size and composition are key contributors to the operational effectiveness of each platform. The analysis included crew validation, options analysis and crew generation. The research was summarized in a study published under the name "Decision Support

for RCN Crewing."

The purpose of the study was to identify and expose factors relevant to crewing analysis. Crew size is affected by and affects many factors like automation or platform design. Therefore, it is important that the RCN is able to refine its analysis continually.

Based on this, DRDC developed a decision-support process for the RCN, named Simulation for Crew Optimization and Risk Evaluation (SCORE). The right size crew is necessary for crew effectiveness, but what the *right* size is exactly is not always obvious. The conclusion might be to reduce the size of the crew to reduce cost. And cost is a consideration, but there are other factors. Too large a crew would have an impact on the design of the ship, and too small a crew might affect the operational capacity of the ship.

There is a series of analyses that can be done to lead to the development of an optimal crew. This is not the finalized crew size, but is an input to the development of the consideration for the crew size. The SCORE Crew Validation process (2012-present) analysed several factors, including: the inputs of scenarios, including missions and capabilities; roles, including the given technologies, policies and procedures; and the crew, incorporating the number, the occupations and ranks. These factors were analysed against the criteria of crew validation and options analysis to determine the role-crew assignments, to ascertain the crew usage and crew assignment conflicts.

The SCORE Crew Generalization process was conducted across different units in the RCN from 2013 to the present, and analysed the inputs of operational demands, watchkeeping demands, maintenance demands, evolution demands, and capability demands against the criteria of crew validation and crew generalization to determine the notional crew size and crew composition. This was done with the recognition that each crew member has a number of roles in a warship, the function related to the

military occupational code, such as resource management support clerk or medical technician, and a watch designation.

These analytical processes yielded results in lowest and highest usage among crew and average daily usage. Results also included the roles filled in time per role and per crew member to ensure the appropriate resource allocation and to identify the implications for training or procedures. This permitted a comparison of roles with higher or lower usage and appropriate prioritization (e.g., for class of ship or the ship's mission). It also identified roles with zero usage to assess whether they were critical to the mission. This process also allowed the identification of second-order effects, such as the impact on force generation.

The SCORE process identified opportunities to:

- resolve conflicts in the crewing of warships, to determine which areas needed to be addressed and how, and which would have to be reconciled by command decision;
- identify technology capabilities to be incorporated into the crewing of a ship;
- define the concept of operations;
- develop thorough policies and procedures;
- undertake force employment versus force generation and force development; and
- identify the minimum crew size, the minimum rank for each job and minimum cost of operations.

At its most basic level, this is a process of making ongoing tradeoffs between navy expertise and navy priorities to make the best decision versus an informed decision. Since 2013, the SCORE Crew Validation has been used to undertake an analysis of crew utilization. The approach is to integrate a crew performance model into a navy crewing decision-support tool. This provides the capacity to see differences between departments, or

between scenarios, and identify risky situations where crew size or at least work distribution may need to be further examined.

More work remains to be done before we can determine the 'right' crew size for every vessel. We would need to study and understand:

- the effects of automated decision support, incorporating automated scenario generation, sources of uncertainty, support for simulation experiments;
- the integration of crew performance models, including the impact of sleep and fatigue, and other performance factors;
- model validation, through scientific literature, allied research, simulator studies or sea trials; and
- model applications in different class ships, ashore and different command organizations.

SCORE is designed as decision support for direct use by RCN personnel. It supports multiple phases of crewing analysis, as ship acquisition projects evolve. Capabilities continue to be added, tested, applied and improved in the SCORE model. The RCN used SCORE to re-evaluate baseline crew for the Canadian Patrol Frigate and it is being applied across multiple ship projects, most notably the Arctic Offshore Patrol Ship.

A Practitioner's View

Lieutenant-Commander Ramona Burke

To date, the RCN has used Simulation for Crew Optimization and Risk Evaluation (SCORE) to validate the increase of the crew of the Canadian Patrol Frigate (recently increased from 200 to 217 due to the addition of equipment and the requirement to account for training positions), and to validate the numbers and skills composition proposed for the Arctic Offshore Patrol Ship crew. SCORE is also intended to be used to validate the crew size and composition for the Joint Support Ship and Canadian Surface Combatant.

The crew development and validation process is done in close collaboration between the project staffs and the future fleet analysts (the small team I lead in Director Naval Personnel and Training 5-3 in the Naval Staff in Ottawa). Director Naval Personnel and Training 5-3 does most of the liaison with Human Systems Integration Section in DRDC Toronto and relies on it for SCORE support and future development. This close and collaborative effort between practitioner and scientist is yielding excellent results.

To determine crew composition for RCN vessels in the future fleet, a number of factors are taken into consideration. First, there are existing RCN regulations such as ship-borne helicopter operations (SHOPs) and ships' standing orders (SSOs) that state the levels of manning that are required for all shipboard

operations. As well there are external regulatory regimes that include the International Marine Organization (IMO), International Convention for the Safety of Life at Sea (SOLAS), and the *Canada Shipping Act* that also must be carefully heeded in the crewing design.

Other factors include a concept of employment/concept of operations for the ship class, and an assessment of equipment manpower/monitoring requirements. Comparisons with Canadian Coast Guard (CCG) and allied crew sizes for vessels of similar size and capability will also be conducted, as will consultation with stakeholders and military occupation managers and studies by independent consultants. And, finally, there will be modeling and simulation using SCORE.

SCORE conducted an analysis for the Arctic Offshore Patrol Ship by running a simulation with the crew numbers that have been proposed for the class through a number of standard at-sea training scenarios. The idea behind this was that the crew size and configuration should be determined by the requirements of the ship when it is under full operations at sea. The analysis incorporated the following functions and activities:

- at-sea underway watches;
- daily departmental work and routines;
- replenishment of fuel and supplies at sea;
- entering and leaving harbour (including force protection);
- cleaning stations and ship's husbandry;
- first level maintenance;
- firefighting and damage control emergencies;
- launching, recovering and operating ship's boats; and
- helicopter operations.

