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CAN THE ROYAL CANADIAN NAVY REDUCE TECHNICAL PERSONNEL ON SHIPS?

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AIM

1. This service paper aims to provide some analysis of the options available for the reduction of maintenance personnel onboard Royal Canadian Navy (RCN) Ships. This analysis will look at two different scenarios. These scenarios are: ships at sea, and ships alongside. This paper does not consider force protection requirements of vessels nor does it evaluate aspects of seamanship activities such as Replenishments At Sea (RAS), coming alongside manning, or the storing of ship. As such, manning needs must be evaluated against overall ship requirements when considering final manning levels. This paper also does not consider the financial requirements associated with any solutions provided. Each solution must be further evaluated to determine financial viability prior to implementation.

INTRODUCTION

2. The adequacy of current manning within the RCN is questionable. They could be adequate or insufficient dependent on the aspects being evaluated. During a period where organizations are struggling to attract exceptional individuals, an approach of reduced manning, without a concurrent increase in technological capability onboard, will result in overburdened sailors.[1] This could risk increased attrition. A consideration in the reduction of personnel must coincide with a lack of need. With the pace of technology evolving and a need to ensure that our ships remain capable around the clock, technical abilities onboard should not be reduced. There may be an argument for the need to

[1] Arvind Kumar, "Optimising Manning & Machinery," 308, no. 9 (Sep 05, 2012), 844. doi:10.1001/jama.2012.3179. http://dx.doi.org/10.1001/jama.2012.3179.

increase the technical abilities present onboard. An evaluation must be conducted for two scenarios: one being alongside and the other being at sea. These two scenarios provide for two very different options when maintenance and safety are considered. When considering the alongside options, if the correct investments are made, it is possible to have ships unmanned in homeport. The at sea option provides a very different scenario. While at first glance, it may appear as if a viable option might be the reduction of maintenance staff onboard, this translates to a reduced capability of the platform. To maintain capability, vessels must be designed with crew reduction in mind, without this capability will be lost.[2]

DISCUSSION

3. Current Halifax Class Frigates have a complex Integrated Platform Management System (IPMS). This system can monitor the situation in specific spaces and the status of some equipment. The lack of instrumentation prevents the system from providing full awareness of all areas of the ship and all equipment onboard. To date, there remains a need to ensure that personnel verify the situation in specific spaces and on specific equipment.[3] The lack of fitted sensors forces the need for rounds to be conducted.[4] With wifi fitted onboard, sailors can communicate around the world without leaving their posts, but they must do rounds on equipment that is less than 100m from their location due to lack of sensors.

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[2] Arvind Kumar, "Optimising Manning & Machinery," 308, no. 9 (Sep 05, 2012), 844. doi:10.1001/jama.2012.3179. http://dx.doi.org/10.1001/jama.2012.3179.
[3] Adrian Mascarenhas (Former IPMS System authority for the RCN), January 2021.
[4] Adrian Mascarenhas (Former propulsion systems manager for the RCN), January 2021.

4. HMCS Halifax, the first of the class, was launched in 1988 and commissioned four years later, making her 33 years of age from date of launch.[5] Given the design life of the Halifax Class is 30 years, as stated in the Halifax Class design intent documentation, the Weibull distribution, provided in Annex A, demonstrates the failures to be expected. This curve highlights the increase in failure that will occur during the current period of the life span of the vessel.[6] Some arguments suggest that a refit may shift some aspects of the curve, providing some respite from the expected failure increase. Annex B demonstrates the impacts that repairs have on the Weibull distribution. These effects would also be seen if these repairs were applied to the infancy stage of the Weibull Distribution. This, however, only applies when the refit addresses all aspect of expected failures.[7] Furthermore, with the equipment currently fitted for failure analysis on Halifax Class frigates, can only predict failures if vessels are operated within understood parameters. Unfortunately, the Royal Canadain Navy has been using Frigates, designed for operation in the North Atlantic, as the workhorse of the Navy. As a result, the vessels have been exposed to arctic temperatures as well as tropical conditions. Although the ships still adhere to the Weibull distribution curve regarding failure, operating outside the design intent will increase the rate of failure and be unpredictable. This result in a reduction of time for the vessel at reduced failure levels. This will also make it difficult to

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[5] Ken Macpherson and Ron Barrie, *The Ships of Canada's Naval Forces, 1910-2002*, 3rd ed. (St. Catharines, Ont: Vanwell Pub, 2002).
[6] Norisca Lewaherilla, Udjianna S. Pasaribu, Hennie Husniah, and Asep K. Supriantna, "A Preventive Maintenance and Minimal Repair Costs Model
with Interest Rate" 29 February 2016).
[7] Norisca Lewaherilla, Udjianna S. Pasaribu, Hennie Husniah, and Asep K. Supriantna, "A Preventive Maintenance and Minimal Repair Costs Model
with Interest Rate" 29 February 2016).

apply standard statistical failure analysis to the current systems as operational strains outside of the design intent have not been recorded.

