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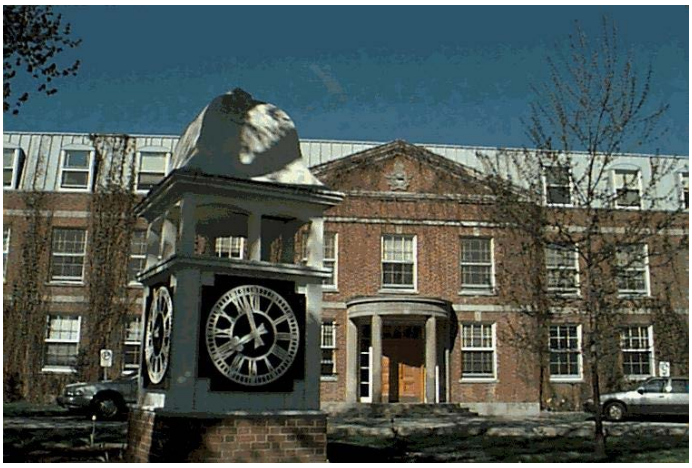

# A RECOMMENDATION TO ACHIEVE AN OPTIMISED CREW FOR THE CANADIAN SURFACE COMBATANT

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## JCSP 45

## Service Paper

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JCSP 45/PCEMI 45
15 October 2018/15 octobre 2018

DS545 Component Capabilities/DS454 Les capacités des composants

SERVICE PAPER/ETUDE MILITAIRE:

# A RECOMMENDATION TO ACHIEVE AN OPTIMISED CREW FOR THE CANADIAN SURFACE COMBATANT

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Word Count: 2,510

Nombre de mots: 2 510

# A RECOMMENDATION TO ACHIEVE AN OPTIMISED CREW FOR THE CANADIAN SURFACE COMBATANT

## AIM

1. Navies are looking at ways to reduce the overall cost of their ships, as a result of the significant cost of recapitalising naval fleets. On the surface, the easiest way to cut expenses is to reduce crew sizes from traditional large ship crew concepts. This service paper will analyse the approach taken by the United States Navy (USN) Littoral Combat Ship (LCS) program to minimise the LCS crew. In Canada, the Arctic Offshore Patrol Vessel (AOPV) and Joint Support Ship (JSS) are too far down the design path to modify. Consequently, this service paper will focus on an RCN approach to optimise the crew size for the Canadian Surface Combatant (CSC) and to decrease the life cycle costs of the CSC ships in the RCN fleet.

## INTRODUCTION

2. The USN's view for its future fleet will be comprised of large surface combatants (destroyers and cruisers) and smaller surface combatants (frigates, mine warfare ships and patrol craft.[1] In 2001, Admiral Vern Clark, the Chief of Naval Operations, announced that the new surface combatant fleet would include a large multi mission destroyer (DD(X)) and cruiser (CG(X)) as well as "a small focused mission ship called the Littoral Combat Ship (LCS)."[2] It is important to point out that the LCS program will replace all USN small surface combatants and will be the first recapitalisation platform delivered for the USN. To reduce overall cost of their ships, USN senior commanders wanted the LCS platform to the "maximum extent possible, [to] employ reduced/optimal manning concepts."[3] The DD(X) program has a "key performance parameter to cut the new crew size by 60-70%" compared to the old destroyers the program is replacing.[4] Similarly, reduced crewing became a key driver for the LCS program with Admiral Clark. He "expected LCS builders and designers to justify each person in the crew and push for the minimum manning possible."[5]

3. The RCN will recapitalise its fleet under the National Shipbuilding Strategy (NSS). The Canadian Government committed to the NSS in 2010 and to the delivery of three new platforms to RCN: the AOPV, JSS and CSC.[6] Given the price tag associated with RCN's delivery of the future fleet, attention to total ownership costs will become increasingly important to analyse as will efforts to control personnel costs. Similar to the USN, the RCN has started to look at how to

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[1] O'Rourke, Ronald. "Navy Littoral Combat Ship (LCS) Program: Background and Issues for Congress". (Congressional Research Service file: 7-5700, 16 August 2018), 1.