Various crew sizes were run through the same routine scenarios using SCORE to determine potential manning shortfalls

and to determine anomalies in crew usage rates. Once manning conflicts were resolved, a small number of options were developed based on available bunk space, training requirements and potential added capability options (e.g., boarding and damage control). Several crew sizes were then compared using criteria determined for the class by senior leadership. Some of the important considerations looked at included the safety of vessel and crew, and resource considerations such as the through-life cost of vessel and crew. Some of the other areas that were carefully looked at include:

- a maintenance concept for the class of ship including its ability to conduct daily first line preventative and longer-term corrective maintenance while deployed in remote areas such as the Arctic;
- flexibility of the ship and its capacity to conduct more than one seamanship evolution at a time along with sustained periods under which the crew would need to be conducting challenging ice navigation;
- human issues such as training space, compensation for reduced crews due illness and mandatory crew rest;
- the capacity to perform husbandry tasks such as cleaning stations, painting, laundry and scullery on a persistent basis to manage the quality of life on the ship while deployed;
- a concept of support and the ship's ability to self-sustain rather than be supported from ashore; and
- planning for the inclusion of training billets both to train junior sailors and to develop ice experience at all ranks and levels.

As mentioned, the most extensive use of SCORE to date in the RCN has been to assist in developing and validating the crew for AOPS. Typically, the crew size of the ship class being

replaced is used as the baseline for the crew of the future class. However, this was not possible for AOPS as Arctic patrol vessels did not previously exist within the RCN fleet. Without existing standards for this new class, much more analysis was necessary to ensure that it would be manned with an appropriately sized and qualified crew to execute its mandate.

SCORE assisted in the analysis by reducing the amount of time that would have been spent conducting trial and error tests on various crew sizes and allowed the analysts the opportunity to create one, all-encompassing scenario and to test various crew sizes against it. Essentially, the usage rate and conflict reports generated from SCORE allowed analysts easily to identify gaps in qualified personnel over the full range of evolutions expected of a naval vessel of that size and capability.

Without SCORE, this type of detailed analysis would take considerably more time and effort and would be susceptible to human error. Often gaps and conflicts in a ship's personnel plans are not identified until the ship has conducted trials either alongside or at sea. Using SCORE has allowed the opportunity to avoid some of these potential challenges well before the ship has even been built. In effect, SCORE reduced time that would have been spent on trial and error with various crew sizes and compositions by:

- allowing for the creation of one scenario, to be used multiple times;
- generating usage reports to identify more easily personnel who were over-tasked in the manning plans for the ship's operations (referred to as the Watch and Station Bill);
- generating conflict reports that more easily identify personnel who have multiple assignments during concurrent evolutions; and
- identifying unassigned roles and gaps in personnel for specific evolutions.

Crewing matters because the bulk of the though-life costs of a ships class are in personnel – although this is not just an issue of too many people. Minimizing crews carries risks, as does having too large a crew, especially in design and construction costs. It is problematic to assign too many people into a small space and it is imprudent for a ship to deploy with an inadequate or insufficient crew.

DRDC is working with RCN to develop the right size of crew at an early stage. But in order to do this we need information about the ship and its missions. We need to know what the ship will be doing. What sort of weapons, etc., will the ship carry? Is it more automated than current classes of ships, or less? There are different threats and missions now, leading to the need for a systematic evaluation of different crew configurations. As well, we need to know if some roles can have 'zero coverage.' This will determine if they are critical, or needed at all.

Because of lack of full information on occasion and the influence at times of RCN traditions, assumptions and cultural factors, what comes out may not be the best solution. It is better that it be an informed decision with tradeoffs made based on consideration of the relevant and up-to-date considerations.

As we know, the size of the crew affects the effectiveness of a ship's operations. Modeling has allowed us to investigate how fatigue affects crews. DRDC fatigue modeling may start to shape watches. This allows decision-makers to forecast where and when the crew might be getting tired and making mistakes, indicating the need to change the crewing.

In the future there will be a focus on trying to automate the decision-support tool, to make scenario creation a lot easier. And we will also integrate human performance indicators into the SCORE model itself. Also, there is potential to apply crewing

analysis to shore commands, etc.

There are many questions that will need to be answered in the future. Will the navy continue to shape its manpower profiles or accommodate its shortcomings in managing crewing? How much risk will be acceptable?

The complexity of some of the single task models and the increased complexity of multiple task models have complicated the understanding of the complete spectrum of the behavioural and occupational complexity of an integrated naval team. However, as we move from a single task or function to a multi-function or array of collateral responsibilities for a larger team, the description of the challenges and the occupational needs of the warship become more pronounced.

Reduced Crewing: Design Considerations

Bernd Kulmus

Let us first take a look at what has been undertaken so far in the German experience. Germany's three *Sachsen*-class (F124) Air Defence Frigates are products of ARGE F124, a consortium of Blohm and Voss, Howaldtwerke-Deutsche Werft (HDW) and Thyssen Nordseewerke (TNSW), which amalgamated in January 2005 to become part of ThyssenKrupp Marine Systems. The first three ships of the FGS *Sachsen*-class were built in a variety of yards and commissioned between 2003 and 2006. These ships have a complement of 255.

The new designing methods that were put in place for the F124 air defence ships paved the way for the German Navy's new F125 frigate. This ship is very unique in that it will have the capability to be deployed worldwide for up to two years before returning to the home base and can be in operations for up to 5,000 hours a year (208 days of continuous service).

Originally conceived as a multi-role combatant, by 2005 the requirement for the F125 was based on a capability to counter asymmetric threats and perform stabilization operations with lethal and non-lethal intervention. The F125 would be armed with land attack systems and air warfare point-defence equipment but would not be equipped with sonar.

Each frigate has two crews of typically 105 to 120 people,

changed every four months. This represents a 50% reduction in crew compared to previous generations of frigates. The reduction has been achieved largely by increased technology.

