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NAVAL TECHNICAL OFFICERS: A JUICE NOT WORTH THE SQUEEZE

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By Lieutenant-Commander R.M. Verbenkov

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> *A number of post-command senior MARS officers were asked what it was they wanted in an engineering department head, and in every case they said they wanted an officer who possessed the leadership and management skills to lead a department.*
>
> - RAdm (ret'd) Pat Finn, RAdm (ret'd) Simon Page, and LCdr Randy Comeau, *MARE 2020: Models for the Future of the Maritime Engineering Occupation*

INTRODUCTION

Within the Royal Canadian Navy (RCN), the Naval Technical Officer (NTO) community is comprised of Naval Combat Systems Engineers (NCS ENGs) and Marine Systems Engineers (MS ENGs) at the rank of Lieutenant-Commander (LCdr) and below, and Naval Engineers at the rank of Commander and Captain (Navy). Over the years, NTO technical credibility has eroded. They are no longer considered subject matter experts and have since become managers of technical trades. With technical depth now provided by Non-Commissioned Members (NCMs) or public servants, it is difficult to justify the lengthy and technical focus of NTO training. Canada's Defence Policy states:

> Striving to continually improve efficiency and effectiveness, we will work tirelessly to modernize the business of defence. A modern "business of defence" maximizes operational output and ensures that every defence dollar is put to the best use in achieving our objectives.[1]

Following this lead, the RCN would be remiss not to consider alternate NTO occupation structures.

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[1] Department of National Defence, *Strong Secure Engaged: Canada's Defence Policy* (Ottawa: DND Canada), 74.

By comparison, the USN employs Surface Warfare Officers (SWOs), the equivalent of Naval Warfare Officers (NWOs), to serve as Engineering Head of Departments (HoDs) on USN ships. Further, the USN has a career path for SWOs to transition to Engineering Duty Officers (EDOs) to support their ships from shore-based positions. Exploring how the USN employs SWOs will show that the RCN could benefit from adopting a similar structure. This paper will compare the roles and responsibilities of RCN NTOs to the USN model to offer a more effective and efficient occupation structure for the RCN. With a recent Problem Definition Paper in April 2019 directing an Occupational Analysis for NTO occupations, this paper is timely and should be given due consideration when examining the future of NTO occupations.[2]

NAVAL TECHNICAL OFFICERS ROLES, RESPONSIBILITES, AND TRAINING

On board Her Majesty's Canadian (HMC) Ships, Engineering HoD positions are filled by MS and NCS ENGs and, in accordance with the Naval Engineering Manual (NEM), they:

> …shall be the recognized onboard technical authorities for equipment and systems in their charge. They are responsible to the Commanding Officer for the technical readiness, and safe and efficient operation of the equipment and systems in their charge. The [Engineering HoDs] must ensure that their departments are suitably organized, manned, and capable of performing their roles at all times.[3]

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[2] Chantal Desormeaux, *Problem Definition Paper - Naval Technical Occupations* (Ottawa: Director Naval Personnel & Training, 2019).
[3] Department of National Defence, *Naval Engineering Manual: NEM Direction and Guidance* (Ottawa: Chief of the Defence Staff, 2011), 2-3.

Post-HoD tour, NTOs are employed primarily in shore-based positions where they are responsible for the repair, maintenance, support, and acquisition of RCN assets.

NTOs must complete a bachelor's degree in Aeronautical, Civil, Chemical, Computer, Electrical, or Mechanical Engineering. Programs such as Computer Science, Mathematics, and Physics are also acceptable.[4] The degree most applicable to MS ENGs is Mechanical Engineering and Computer or Electrical Engineering for NCS ENGs; however, most of the other degrees listed above have little relevance to the NTO occupation. NTOs must also complete several occupational qualifications, such as Naval Environmental Training Plan Officers, Naval Engineering Indoctrination, Basic Officer Qualification (commonly referred to as Phase VI training), and HoD Qualification.[5,6] After qualifying as a HoD, NTOs will usually work in shore-based positions for three to five years, before returning to a ship for their 18-month HoD tour. With few exceptions, following their HoD tour, NTOs will never sail again and will support the Fleet from ashore.