5. Current vessels are plagued with hull and equipment issues. These issues impede the reduction in technical personnel onboard. Some ships platting problems are expected to be addressed during upcoming refits. Unfortunately, these repairs will only be patchwork solutions and not complete repairs.[8] This course of action could result in the need for more technical expertise within the hull domain. This will ensure that new stresses and fractures within the patchwork solution are understood. The most logical course of action to avoid the need for new technical expertise is to stand up a new refit project. The refit should address the issues persistently appearing within the fleet. This would ensure a complete solution rather than a patchwork solutions.

6. The introduction of a refit would also provide an opportunity to address the aging marine systems equipment currently present on the Halifax Class vessels.[9] In addition to increasing the reliability of the marine systems equipment, this would also provide an opportunity to ensure that technical personnel are reduced. To do this, the marine system refit must prioritize the reduction of manning. This would correlate to the implementation of more sensors and remote capabilities for the marine systems.[10]

7. With the reduction of maintenance personnel onboard, there will be a need for more connectivity ashore. This will ensure the same level of support is available to ships, despite the reduction in technical abilities onboard. Tools like Virtual Reality (VR) and Augmented Reality (AR) will help ensure general technicians have the abilities once only

[8] Adrian Mascarenhas (Former Halifax Class Program Coordinator), January 2021.
[9] Adrian Mascarenhas (Former propulsion systems manager for the RCN), January 2021.
[10] Adrian Mascarenhas (Former IPMS System authority for the RCN), January 2021.

held by specialists. Although these tools will help augment the generalist capabilities, they will be limited by the connectivity available. This is a possible solution, however, there are certain aspects of the current platform that require a specific level of skills to ensure the ship's plant is operational.[11] It is therefore essential these areas are upgraded. This will ensure a general technician can complete the service with or without the aid of AR.

8. The establishment of foreign repair locations may assist with the necessary service requirements. The Navy, or ADM(Mat), could establish sites in conjunction with the hub and spoke framework, currently being developed by CJOC. These locations will allow an increased level of support to deployed ships. There will still be a need for some level of experienced maintenance personnel onboard the ship. However, through the use of this field support model, it may be possible to reducer some technical abilities. The limitation is that this would require specific port visit schedules that coincide with equipment maintenance requirements.[12] Additionally, while there is always a need to conduct constant preventative maintenance (maintenance to prevent failures), there is an opportunity to relieve some preventative maintenance pressure, as well as corrective maintenance (maintenance to correct failures) pressure from ships staff by offloading this maintenance to ashore personnel. As it stands, there is currently excessive maintenance for ship staff to conduct.[13] This model provides additional maintenance personnel while removing the excessive burden from the crew.

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[11] Adrian Mascarenhas (Former propulsion systems manager for the RCN), January 2021.
[12] Ibid.
[13] Adrian Mascarenhas (Former propulsion systems manager for the RCN), January 2021.

9. Currently, the RCN conducts some level of ashore maintenance in foreign ports through the use of Technical Assistance Visits (TAV). The limitation of TAVs is, it shifts the pressure of personnel, from ship staff to the FMF. The establishment of foreign locations with technical capabilities would avoid this pressure. The use of an established location avoids the need to rush experienced personnel to an overseas location. Additionally, this could provide a revenue stream for the Navy. To ensure that the resources at these locations are effectively employed, they could be used by either: other elements, or other countries. This would ensure a level of diverse experience for personnel while contributing to alliances. The equipment experience gained from working in areas outside of RCN ships will better position Canada for assessment of future equipment. By knowing what is out there, Canada becomes a more informed client. The hands-on experience ensures that Canada has a good understanding of the limitations of new equipment.

10. The reduction on maintenance personnel is very different alongside and at sea. Both the at sea and alongside are problems of risk the alongside problem presents safety gaps rather than capability gaps.

11. While alongside, the lack of sensors in spaces leads to a level of risk. There are several possible ways to reduce this risk. To date, the approach has been to ensure that ship staff conduct rounds on the vessel. Another approach is to have ship staff monitor equipment remotely and only conduct necessary rounds. The third course of action could be to have the current IPMS system fed to a jetty connection and have all jetty connections monitored by a central location. Additionally, there would be a need to have

rounds conducted on ships while alongside in necessary spaces and on the necessary equipment.