Reduced crewing of warships will require consideration of the design of platform systems. The propulsion plant's service requirements will have to be reduced as much as possible, without compromising the need for speed and fuel efficiency. The propulsion plants should have fewer service requirements, utilizing unmanned, camera-controlled propulsion compartments and a high level of automation in the control systems. As well, a possible solution to reduce maintenance/service but maintain efficiency is an electric drive solution and a gas turbine in a combined diesel-electric and gas (CODELAG) turbine configuration.

Battle damage is a fundamental consideration in warship design and development. The control system should incorporate smoke detectors in all compartments, and sprinkler systems and selected flooding indicators in strategic locations. Battle damage assessment can be simplified through notebook computers, control system automatic sequences would be implemented as necessary with minimum human involvement.

With reduced crewing, various automated systems would be automatically activated in the event of damage, including fuel, air conditioning, salvage, firefighting, compressed air to combat flooding, nuclear-biological-chemical (NBC) pre-wetting, freshwater, black water clean up and liquid sewage management.

Reduced crewing would also require reconfiguration of the resupply at sea stations to reduce manning as much as possible. Furthermore, a ship with a reduced crew would require automated transfer and forklift devices for provisions and material, and efficient warehousing with elevators close to the RAS area.

Providing a design to minimize the crew size must be an essential design-driver and it must be integrated from the

beginning to the end of the design process, especially the impact of reduced people to do maintenance, clean up and repair. The design of the ship must consider the placement of equipment and systems within compartments that lead to efficient operations, including ship‘s husbandry and maintenance, and consider the design impact of a reduced crew with respect to maintenance.

Reduced crewing in a modern warship is not a new development, but a logical step in the development of advanced technology that allows selected sailors to be replaced by machines and computers.

Reducing personnel on naval ships has become necessary in today's fleet as a dwindling budget and declining force levels become more critical. Technology is a logical substitute for personnel due to its availability, continuous improvement, speed of operation, capacity for information exchange, and complete integration with human systems.

Another consideration is the development of a two-crew concept for each warship. This would enable ships to deploy for longer periods. There are, however, a number of questions about the employment of the members of the crew that are not embarked onboard the ship having turned the ship over to the second crew. Questions would include:

- How would it be possible for them to remain as an integrated team while at home?
- How might this dispersed employment affect unit cohesion? This is important because you want to minimize the time necessary to reconstitute them back together as one team before they are sent back to take over the crewing duties.
- What types of contribution can they make to the navy while they are not embarked in the ship?
- While the crew is not embarked in the ship is it even cost-effective to keep them on payroll?

Exploring New Trends in the Crewing of Modern Warships

Nelly Chouvy

With its new *Aquitaine*-class FREMM frigate (*Frégate européenne multi-mission*), the French Navy has adopted a new and cost-effective approach to crewing, to replace crew members when and where possible. The principal challenge was to develop a ship with high capability, high effectiveness, improved habitability and technical standards, but with reduced life-cycle cost – i.e., to find the right balance of financial resources with quality systems. Like warships with comparable capabilities of other states, the FREMM is a concentration of functions, including: propulsion, navigation, weapons, counter-measures, sensors, aviation and supplementary surface transportation. It also must be able to conduct operations, both autonomously and in co-operation with partner states and survive battle damage, mishaps and accidents.

The French designers utilized Human Factors Engineering Processes when designing the ship to ensure utmost efficiency. They developed simulators to test bridge and Combat Information Centre (CIC) designs, and preliminary studies enabled validation and statement of requirements to fit the design to an optimized crew. Five years of research was conducted even before the contract was signed, and for seven years after the design was improved during building. This included provision

for use of a specified 'optimal' crew for all sea trials, so as to test the ship as it would be used in real life with this reduced crew. The research began in 2000 with a preliminary study of the requirements for the bridge, followed in 2002 with a study of the Combat Information Centre, as well as damage control systems that used online maintenance and command station sub-systems to ease the job of the operators at sea. In these ships, battle damage control is not only assisted by automation, but also by design. There is one large central passageway and two side passages which allow for very good flow of personnel during emergency situations throughout the ship.

The FREMM's immediate predecessor, the *De Grasse*-class, employed a crew of 240, while the FREMM has a crew of 108, consisting of 94 naval personnel and 14 members of the helicopter detachment. The FREMM crew is thus 54% of the *De Grasse* crew.

The ship employs commercial off-the-shelf (COTS) solutions for cost-efficient design, although higher standards had to be brought to the design because of the smaller crew, which resulted in the exploration of the benefits from civilian standards for the platform.

The designers of the FREMM also used crew optimization tools to validate theoretical crew size. Detailed studies and validation were carried out from 2006 to 2011, and looked at scenarios, simulations and verification with virtual reality tools and integration platforms. Adaptations for crew optimization are also included in the contract to allow for constant improvement.

Total crew target validation with a scenario on a modeling tool (OPTIPAM/furnished by the customer) was conducted with a crew of 108 during a six-month deployment, consisting of:

- full action states while manoeuvring with daily damage control exercises;

- 163 days at sea and 20 days in port;
- two-thirds of the active phases of the deployment were at watch stations, and one-third of the time at defence stations;
- maritime helicopter manoeuvres were conducted during 43% of the time at sea;
- 33 damage control and firefighting exercises at watch stations were conducted;
- 96 visits at watch stations and five at defence stations; and
- 29 rigid-hull inflatable boat (RHIB) manoeuvres at defence or watch stations.

This demanding deployment was undertaken to validate the theoretical allocation of the watch and all conditions of action, which resulted in the refinement of the final 'scheme of complement' that was used for the operations in this class of ship.

In order to make this new type of ship efficient and effective to operate there were also a number of new types of equipment and procedures that were introduced such as:

- The FREMM integrated bridge system, which uses the pilot-co-pilot system requiring only two to five people on the ship's bridge for normal operations at sea. This was a significant change in the French naval systems used on the ships.
- The Combat Information Centre (CIC) features multi-function consoles, raw data fusion of sensors, along with centralization and automatic correlation of information. The idea is to allow the crew to spend more time on the operational activities and less time on maintenance requirements. This concept was accomplished through greatly automated information correlation and data management.
- The FREMM damage control system allows for a ship that is resilient and needs fewer people to survive, allowing more of the crew to remain at their primary fighting workstations.