[2] Work, Robert., "They Littoral Combat Ship: How We Got Here, and Why,". (Undersecretary of the Navy, file: OMB No. 0704-0188, 2014), 3.

[3] Ibid, 18.

[4] Report to Congressional Requesters. "Military Personnel: Navy Actions Needed to Optimize Ship Crew Size and Reduce Total Ownership Costs". (US Government Accounting Office, file: GAO-03-520, 9 June 2003), 3.

[5] Work, Robert., "They Littoral Combat Ship: How We Got Here, and Why,", 18.

[6] Public Service and Procurement Canada. "National Shipbuilding Strategy", Last modified [or accessed] 11 July 2017. https://tpsgc-pwgsc.gc.ca/app-acq/amd-dp/mer-sea/sncn-nss/apropos-about-eng.html, 1-4.

minimize the crew for AOPV as well as for JSS. Defence Research and Development Canada (DRDC) was tasked by Director Naval Personnel and Training (DNAV P&T) to support crew reductions for AOPV and JSS. Since 2010, DRDC has worked closely with the RCN to develop a decision tool to analyse the reduced crew numbers allotted for AOPV and JSS and has developed the Simulation for Crew Optimization for Risk Evaluation (SCORE) program to support this task for AOPV and JSS.[7]

## DISCUSSION

4. In 2000, the US Naval Research Advisory Committee found that 70% of a ship's total cost of ownership is tied to operations and support (personnel, maintenance, consumables and support).[8] Furthermore, 51% of this operational and support cost is associated with personnel, meaning that a reduction in crew size could offer large savings to ship procurement.[9] The US General Accounting Office determined that decisions on requirements made early in the design phase will lock in 80-90% off the total ownership costs.[10] Given this finding, ship design and project teams should take personnel into account for not only life cycle costs, but more importantly at the onset as a design driver.[11]

5. As describe above, a ship's crew size is one of the largest drivers of overall cost of ships. Given the requirement on navies to reduce total life costs, crewing is the easiest way to reduce these costs. If crew size is over estimated in the design phase, then design and build costs inflate due to accommodation costs.[12] If crew size is under estimated, then the platform may fall short in operational capability and feasibility which could lead to delays/cost increase due to design changes to correct it.[13] Therefore, it is imperative to get the crew size correct from day one of the ship design program.

6. A key factor to support the correct crew size is using a human systems integration (HSI) approach to optimise ship crew size and reduce overall costs for new ship systems.[14] An optimised crew is not simply a reduction in crew members in favour of technology, an "optimised crewing for ships refers to the minimum crew size consistent with the ship's mission, affordability, risks, human performance and safety requirements."[15] In order to optimise how a navy employs its personnel, HSI uses a system engineering approach to evaluate which functions should be performed by the crew versus technology. When used early and properly HSI can

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[7] Chow, Renee, Cdr Ramona Burke, LCdr Dennis Witzke. "A Systems Approach to Naval Crewing Analysis: Coping with Complexity*"*. *Canadian Naval Review*, vol 11, no. 16 (2016), 17.

[8] Naval Research Advisory Committee Report. "Optimized Surface Ship Manning". (Office of the Assistant Secretary of the Navy, Report No. NRAC 00-1, April 2000), 19.

[9] Ibid, 19.

[10] Report to Congressional Requesters. "Military Personnel: Navy Actions Needed to Optimize Ship Crew Size and Reduce Total Ownership Costs", 5-6.

[11] Ibid, 7.