12. This last option likely provides the most reasonable solution when considering the need for the reduction of personnel. Although this appears to be a simple solution, it is a complicated problem space. Personnel monitoring the central IPMS location must have a detailed understanding of each ship system, including the reasoning for any equipment states and current lockouts. Today, this would require a daily brief from ships staff to ensure the necessary communication. In the future, this communication should be conducted through detailed entries in either the Defence Resource Management System (DRMIS) or IPMS. The information must be conveyed accurately. It requires a uniform approach with no deviation. Additionally, the addition of IPMS cameras and sensors throughout each ship can reduce the requirement for rounds on platforms.[14] While the IPMS system can be upgraded, a good understanding of the overall requirements will ensure ADM(Mat) can preposition capabilities within IPMS. This will ensure that the necessary growth of the system is possible in the future.[15] Another risk mitigation approach can be taken to rounds conducted, that is through statistical analysis. Through the use of statistics, it will be possible to identify specific areas in each ship that require rounds. These locations will likely be different on each ship. This analysis would have to be updated daily to ensure accuracy.[16] Additionally, as the vessels age, there is a

[14] Adrian Mascarenhas (Former IPMS System authority for the RCN), January 2021.
[15] Ibid.
[16] Ibid.

likelihood that the necessary rounds will have to increase. This, once again, could be considered through the use of statistical data.[17]

13. There are benefits to having ship staff monitor the ship; that is, ownership of the issues. There is value in the level of care that the ship staff will provide to equipment when compared to non-ship personnel. Additionally, ship staff can address issues immediately and are likely better suited to address these issues. The counter is that a trained team stationed ashore would meet the need should an issue arise. While practical in theory, each ship has specific nuances. The ashore team may have the technical ability but these nuances may elude them. Additionally, having ship staff available ensures that personnel are available to combat a flood situation should it arise. While the dockyard fire department is available to combat a fire, should one arise, there is no established team to address floods.

14. Ship staff also provide the benefit of efficient and effective boundaries. Some may argue that the ship personnel need to improve their knowledge on the duties of a boundary. That said, military personnel are the only ones available that can act as an individual boundary. The logic behind the establishment of a boundary is that they prevent a fire from spreading throughout the ship, thus containing the fire.[18] This level of containment could be accomplished using fitted systems. However, with the lack of fitted systems installed, the next most effective option is a sailor with a hose. As with the flood, the establishment of a shore facility to provide boundaries in the event of a fire may mitigate the need for ship staff. Once again, the level of familiarity with the ship may be

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[17] Norisca Lewaherilla, Udjianna S. Pasaribu, Hennie Husniah, and Asep K. Supriantna, "A Preventive Maintenance and Minimal Repair Costs Model with Interest Rate" 29 February 2016) P 3-4.

[18] Department of National Defence, C-03-005-032/AA-001, *Damage Control Manual* (Ottawa: DND Canada, 2012).

the issue in this area. To ensure effective boundaries, there will be a need for the training of ashore personnel, in all classes of ships and equipment.

15. Both the introduction of a flood team and shore-based boundaries will require training in these areas. Perhaps this will ensure the effectiveness of the teams as they will have a dedicated set of expertise. The counter is that there is a possibility that their breadth of experience as a sailor will be limited. Would the establishment of a trade for these specialties ensure a level of accuracy? Perhaps these positions could be treated as the guard trade within the United Kingdom services. Could this type of force also act as an augmentation to the base security force?

CONCLUSION

16. If there is a desire to reduce the number of technical personnel onboard Halifax Class ships, there is a need to ensure that systems and equipment are upgraded to reflect the change. It will not be possible for the Halifax Class to continue operating in its current configurations with reduced maintenance personnel. However, if the modernization of the marine systems equipment is conducted while considering the need to reduce technical personnel onboard, it may be possible. Overall the current Halifax class has not been designed for a reduced maintenance crew, to accomplish this significant investments in equipment must be made. Technicians provide a capability to Commanding Officers (CO). By reducing technical abilities without the necessary technical upgrades, COs will lose capability within their vessels.