Battle damage control capacity integrates passive protection and water mist systems in main propulsion compartments, and aft and forward zone redundancies. There is increased detection coverage, two remotely-controlled powder foam guns for firefighting on the helicopter deck, two damage control zones, centralized commands for the three zones available from the Ship Control Ccentre (SCC) and the secondary SCC (except powder and foam guns). With this significant damage control capacity the ship is thus designed to survive challenges with a smaller crew.

- Accommodation for the crew is comprised of 58 cabins. There are several single-berth cabins for the Commanding Officer and VIPs, and a number of two- and four-berth cabins. All have en suite bathrooms, simplifying gender integration. These efficient well-laid out accommodation spaces make for a better rested crew, enhancing the fighting efficiency of the ship.

The FREMMs also employ an engineering support concept referred to as 'reachback.' In this concept the ship is supported during its deployments away from home port by a dedicated group of staff who remain ashore that are available at all times to assist the at-sea operations of the ship. This multi-disciplinary 'alert pool' of 29 trained individuals are poised to replace unavailable crew members at short notice. When these replacement crews arrive they are already completely educated and trained in the FREMM-class allowing them to set to work immediately. The concept also provides the crew with dedicated access to shore-based maintenance support experts. There are also special teams that can join the ship for more complex activities such as cruise missile operations, electronic warfare and specialized shipborne aviation.

With two years of experience at sea, the French Navy has

found that the FREMM offers an exceptional operational capability that can be managed by an optimized crew of 94 dedicated members + 14 specialist crewmen for most missions. Few adaptations (less than 10%) to the core crew are foreseen at present and a shore-based reachback capability provides a cadre for a resilient flex team in the event that higher endurance team may be needed at short notice onboard the ship.

In order to use this reachback concept the navy must create a strong shore support organization with a ready pool of operationally prepared personnel to compensate for challenges faced by deployed ships. There must also be a robust shore maintenance facility that can rapidly support the maintenance requirements of the ships deployed at sea.

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The presentations in this section discuss the second theme of the workshop – the novel crewing concepts that must be considered as part of the design and construction of the future fleets. The speakers in this group contained both Canadian and international experts. They spoke about some of the research tools that are being used for crewing designs and shared some valuable international shipbuilding expertise that Canada should considered as it prepares the crews for the new NSPS fleets. Determining crew size is not a simple matter. There are a variety of considerations involved – for example, cost, labour market competition and effectiveness of ships.

Crew size has a significant impact on the life-cycle cost of a ship. Personnel is a resource that is in increasing demand, as navies are in competition with the industrial and business sectors. Because of competition for personnel with other sectors of the economy, and an ageing population in Canada, smaller crews

may be a modern imperative. So getting the size of the crew right is fundamentally important. But what exactly, as two presentations here ask, is the 'right' crew size? And how do we determine this? As is illustrated in the presentations by Dr. Chow and Lieutenant-Commander Burke, this is something that DRDC and the RCN are already exploring.

To be attractive employers, navies need to take measures to avoid having exhausted and demoralized crews. Crew accommodation to the RCN's standard requires significant space onboard and a particular crew size must be determined early because of design and construction considerations.

Since it has been some time since Canada built new ships, it is helpful to look at the experience of other countries to learn from them. The crewing considerations for the next German Navy F125 Global Deployment Ship were being considered at the very beginning of the class design. Examples of this approach can be seen in areas such as the selection of the construction materials that are easy to maintain and clean with a small crew all the way to using simple engineering configurations that will ease maintenance routines and allow for the most efficient operations over a protracted period of time. It is clear that the German designers have paid close attention to the crewing issues.

Support ashore is an important consideration if crew sizes are to be reduced. It would be helpful for Canada to take a closer look at the 'reachback' method of operations that the French Navy has adopted for the FREMM-class of ships.

Is there really a cost savings overall by employing reduced crew sizes? If the crew size at sea is small then you must develop additional shore maintenance support structures in order to compensate for the light crews. It would be worth exploring how expensive it actually is to sustain a highly trained manning pool ashore waiting to deploy. Also what would be the cost of

producing a supply chain that could be responsive enough to replace damaged equipment on these ships at short notice from shore facilities rather than having the crew strength already embarked in the ships to fix the systems that are degraded and or damaged?

As was made clear from the presentations on this theme, there are key questions that remain to be answered before the crew size of the new fleets can be decided. As well, key questions arise about the nature of savings that can be accrued and also about how long you can sustain high-tempo operations with reduced crews. And given the effect the crew size has on the ship design, it is important to consider the questions – as the Germans and French have done – early in the shipbuilding process.

Theme 3: Sustaining Human Capital: The Long View

- "A Strong Workforce," Vice-Admiral (Ret'd) Peter Cairns, Shipbuilding Association of Canada
  - Admiral Cairns notes that because of the boom-and-bust cycle of shipbuilding in Canada, both skills and shipbuilding options have been lost. The NSPS is the right approach because it focuses on the long term, and it insists on building in Canada.
- "Shipbuilding Research: A Systems Approach," Ken Hansen, Centre for Foreign Policy Studies
  - How can we sustain the human capital of the future? Ken Hansen addressed this by discussing how organizations must adapt to change and risk, and how shipbuilding industry organizations in Denmark and the United States may help Canada learn valuable lessons.

A Strong Workforce

Vice-Admiral (Ret'd) Peter Cairns

The Shipbuilding Association of Canada initiated an effort to do 'continuous shipbuilding' in which ships were replaced rather than undergo refit. This is a process that has been adopted by several of Canada's allied navies, and if adopted by Canada, would ensure that we would have the ongoing shipbuilding demand that would allow us to keep the workforce in place in Canada.