[12] Chow, Renee, Cdr Ramona Burke, LCdr Dennis Witzke. "A Systems Approach to Naval Crewing Analysis: Coping with Complexity*"*. (*Canadian Naval Review*, vol 11, no. 16 (2016)) ,16,17

[13] Chow, Renee, Cdr Ramona Burke, LCdr Dennis Witzke. "A Systems Approach to Naval Crewing Analysis: Coping with Complexity*"*, 16,17.

[14] Report to Congressional Requesters. "Military Personnel: Navy Actions Needed to Optimize Ship Crew Size and Reduce Total Ownership Costs", 8,9.

[15] Ibid, 8.

minimize personnel requirements, along with workload while maximising gains from technology.[16] Assistant Secretary of the Navy stated, "failure to incorporate HSI approaches can only lead to increasing manpower costs in the future what will threaten the ability of the Department to sustain the transformation, readiness and investment priorities we have established."[17]

**Littoral Combat Ship (LCS) Project**

7. The LCS would be the first ship delivered under the USN recapitalisation plan and many new USN key performance parameters envisioned for the USN's future fleet were to be employed on the LCS. One of the key performance factors for the LCS project was to reduce total life costs, in doing this the USN wanted to employ minimal core crew concepts as well as employ module mission crews to maximise effectiveness.[18] Admiral Clark directed a core crew of 30 to 50 for LCS which was largely based on his idea that innovation and technology would drive crew numbers down from the traditional frigate crews of 170. The Preliminary Design Interim Requirements documents set the LCS crew was set at 75; a core crew of 40, an aviation crew of 20 and a 15-person mission module detachment.[19] The LCS project team's objective was to keep the crew at no more than 75. Admiral Clark believed that this aggressive target would drive industry to use automation as much as possible in order to drive down core crew numbers and overall life cycle costs.

8. With this initial minimalist crew concept set for LCS, the "supporting off-board for logistical, maintenance and training would be absolutely critical" to the success of such a reduced crew.[20] Therefore, LCS crews were to be fully trained ashore prior to joining the ships as there was no ability to conduct on the job training. The LCS would not have any logistical capabilities on board, "and a limited ability to conduct maintenance at sea; instead, it would rely heavily on shore-based support, including flyaway maintenance teams made up of contractors flown in to conduct scheduled maintenance".[21] To meet the maintenance requirements the LCS was to follow a rigid schedule of a five day preventative maintenance port visit every 25 days at sea as well as a two week intermediate maintenance period every 120 days.[22] Navy planners knew that these numbers were aggressive, and the project was content to let LCS Flight 0 iron out the details and then make adjustments based on the experience operating with Flight 0 ships.[23]

9. From the experience of the first USS FREEDOM (LCS 1) deployment the USN decided to increase the size of the core crew from 40 to 50 due to crew fatigue and crew readiness and

[16] Ibid, 9.

[17] Ibid.

[18] Report to Congress. "Littoral Combat Ship Manning Concepts". (Department of Defense OPNAV – Surface Warfare, file: RefID: 4-7F8BB29, July 2013), 2.

[19] Report to Congress. "Littoral Combat Ship Manning Concepts", 3.

[20] Work, Robert., "They Littoral Combat Ship: How We Got Here, and Why", 18.

[21] Report to Congressional Committees. "Littoral Combat Ship: Deployment of USS Freedom Revealed Risks in Implementing Operational Concepts and Uncertain Costs". (US Government Accounting Office, file: GAO-14-447, July 2014), 5.

[22] Ibid, 45.