RECOMMENDATION

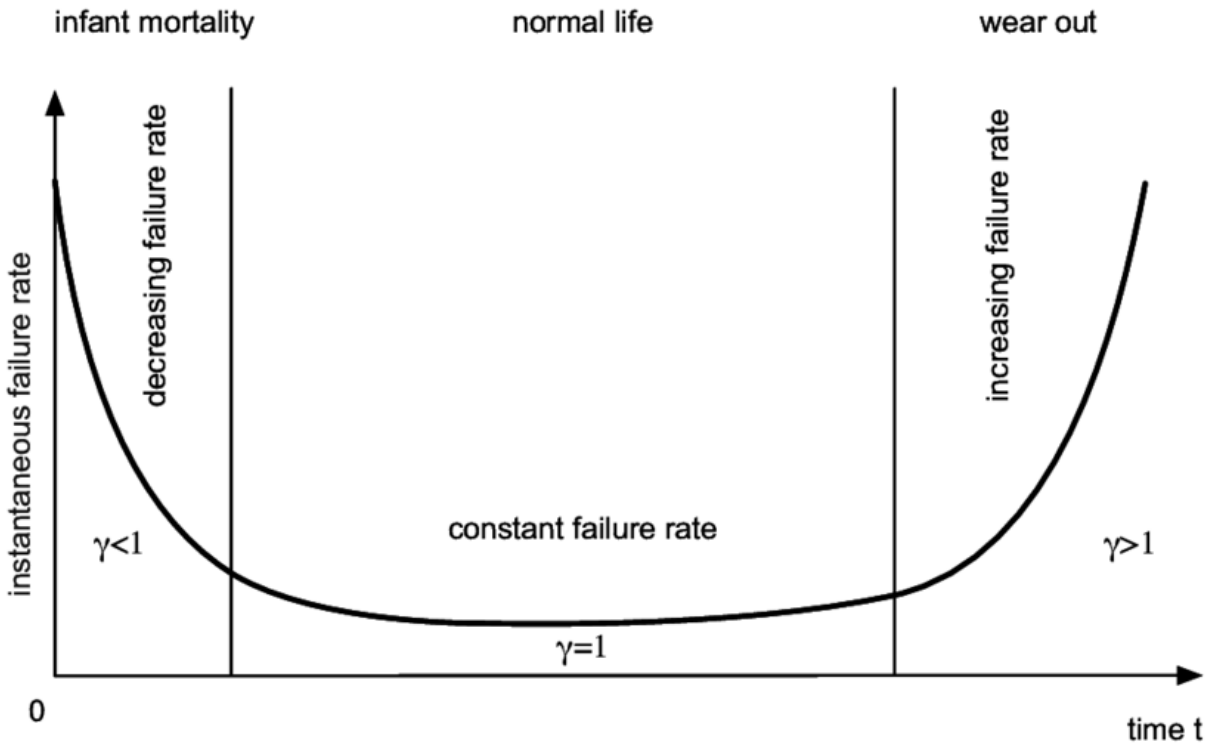
17. It is recommended that the Royal Canadian Navy investigate methods that will augment the capabilities of general technicians. These tools can be used in many aspects to ensure certain abilities always reside with ship staff. The idea of the augmentation of

ships staff through established port capabilities will have tremendous value. It would augment the abilities of general technicians without the addition of personnel to the ship. There is an opportunity to leverage abilities with CJOC as they develop the Hub and Spoke model. The Navy should investigate the viability of a joint venture in this area. Without investment, the RCN should not reduce technical staff onboard. With the right investments, the RCN could gain capability while reducing personnel posted to ship.

Annex(es): A. Weibull distribution

B. Effects of Repairs on the Weibull Distribution

Annex A – Weibull Distribution Curve



Annex B – Effects of Repairs on the Weibull Distribution

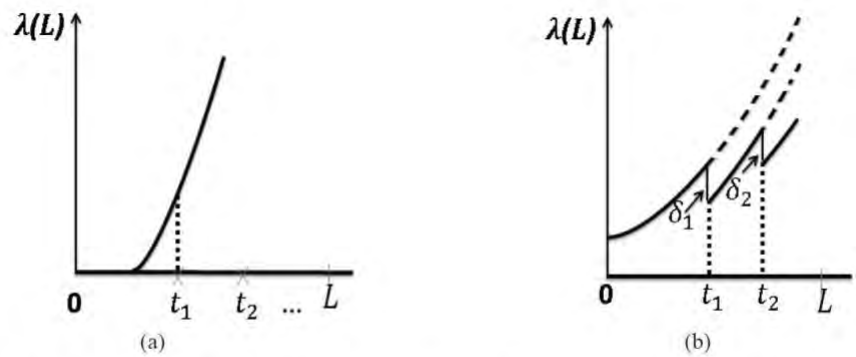


FIGURE 2. Failure rate for minimal repair (a) shows the rate before and after repairs have not changed. Correction indicated by dotted lines. While (b) shows the imperfect PM actions. The function of the intensity of the failure is nondecreasing, and will be reduced along δ current PM is done (taken from [1]).

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