We have lost these skilled tradespeople because there have been 20-year gaps in our shipbuilding. This sadly has been the Canadian experience. As an example, the Saint John Shipbuilding facility in New Brunswick, which was the most modern shipbuilding facility in North America when producing the *Halifax*-class ships in the 1990s, no longer exists, and probably never will be operational again. Its workforce has long since departed the region.

Industry must have a strong sustainable workforce. And we must have long-term vision for shipbuilding in Canada. We must put Canadian equipment into Canadian ships. Unfortunately this is not possible unless defence research and development (R&D) is better funded.

The fundamental principle of NSPS is that we must keep key strategies foremost in mind. NSPS is predicated on a 'build in Canada' policy and the policy doesn't work if the shipbuilding

is done anywhere else. The NSPS allows Canadian firms to create Canadian equipment that will be put in Canadian ships. Canadian firms have to be seen to support their own navy or they will not be able to market their materials to other countries. There is no benefit to Canadian industry, and Canada generally, to build NSPS ships offshore. This is why the strategy was adopted to build at home.

The NSPS is the right program and we have to remember why we are doing it. We need to have a continuous process, and we need to be a country that builds ships and marine equipment. The outward appearance of the ship is irrelevant; it is what is inside the hull that matters. An excellence in build quality along with robust equipment design and selection is what sells Canadian technology to other parts of the world.

The levels of automation have to be carefully considered as well. But we need to ask how much automation we want and need. It is important to define what this looks like. We have to have the latest design and latest technology for our ships, and in a way that supports our industry.

Industry Canada policy is that Canada must only use proven technology in ships. The policy is wrong. Let our engineers and our visionaries loose to explore new technology and new processes. When we have done this in our past, we have been surprised.

Shipbuilding Research: A Systems Approach

Ken Hansen

When looking at a project such as the National Shipbuilding Procurement Strategy, one could ask two questions:

- What should it do?
- What should it look like?

If we look at shipbuilding and the NSPS, we can see that it faces a challenge that other programs or organizations may not. Shipbuilding is the most complex industrial activity known to humanity. Some warships are more complex than spacecraft. In some cases, the large organizations that produce ships are so intricate and delicately balanced that the prospect of change is difficult to understand and manage. But in any new program such as the NSPS there will be change, and inherent in that is risk. Risk must be recognized as a major factor and it must be managed. The process of risk assessment and management has many dimensions to it but mainly it is about how individuals independently view change (uncertainty about effect and cost) and how individuals collectively view it (uncertainty about effect of process and product).

In everyday life, we know there's a problem if time runs out, money runs out, space runs out or the people run out (or away)

before the job gets done. Product and process improvement can be achieved but most often it is the result of a random (worst) or incomplete (most common) change to practice.

From my perspective when looking at the future of the NSPS, I sense that there are very clear signs that a potential problem is looming. There is a danger that going forward with our shipbuilding planning we will simply just do things the way we have always done them. We may leave little room for innovation and our tradition of accepting very low risk may continue at a time when courage and risk taking will be required more than ever to ensure that we succeed in such a large endeavour as the NSPS.

It is clear that many things have changed since the last ships were built in Canada over 20 years ago. The industrial practices will need to be updated and the way we generate and sustain our shipbuilding workforce will also have to be transformed. Here are a few of the things I have learned about shipbuilding and change.

Everywhere you look, the word innovation is used in conjunction with discussions on shipbuilding. The definition of the word has three key aspects to it: the development or acquisition of new methods and ideas; making change based on them; and how that affects production. There is a clear agenda for change here that cannot be avoided if we are to be successful. Change is based on new knowledge that must be incorporated in how things get done.

Shipbuilding will need to involve innovation if we are going to be able to tackle the daunting challenges that lie ahead. In order to build new ships, there will be a need to change. And in this, organizational complexity presents its own challenges.

- What do we change – processes, people, best practices?
- How does it affect the industry writ large?

- Where do we start?
- When does it end?

The literature on the issue of organizational change is categorical about the need for change and the risks of maintaining the status quo in times of societal change. Resistance to change, however, has often hindered an orderly process to the point that it becomes a crisis. This is not the best way of doing business. Planning and preparation that is supported by a good understanding of a wide array of options is the best way to mitigate against chaos.

Here is how I view the systematic and planned approach to the question of what the NSPS project should do. We have a problem, a recognized and accepted problem – completing the NSPS within the time and budget available. So how do we address this? In a complex organization such as the shipbuilding industry, it is important to establish what levels of the organization are affected and what activity within that level may need change. Acceptance of the need for change is, more than anything, an attitudinal problem. Recognizing that the status quo is not tenable is key to shaping expectations, managing risk and opening a wider discussion about where the need for change will go and what it will affect.

The application of change should not always assume the lowest common denominator. This is the tinkering approach that is, in my view, endemic in Canada. It is a tough thing to acknowledge that something we have done successfully in the past is no longer relevant or effective. Identifying that knowledge gaps exist is very important, but it is clearly not all there is to setting out a plan for innovation. It should be understood that all levels and applications in an organization may be changed as the result of a recognized need for innovation.

Cost factors are important, both social and monetary, which

may lead to the need for a phased implementation plan of the changes needed across the industry to be successful in building all of these ships. The literature is rife with argument for continuous innovation, which means that the cost of innovation becomes a normal cost of operation. However, without the support of the highest levels of authority in an organization, innovation will fail. Sometimes it is due to conflicting views, other times because of limited resources, but many times failure will happen because of a simple resistance to change, which includes attitudes that emphasize 'not on my watch' or 'not in my department.'

In order to find international examples of organizations that have embarked on significant change to be successful let us first look at the Danish example as an illustrative case study. In 1988, six legacy Danish marine institutions related to shipbuilding, ship repair, marine technology, etc., merged to become a new organization called the Danish Maritime Authority (DMA). It is a collaborative industrial association for Danish producers of maritime equipment and ships, and contributes to the success and competitiveness of the maritime industry by advocating on behalf of the industry, as well as providing members, public authorities and the media with information about the maritime sector.