[23] Work, Robert., "They Littoral Combat Ship: How We Got Here, and Why", 18.

performance levels.[24] Even with the additional 10 core crew members, on FREEDOM's second deployment the crew had to depend heavily on the mission module detachment to stand watches, assist with training and maintenance.[25] Furthermore, the "core crew also relied heavily on the maintenance contractors embarked" to stand watches in the engineering spaces.[26] Even with the additional manning for the second deployment of FREEDOM, the crew was only able to average six hours of sleep per day, two hours below the navy standard.[27] Key members from the engineering and operations departments averaged even less than the average six hours of sleep.[28]

10. The initial vision for the LCS was to leverage innovation and automation in order to reduce crew numbers with an end state to lower total ship cost. As the Dean of the Center for Naval Warfare Studies stated, "perhaps the most serious objection to LCS is that the Navy charged into series production without having a clear idea of how the ship would be used."[29] The USN failed to apply HSI policy and direction from day one for LCS. By setting key performance parameters of a maximum 50 core crew and by using Flight 0 as its way to test its reduced crew assumptions, it did not allow flexibility to grow the core crew without having significant design change. The lessons identified from USS FREEDOM's deployments have not solved the problem of operating with a reduced crew in a high tempo environment. In 2013, the USN decided to increase the LCS permanent crew from 75 to 98.[30] The cost to modify LCS 3 and 4 is estimated at $600,000 to $700,000, to modify the remaining LCS hulls from the initial bulk buy is estimated at $6 million and funding for follow on ships will be addressed in future budgets.[31] In 2014, the LCS life cycle cost estimate was $79 million which is comparable to the more crew intensive DDG-51 Flight IIA of $88 million.[32]

**LCS Lessons Identified for Crew Reduction**

11. Looking at the USN's LCS project, two factors limited the USN from optimizing its crew for LCS. Firstly, was the failure of leadership to create the environment to apply HSI. It has become evident that HSI needs to be engrained in the project from the beginning of the design phase and throughout the build. If HSI experts were part of the project team, they would be positioned to support the Project Managers ability to leverage labour saving technology over holding down acquisition costs by using in-service systems without considering the through life costs.

12. Secondly, the support and sustainment framework required to support an optimised crew needs to be developed in conjunction with the delivery of the ship. The key component to managing crew workload and fatigue is to ensure effective policies are in place to guide the

[24] Report to Congress. "Littoral Combat Ship Manning Concepts", 3.

[25] Report to Congressional Committees. "Littoral Combat Ship: Deployment of USS Freedom Revealed Risks in Implementing Operational Concepts and Uncertain Costs", 39.

[26] Ibid, 41.

[27] Ibid, 38.

[28] Ibid.

[29] Work, Robert., "They Littoral Combat Ship: How We Got Here, and Why,", ii.

[30] Report to Congress. "Littoral Combat Ship Manning Concepts", 4.

[31] Ibid.

[32] Report to Congressional Committees. "Littoral Combat Ship: Deployment of USS Freedom Revealed Risks in Implementing Operational Concepts and Uncertain Costs", 25.

required training, maintenance and logistical support for reduced crews. As demonstrated with LCS, an optimised ship (crew) will fail without a robust policy and organisational structure in place to meet the operational demands of the ship by taking those demands away from the crew and enabling them to focus on mission tasks.

RCN Crew Reduction Approach

13. Comparable to the USN, the RCN has not embraced an HSI approach in regard to its crew reduction plan for its future fleet. The initial crew concept for AOPV was to be a small crew similar to a Maritime Coastal Defence Vessel crew of 35. Once the AOPV platform was selected and crew manifests were being developed by DNAV P&T problems were soon identified that the AOPV crew would not be able to operate the vessel with such a small crew. DNAV P&T contracted DRDC to support the RCN with crew optimisation for AOPV using their SCORE program. The crew numbers that SCORE generated fell between 45 to 65 personnel, in the end the RCN endorsed the 65-person crew.[33]

14. Similarly, JSS was mandated a core crew of 165 which was calculated by the two crews (500) of the two AORS divided by the three JSS that would be delivered by the project. Project Management Office JSS with DNAV P&T and DRDC used SCORE to generate a crew of 199 for JSS which would enable it to conduct its primary task of replenishing a task group at sea.[34] Both the SCORE validation of AOPV and JSS used current RCN doctrine, policy, regulations, Standard Operating Procedures (SOP's) and Tactics Techniques and Procedures (TTP's) to generate the respective crews. The AOPV and JSS crew studies did not use HSI experts to optimise crews by incorporating the use of technology and automation in the design of the ships.