EROSION OF THE 'TECHNICAL' IN NAVAL TECHNICAL OFFICERS

In previous years, NTOs were regarded as subject matter experts. Not only did NTOs spend significantly more days at sea than they do today, but trainees were also required to obtain the same shipboard technical certifications as the NCMs in their

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[4] Rock Hau, "Military Occupation and University Degree Compatibility," accessed 28 April 2021, https://www.rmc-cmr.ca/en/Registrars-office/academic-programmes-and-occupation-compatibility.
[5] The Canadian Armed Forces, *Occupational Specification Marine Systems Engineering Officer (MS ENG - MOS ID 00345)* (Ottawa: DND Canada, 2019).
[6] The Canadian Armed Forces, *Occupational Specification Naval Combat Systems Engineering Officer (NCS ENG - MOS ID 00342)* (Ottawa: DND Canada, 2010).

department, which gave them authority to operate the equipment under their responsibility. In the last few decades, the reduction in sea day requirements for trainees, the removal of the certification requirement, and the consolidation of Naval Architects and Constructor Officers into the MS ENG occupation was the beginning of creating a generalist NTO.[7]

The erosion of technical expertise in the NTO occupation and the transition to becoming generalists focussing on management was forecasted two decades ago by Commodore Sylvester, Director General Maritime Equipment and Program Management, stating the following in 2001:

> Commanding Officers today should expect their [NTO] department heads to lead, to manage and … not to be equipment-specific experts. Engineers have many resources upon which they can draw for specific technical expertise. We would, of course, have to rely heavily on the skill and expertise of our senior NCMs...Note also, though, that systems and equipment are generally more reliable now than in the past, and that repair-by-replacement maintenance has reduced the need to get into the detail.[8]

His statement acknowledged that Engineering HoDs were no longer technical experts, yet 20 years later, NTO training is still very much technically focused. As such, justifying the time, effort, and cost associated with the current training model becomes increasingly more difficult.

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[7] Patrick Finn, Simon Page and Randy Comeau, "MARE 2020 — Models for the Future of the Maritime Engineering Occupation," *Maritime Engineering Journal* 21, no. 1 (2002), 5-10.
[8] J. R. Sylvester, "Commodore's Corner: MARE Branch Restructuring," *Maritime Engineering Journal* 20, no. 1 (2001), 3.

Adding to the problem, the RCN has faced significant issues with recruiting and retention in recent years. The average recruiting intake of NTOs over the past five years has only reached 83% of desired levels.[9] Requiring skillsets that are highly marketable in civilian industry, NTOs also experience attrition at a higher rate than other occupations in the Canadian Armed Forces. In 2002, Rear-Admiral (Retired) Finn and Rear-Admiral (Retired) Page predicted high NTO attrition by the year 2020:

> The Canadian Forces generally, and the [NTO] occupation specifically, will have to deal with that reality [higher attrition due to marketable skillsets] by becoming an employer of choice. Not only will we have to offer interesting and diverse employment, but the transitory nature of employees will mean that junior officers must not remain in the training pipeline for extended periods. Locking junior engineers into the training system for several years may only result in their serving a relatively short career in the navy with no opportunity to actually do a job.[10]

As predicted, NTO attrition has increased in recent years, likely partly because little has changed with the NTO training system. As the NTO occupation can expect issues with recruiting and retention to continue, it makes sense to consider a different employment model.

PROBLEMS WITH THE CURRENT MODEL

After an NTO completes Phase VI training, they have reached the Operationally Functional Point (OFP) and can be meaningfully employed within their occupation while they await subsequent training and their HoD tour.[11,12] After OFP, as a junior officer,

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[9] Desormeaux, *Problem Definition ….*
[10] Finn, Page and Comeau, "MARE 2020….
[11] The Canadian Armed Forces, *Occupational Specification Marine Systems Engineering Officer ….*
[12] The Canadian Armed Forces, *Occupational Specification Naval Combat Systems Engineering Officer....*

they will usually be employed as a divisional officer, manager, junior project manager, or staff officer. While most of these jobs will have military or civilian technicians working for them, rarely will the job require significant shipboard technical knowledge.

Once becoming a HoD, the vast majority of the position is focussed on administration, divisional issues, risk assessments, and long-term operational and maintenance planning. Technical issues, troubleshooting, and repairs are coordinated by the Chief Engineer (CEng) or Combat Systems Engineering Chief, NCMs that work directly for the Engineering HoD. When dealing with technical issues, the main role of the NTO is to ensure resources are allocated to support Command priorities and the Commanding Officer understands operational impacts.[13] During damage control scenarios, NTOs support the Damage Control Organization by acting as the Damage Control Officer (DCO) and the Emergency Response Team In Charge (ERT I/C).[14] While these duties are extremely important and challenging, they do not require strong technical knowledge, but instead rely on prerequisite coursing, training at sea, and support from senior NCMs. In summary, NTOs do not need to be specialists, when they have specialists working for them and another officer trade provided with specific just-in-time training could fill their roles.