As an industrial association, in general, the DMA provides customers and clients with products and solutions that conform to agreed legislation, and anticipates future demands within the industry to allow its members to be better prepared to innovate and accept risk as they develop their businesses. It promotes cooperation among member businesses and established a centre of knowledge, which features current information and opportunities for networking.

The DMA sees innovation as an important driver for greater interaction. For a significant number of maritime enterprises,

user-driven innovation is the dominant element. Here, it is the dialogue between suppliers and the customer that contributes to the development of processes and products. In other areas, emphasis is on research-driven innovation – where research is the focal point. There are many examples of these types of innovation, but there is a need for further enhancement. Most notably, organizations like DMA urge businesses in the maritime sector to develop the right skills for their tradespeople, if they are to continue to be able to operate successfully. They see the development of the people in the industry as one of the key enablers to managing innovative processes.

The DMA is the result of a top-down governmental insistence for change and innovation. This major reorganization resulted in a merger and resetting of priorities, which are expressed in a coherent strategic planning framework.

On this side of the Atlantic, there is the similar example of the US National Shipbuilding Research Program (NSRP), a collaboration of US shipyards working together to reduce the cost of building, operating and repairing US Navy ships by improving productivity and quality through advanced technology and processes. NSRP leverages public/private cooperation to manage cost-shared research and development based on a consensus-agreed Strategic Investment Plan.

The founding NSRP began as a research and development program in 1971 under the guidance of MARAD (US Maritime Administration). The program's initial goal was to respond to the direction given to the Secretary of Commerce in the *Merchant Marine Act* of 1970 to collaborate with shipbuilders in developing plans for the economic construction of vessels. Since its inception, the NSRP's goals have remained the same: to reduce production costs; and to accelerate delivery schedules through improved shipbuilding methods. The funding for the NSRP slowly grew with enhanced industry and academic engagement.

However, as a cooperative arrangement among companies in the United States, the NSRP has more limited objectives than government-mandated organizations such as the DMA. As a result the NSRP authorities have devolved reform to a looser associational construct. This more open approach has proved to be sufficient for the needs of US shipbuilding companies.

This discussion begs the question – does Canada need a shipbuilding research organization? If so, what would it look like? Here is what some Canadian experts have suggested a shipbuilding research organization should be able to do:

- provide a knowledge base;
- create new knowledge;
- link with other knowledge sources;
- demonstrate skill in knowledge application;
- develop or access analytical skills; and
- lead in advance of analysis and design.

In such a large country as Canada we have a broad physical distribution of our ocean clusters so we may have to adopt a model that is as open and flexible as the United States has done for its shipbuilding organization. At present in Canada the ocean research clusters have primarily focused on science and technology, mainly environmental studies, but defence and security, and marine transportation could be recognized as major sectors in time as the shipbuilding industry matures. Canada's model could comprise clusters (geographic concentrations) and also nodes (distributed networked sites). Whether such an organization in Canada should be virtual or real is also the subject of discussion. Clusters take advantage of local concentrations of skills and infrastructure while nodes are widely distributed and connected into virtual organizations. Cost is also a major factor and figures into any decision to adopt either approach. In the

case of Halifax, a major oceans cluster exists here and it is lauded by governments (federal, provincial and municipal), industry, academia and others. We are well down the road towards cluster development in ocean sciences with the creation of the Institute for Ocean Research Enterprise (IORE) at Dalhousie University.

For Canada, as shown in other international examples such as DMA and NSRP, collaboration is essential to encourage continuous innovation. And clearly Canada's national shipbuilding industry would benefit from an industrial association as marine industries and suppliers begin to grow in response to the strategy laid out in the NSPS.

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These two presentations addressed the need to sustain the shipbuilding workforce in place once it has been created. This is a vital topic given that the NSPS is envisaged to stimulate over 30 years of shipbuilding work. However, it has been a long time since Canadian shipyards have operated at full employment, and the concerns about retaining a workforce for generations have not been examined very often. These last two presenters provided some helpful context on this topic but clearly much more research will need to be undertaken to get a better appreciation of how to sustain the NSPS workforce through the life of the shipbuilding planned under the NSPS.

Workshop Program of Events

0800 - 0815. Introduction and Welcome

0815 - 0915. **Panel 1**
Building Human Capital: Skills Development
Chair: Professor Ken Hansen, CFPS Fellow
In this panel government officials, representatives from academic institutions and training experts will discuss how they can contribute to the development of the labour force necessary to undertake the demands of shipbuilding.

- **Dr. Ronald Pelot**, Industrial Engineering and Associate Scientific Director, MEOPAR, Dalhousie University
- **John Somers**, Senior Executive Director, Labour and Advanced Education, Province of Nova Scotia
- **Rosaline Penfound**, Vice-President, Academic, Nova Scotia Community College
- **Dr. Roddy Warnock**, Senior Instructional Designer, Bluedrop Performance Learning

0915 - 1000. Moderated Q&A Session for First Panel

1030 - 1130. **Panel 2**
Maritime Crewing Concepts: New Trends
Chair: Commodore (Ret'd) Dr. Eric Lerhe, CFPS Fellow
This panel will explore novel approaches that navies and ship designers are undertaking to optimize the crewing of their fleets and how these concepts may influence the ship designs for the new classes of government fleets under the NSPS.

- **Dr. Renée Chow**, Defence Research and Development Canada
- **Lieutenant-Commander Ramona Burke**, Director Naval Personnel and Training 5-3: Future Fleet
- **Bernd Kulmus**, Proposal Manager CSC, ThyssenKrupp Marine Systems of Germany
- **Nelly Chouvy**, Defence Scientist, Directorate General of Armaments, France

1130 - 1215. Moderated Q&A Session for Second Panel

1330 - 1430. **Panel 3**
Sustaining Human Capital
Chair: Dr. Dan Middlemiss, CFPS Fellow
In this panel representatives from industry will examine the issues associated with building and retaining the 30+ year workforce necessary to complete the shipbuilding in the NSPS.