## CONCLUSION

15. As Navies strive to recapitalise their fleets they will continue face further pressures from their governments to reduce the overall cost of ships, in reducing the total life costs. The easiest approach taken by navies to achieve this has been to reduce the size of a ship's crew. As discussed above, reducing crew levels is easier said than done. If HSI principles are not followed from the start of the design phase through the build of the ship, then opportunities will surely be missed that could have leveraged technology and automation to support crew optimisation.

16. Furthermore, if Navies do not have a robust policy to effectively manage and sustain the logistical, maintenance and training requirements that fall out of an optimised ship, then the crew will be over tasked with additional responsibilities and this will hamper the operations of the ship.

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[33] Chow, Renee, LCdr Burke R, CPO1 Labbe D, CPO1 Charest G, Lamb, Matthew. *Scientific Letter "Lessons Learned from a crewing options analysis in SCORE: The Arctic Offshore Patrol Ship (AOPS) case study*. (Defence Research and Development Canada – Toronto Research Centre: file DRDC-RDDC-2015-L100, 21 April 2015), 1,7.

[34] Burke, R, Charest, G, Chow, R, Labbe, D, Lamb, M, Okoh, R, Versteeg, T, Vince, R. *Scientific Letter "Joint Support Ship Crew Development.* (Defence Research and Development Canada – Toronto Research Centre: file DRDC-RDDC-2017-L315, October 17DRDC-RDDC-2017-L315, Scientific Letter "Joint Support Ship Crew Development, October 17), 1,3.

17. Finally, evidence suggest that total life costs will go up if HSI as well as operational support and sustainment concepts are not put into place before the ship is delivered primarily due to redesign work and additional crew numbers. More importantly than rising cost are the impacts on the crew due to increased workload and lack of support. These factors will contribute to fatigue and lower readiness and preparedness levels of the during operations. Unlike the USN's use of Flight 0 ships to correct shortcomings, the RCN will not be afforded that opportunity due to the limited amount of CSC ships being delivered, therefore, the RCN needs to put the time and effort in at the beginning of the platform design phase in order to optimise the crew before the majority of the systems are locked down.

**RECOMMENDATION**

18. If the RCN wants to maximise the opportunity to cut the total ownership costs of the CSC through optimisation of the platform then it must learn from the lessons of the LCS project. In order to effectively optimise the crew for CSC, it is recommended that the RCN apply the two main lessons identified from the LCS' procurement analysis for optimising crews.

19. First and most important, the CSC project should follow an HSI and a system engineering approach to reduce the crew numbers. HSI policy should be ingrained in all project documents, specifically the Statement of Operational Requirement and Project Charter, with the aim to empower the Project Manager and Project Director (PD). Furthermore, an HSI subject matter expert, with potentially a small detachment, should be part of the PD staff to coordinate with all RCN and Department of National Defence organisations to maximise resources and ensure all organisations are meeting the aim to optimise the crew of CSC.

20. Second, optimising ship crew size is not simply reducing numbers of sailors, but more importantly, it is referring to the "minimum crew size consistent with the ship's mission, affordability, risks, human performance and safety requirements."[35] Therefore, the RCN should give direction to all RCN logistics, training and maintenance organisations to commence the development of new RCN concepts, policy, doctrine, SOP's and TTP's that will be required to sustain an optimised CSC at sea. This process will be resource intensive, however as noted by the LCS project, if these mechanisms are not in place, then any optimised ship will not succeed.

Prepared for: VAdm M.F.R. Lloyd CRCN thru Cmdre S. Waddell DGNSR

[35] Report to Congressional Requesters. "Military Personnel: Navy Actions Needed to Optimize Ship Crew Size and Reduce Total Ownership Costs", 8.

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