Once promoted to the rank of LCdr and above, training does little to prepare NTOs for roles and responsibilities in managing resources and projects. While NTOs will have life-cycle materiel managers, project managers, technicians, and engineers working for them, again their role is managerial in nature, focused on strategic goals, fiscal

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[13] Department of National Defence, *Naval Engineering Manual…*,2-2.
[14] Royal Canadian Navy, *Ship's Standing Orders AL11* (Ottawa: DND Canada, 2020).

management, and administration. Even in the case of the one exception, where a LCdr NTO will be at sea with Sea Training Group, this position is focussed on mentoring ships' crews in dealing with damage control scenarios.[15] While these Sea Training positions require strong leadership and experience at sea, they are not technical. Excellent leadership, supervision, and management, and not technical competence, is what separates strong NTOs from weak ones. Understanding how the career of an NTO has transitioned away from a technical expert to one of a technical manager begs the question: why does the RCN continue to invest so heavily in an occupation that does not require technical expertise?

THE UNITED STATES NAVY MODEL

In 1976, the USN discontinued having EDOs (RCN NTO equivalents) on surface ships and moved this role to SWOs (RCN NWO equivalents). The rationale was documented in a Chief of Naval Operations report:

> EDOs have turned away from their role as technical experts and as a result, their capability and effectiveness have declined. … SWOs have also turned away from technical matters and their knowledge of the details of maintenance and operation of their ships has declined. … The idea that [EDOs and SWOs] should be technically oriented professionals who know the details of their ships was overtaken by the notion that Naval officers should be managers.[16]

Acknowledging the trend that EDOs were no longer technical experts, reliance on technical aspects was placed more heavily on the NCMs, and EDO training was

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[15] Royal Canadian Navy, *Ship's Standing Orders….*
[16] Office of the Chief of Naval Operations, *Report of Study Group to Determine Navy Requirements for Engineering Duty Officers and the Actions to Satisfy those Requirements* (Washington, DC: 1976), 1.

refocussed to encompass management instead of technical expertise.[17] The report goes on to recommend that most EDO sea billets should be replaced by SWOs, who would also benefit from more technical experience. EDO training would then shift from shipboard technical training to the art of "technically directing the design, acquisition, and maintenance of ships and combat systems."[18]

The Chief of Naval Operations report resulted in SWOs being given the vast majority of engineering officer positions on USN ships (except for some complex/large ships such as CVNs and SSBNs). An example of typical sea postings for a SWO, up to and including HoD, was provided in an article for the Center for International Maritime Security Journal:

> Ensign Timmy starts his career as a SWO by serving two division officer tours. He has little to no say in what his first billet will be – he could just as easily serve as the Electrical Officer as he could the Gunnery or Communications Officer. When proceeding to his next tour, his desires and performance are taken into account along with the ever-present needs of the Navy. En route to his second ship, LTJG Timmy receives his first formalized billet training. His second division officer tour may or may not fall under the same department as his first. After four years ashore, now-LT Timmy serves two 18-month Department Head tours. While his desires are given heavy weight, his assignment will not necessarily be to a department in which he previously served. The career experiences, training, and development of SWO's is designed to ensure that they are notionally plug-and-play – able to serve in any capacity at a moment's notice.[19]

The benefit of have SWOs fill the roles of Engineering HoDs and divisional officers, is that by the time they reach positions of Executive Officer and Commanding Officer, they

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[17] Harry J. Thie *et al*, *Aft and Fore: A Retrospective and Prospective Analysis of Navy Officer Management* (Santa Monica, CA: The RAND Corporation, 2003), 129.
[18] Office of the Chief of Naval Operations, *Report of Study …, 1.*
[19] Jon Paris, "The Virtue of being a Generalist, Part 1: A Day in the Life of Sub Lieutenant Snodgrass," accessed 28 April 2021, https://cimsec.org/tag/officer-of-the-watch/.

have gained a higher degree of technical knowledge from managing those departments. Any coursing required to perform the duties of an Engineering HoD, such as Environmental or Damage Control Officer, would simply be provided to SWOs in the form of just-in-time training.[20]

EDOs in the USN are not eligible for Command as their occupation's role is to support the USN fleet from ashore. The USN MyNavy HR website describes EDOs as follows:

> The Engineering Duty Community provides technical and business leadership in the design, acquisition, construction, maintenance, modernization, conversion, overhaul and disposal of ships, submarines, and onboard systems. The Engineering Duty Community's roles is to sustain combat readiness and build a fleet of the future. Engineering Duty Officers are a cadre of specialized career naval officers. They are warfare qualified and technically educated through Engineering Master's Degree and/or Doctorate programs.[21]

In essence, EDOs are responsible for sustaining and improving the current fleet, while building the fleet of the future. With onboard technical expertise removed from their job description, EDOs are trained to become specialists in their support streams.