- **Brian McCarthy**, VP Human Resources, Irving Shipbuilding Inc.
- **Duff Montgomerie**, Deputy Minister, Labour and Advanced Education Province of Nova Scotia
- **VAdm (Ret'd) Peter Cairns**, Shipbuilding Association of Canada
- **Ken Hansen**, Centre for Foreign Policy Studies

1450 - 1535. Moderated Q&A Session for Third Panel

1550 - 1610. Workshop Closing Remarks

About the Workshop Presenters and Chairs

Vice-Admiral Peter Cairns
Vice-Admiral Peter Cairns (RCN, Retired) is the President of the Shipbuilding Association of Canada, as well as Director of Business Development in the Aviation Services Division of SPAR Aerospace. VAdm. Cairns retired from the Canadian Navy in 1994 after 37 years of service, during which he commanded the navy and the navy's Pacific Fleet. He is a qualified submariner and his commands include one submarine, a submarine squadron, two frigates, and a frigate squadron. VAdm. Cairns' international experience includes serving as Assistant Chief of Staff Operations to the Supreme Allied Commander Atlantic in Norfolk, Virginia, and tours with the US Navy, the Royal Navy and NATO's maritime staff. VAdm. Cairns is a graduate of the US Naval War College, a member of the Naval Officers Association of Canada, and a Senior Research Fellow with the Canadian Institute of Strategic Studies.

Nelly Chouvy
Nelly Chouvy entered the French Ministry of Defence (DGA) as a Human Factors Engineer in 2002. She has been working for many years on military shipbuilding programs on the topic of crewing. She actively participated in research that was designed to place humans at the centre of the design when optimizing warship crew size. This has become a major research topic for the French Navy since the beginning of the 21st century. Her

research was relied upon heavily during the design and eventual contracting of the build for the French FREMM-class frigates.

Renée Chow
Dr. Renée Chow received a MS in Industrial and Systems Engineering from the Ohio State University in 2000, and a PhD in Mechanical and Industrial Engineering from the University of Toronto in 2005, specializing in human factors engineering. She joined DRDC Toronto as a Defence Scientist in 2004, and is a member of the Human Systems Integration section. Her research interests include cognitive work analysis, computer-supported collaborative work, and human systems modeling and simulation. Her current projects address navy crew generation analysis, critical control spaces for naval platforms, impact of automation on navy crewing, and joint command and control and intelligence. Dr. Chow is also an Adjunct Assistant Professor in the Department of Systems Design Engineering at the University of Waterloo, and has taught undergraduate and graduate level courses in the design of human interfaces for complex systems.

Major Tim Dunne
Major Tim Dunne (Retired) is a communications consultant, lecturer, writer and practitioner with more than 40 years Canadian and international experience. He is a professionally accredited, award-winning communicator, international public affairs instructor and educator, and a consultant for senior representatives of government and international agencies.

Ken Hansen
Ken Hansen was the Military Co-Chair of the Maritime Studies Program at Canadian Forces College in Toronto before holding the Naval Defence Fellowship at Dalhousie. Retired from the navy in 2009, he joined CFPS as a Resident Research Fellow and

lecturer before appointment as Adjunct Professor in Graduate Studies (Department of Political Science) in 2013. Ken is a member of the Science Advisory Committee for International Oceans Research Enterprise, a member of the Security Affairs Committee for the Royal United Services Institute, a member of the Editorial Board of *Canadian Naval Review* and the moderator for *Broadsides*, the online discussion forum of the journal. His research includes joint and interagency maritime security theory and doctrine, planning processes and logistical requirements. He received numerous naval service and literary awards, plus a Commendation from the City of Edmonton Police Department.

Bernd Kulmus

Bernd Kulmus is Proposal Manager at ThyssenKrupp Marine Systems GmbH. After graduating from high school, he enlisted in the German Navy, first as a draftee, and later as a career officer. He holds a Masters degree in Electrical Engineering from the University of the Federal Armed Forces in Munich. After graduating from university in 1990, he joined an air warfare destroyer as an operations officer and subsequently served as an electronic warfare officer. In 1998 he joined Blohm + Voss shipbuilders as a systems engineering manager, and then as the deputy project manager of the F124 project and proposal manager. During the proposal phase of F125 in 2005, he was involved in establishing the concepts that apply for F125.

Commodore Eric Lerhe

Commodore Eric Lerhe (RCN, Retired) joined the Canadian Forces in 1967 and was commissioned in 1972. From 1973 until 1983 he served on HMCS *Restigouche*, *Yukon*, *Fraser* and *Annapolis*. He was promoted to Commander on 1 January 1986, and assumed command of HMCS *Nipigon* in September 1987

and then HMCS *Saguenay* on 6 January 1989. During the 1990s he served as Director Maritime Force Development and Director NATO Policy in NDHQ. He earned his MA at Dalhousie in 1996 and was promoted to Commodore and appointed Commander Canadian Fleet Pacific in January 2001. Commodore Lerhe retired from the CF in September 2003 and commenced his doctoral studies at Dalhousie. His dissertation was published by the Centre for Foreign Policy Studies as *At What Cost Sovereignty? Canada-US Military Interoperability in the War on Terror*. His other interests are defence policy, NATO, the three-dimensional approach and general naval issues.

Brian McCarthy

As Vice-President of Human Resources at Irving Shipbuilding, Brian McCarthy is responsible for the systems, processes and programs that support the company's growing workforce. Much of his focus in the immediate future will be on the strategic growth and development of the Irving Shipbuilding team as it moves into the production phases for Canada's next naval combat ships as well as firmly establishing the company as a global shipbuilding employer of choice. Brian joined Irving Shipbuilding in 2012, relocating from Houston, Texas, where he held the position of Executive Director, Human Resources for Sysco, a distributor of food service products. Brian had been with Sysco since 2005 and brought to Irving his experience in HR strategy, operations, systems and programs as well as leading a team that supported more than 75 operating companies across the United States and Canada. No stranger to the Maritimes, Brian served as Human Resources Manager for Kent Building Supplies in Saint John, NB, from 2001 to 2005, and prior to that worked with both the Atlantic Health Sciences Corporation and the City of Saint John. He is a graduate of Saint Mary's University and also has an MBA from McGill.

Danford W. Middlemiss

Dr. Danford W. Middlemiss was educated at the University of Toronto (BA: 1967; MA: 1968; PhD: 1976). From 1973 to 1976 he was engaged in Canadian maritime enforcement studies with the Institute of International Relations at the University of British Columbia. From 1976 to 1981 he was Director of the Centre for Strategic Studies at the University of Alberta. Since 1981, he has been with the Department of Political Science, Dalhousie University, and attained the rank of Full Professor in 1993. From 1987 to 1993, and again from 2005 to 2008 he served as the Director of the Centre for Foreign Policy Studies at Dalhousie University. Today he serves as a Senior Research Fellow at the CFPS and is a member of the Editorial Board of *Canadian Naval Review*.

Duff Montgomerie

Duff Montgomerie was appointed Deputy Minister of the Nova Scotia Department of Labour and Advanced Education on 28 April 2014. Prior to this appointment Mr. Montgomerie had been Deputy Minister of Natural Resources since January 2011 and before that he served as Deputy Minister of Health Promotion and Protection, March 2007 to January 2011, where he previously served as the department's Assistant Deputy Minister. Mr. Montgomerie was also one of the co-chairs of the Federal/Provincial/Territorial Conference of Health Deputies and co-chair of the Federal/Provincial/Territorial Conference of Physical Activity Sport and Recreation Deputies. For the last number of years, he has also been a steering committee member of the Reforming States Group sponsored by the Millbank Memorial Fund. Mr. Montgomerie has also served as the Executive Director of the Nova Scotia Sport and Recreation Commission, was the first full-time Director of the Nova Scotia School Athletic Federation and was a member of the Canada Games Council

Board of Directors. In addition to his significant provincial government experience, he has worked with the Central Nova Tourism Association and been in the real estate business. He has a Physical Education Diploma from the Nova Scotia Teachers College and began his career as a physical education teacher in his native Bridgetown in the Annapolis Valley. He remains active in the sports world as a basketball referee at the community and school level.

Ronald Pelot

Dr. Ronald Pelot is a Professor in the Department of Industrial Engineering at Dalhousie University, and the Associate Scientific Director of the MEOPAR National Centre of Excellence. In 1997, he founded the Maritime Activity and Risk Investigation Network (MARIN) at Dalhousie, and since then his team has developed new software tools and analysis methods to apply to maritime safety (accidents), coastal zone security and marine spills. Courses taught include project management, engineering economics, human factors, industrial psychology, systems engineering, operations research, and decision and risk analysis. With respect to training, he is also the Assistant Dean of Co-op in Engineering.

Rosalind Penfound

Rosalind Penfound joined the Nova Scotia Community College in the fall of 2013 as Principal for the IT and Akerley campuses. In February of 2014 she was appointed Vice-President Academic. Prior to coming to NSCC, Rosalind was a Deputy Minister in the Nova Scotia Public Service, including terms as Deputy Minister of Immigration, Environment and Labour, Agriculture, Fisheries and Aquaculture, the Public Service Commission and Education. Earlier in her career she worked with the Nova Scotia Department of Natural Resources, was a solicitor with the

Council of Maritime Premiers, served as Executive Director of the Association of Nova Scotia Land Surveyors and briefly practiced law. Rosalind holds degrees in Physical Education and Law from Dalhousie University and was a part-time member of the Faculty of Law for almost 20 years. Through her senior leadership roles she has gained experience in operational, fiscal and human resource management, as well as leading change in large, complex organizational environments. Rosalind is committed to NSCC's mission: building Nova Scotia's economy and quality of life through education and innovation.

John Somers

John Somers joined the Nova Scotia Department of Labour and Advanced Education (LAE) as Senior Executive Director, Skills and Learning Branch in August of 2013. His current responsibilities include the Employment Nova Scotia, Workplace Initiatives, Adult Education Divisions of the Department, as well as Youth Initiatives, and the Volunteerism and Non-Profit Sector Division. He joined the Nova Scotia Public Service in 1990, serving in progressive management positions in the tourism portfolio, including Executive Director of Tourism. Prior to joining LAE, John worked as a Senior Corporate Policy Analyst in the Office of Policy and Priorities, a central agency of government.

Roddy Warnock

Dr. Roddy Warnock is Senior Instructional Designer at Bluedrop Performance Learning. Roddy's twin interests of the oceans and education have propelled him from a Bachelor's degree in Zoology (First, Trinity College, Dublin) to studying coral reefs in Jamaica (MPhil, University of the West Indies) and oceanic phytoplankton in Canada (PhD, Dalhousie University). Research involving satellite remote sensing of the sea (University of

Groningen, the Netherlands), the commercial cultivation of seaweed in Nova Scotia, and lecturing at Dalhousie followed. Throughout, Roddy maintained an abiding interest in teaching and how people learn. Serendipity intervened 20 years ago with an opportunity to help create CD-based interactive multimedia resources for inclusion in science textbooks. With overall responsibility for the conceptualization, design and development of instructional multimedia products, Roddy helped create dozens of educational products targeting high school and undergraduate students. With the arrival of the Web, Roddy formed Jigsaw Interactive and created a number of web-based virtual experiments in science, mostly in chemistry and astronomy. Four years ago, Roddy joined Bluedrop Performance Learning to focus on the instructional design of training systems. Roddy is responsible for identifying training performance requirements, specifying instructional strategies, defining lesson content and learning guidance, creating learning materials, designing learning assessment instruments, and evaluating training programs. Roddy has worked on many DND programs and most recently has been supporting the analysis and design of the Arctic Offshore Patrol Ship Training Program.

Commander Ian D.H. Wood

Commander Ian D.H. Wood has been the Defence Fellow at Dalhousie University's Centre for Foreign Policy Studies since 2013. He has over 30 years of service in the Royal Canadian Navy and has served both at home and abroad in Command, Staff and Policy Advisor positions. He is departing the Centre in the summer of 2015 for Assistant Naval Attaché duties in the Canadian Embassy in Washington DC.

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