As there is no direct entry into the EDO program, they start their careers as SWOs to gain valuable experience at sea and then conduct a lateral transfer to EDO after they have obtained their warfare qualification and completed 24 months at sea.[22] EDO candidates must also obtain an Engineering Master's Degree in an area that will benefit

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[20] Ryan Verbenkov, telephone conversation with CDR John Hamilton, USN, 8 March 2021.
[21] Navy Personnel Command, "Engineering Duty," accessed 1 April 2021, https://www.mynavyhr.navy.mil/Career-Management/Community-Management/Officer/Active-OCM/Restricted-Line/Engineering-Duty/.
[22] BU Division of Military Education, "Surface Warfare Officer (Engineering Duty)," accessed 1 April 2021, https://www.bu.edu/rotc/navy/careers/surface-warfare-officer/surface-warfare-officer-engineering-duty/.

their role in supporting the USN fleet.[23] Following graduate school, the EDO Basic Course provides requisite training in "research and development, design, acquisition, construction, maintenance, and modernization of ships and systems."[24] EDOs then undergo at least one year of on-the-job training, several correspondence courses, and an oral examination before being fully qualified.[25,26] At this point, EDOs choose a specialization stream in ship systems engineering, electronic systems engineer, or combat/weapons systems engineer.[27]

Overall, the USN model generates SWOs who gain technical experience through the management of engineering departments and highly specialized EDOs who have previous operational experience at sea and specialize in maintaining the current fleet and designing the future fleet.

Considerations When Applying the USN Model to the RCN

While NTOs spend a great deal of time becoming proficient in shipboard technical aspects, there are a few noteworthy issues worth considering. Despite all the technical training, Engineering HoDs are not technical experts. Senior technicians that work for NTOs have years of technical training and experience that far exceed the

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[23] Navy Personnel Command, "Graduate Education," accessed 1 April 2021, https://www.mynavyhr.navy.mil/Career-Management/Detailing/Officer/Pers-44-Staff-RL/Engineering-Duty/Graduate-Education/.
[24] Engineering Duty Officer School, "EDO School Transitions to Modernized Delivery of its Basic Course Curriculum," accessed 29 April 2021, https://www.netc.navy.mil/Media-Center/News-Stories/News-Stories-Display/Article/2444448/edo-school-transitions-to-modernized-delivery-of-its-basic-course-curriculum.
[25] Navy Personnel Command, "Engineering Duty Qualification Program (EDQP)," accessed 1 April 2021, https://www.mynavyhr.navy.mil/Career-Management/Detailing/Officer/Pers-44-Staff-RL/Engineering-Duty/Qualification-Program/.
[26] *Ibid*.
[27] Rod Powers, "Navy Commissioned Engineering Duty Officer," accessed 29 April 2021, https://www.thebalancecareers.com/engineering-duty-officer-3356593.

training provided to NTOs. Furthermore, the NEM states that for a ship to sail there is no need for the NTOs to be on board.[28] The Department Chiefs can act as the HoD and, more specifically, the ship cannot sail without the CEng because of the technical certification he/she holds.[29] Understanding the Department Chiefs have more technical expertise and, in the case of the CEng, are required on board for the ship to sail, this reinforces the position that NCMs of the department should be recognized as the lead for technical aspects.

Looking at Transport Canada (TC) regulations, which set policies and regulations for commercial vessel safety, there is a direct correlation between Marine Technician certifications and TC certifications. For example, a Certification 4 Marine Technician can directly challenge the Second-Class Engineer exams.[30] No such accreditation exists for NTOs. What this means is if TC recognizes the Department Chief as a technical expert, the RCN should follow suit. While the HoD would still be the onboard technical authority as mandated in the NEM, their decisions would strongly hinge on the recommendations of the Chief.[31] Leadership, management, planning, administration, and interdepartmental coordination are the main roles of the Engineering HoDs. None of these skillsets require extensive technical training. NWOs posted into Engineering HoD positions can easily fulfill the HoD role while also be given just-in-time training to fulfill the secondary roles of DCO, ERT I/C, Environmental Officer, Ammunition Officer, etc. In fact, this type of training could prove more effective than the current model where

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[28] Department of National Defence, *Naval Engineering Manual…*, 2-3.
[29] *Ibid.*, 2-4.
[30] Transport Canada, *The Examination and Certification of Seafarers Revision 5* (Ottawa, Canada: Minister of Transport, 2007), 24.
[31] Department of National Defence, *Naval Engineering Manual…*, 2-3.

DCO training is front-loaded at the very beginning of an MS ENG's career but then not practiced at sea until years later. Finally, more research would need to be conducted to determine at what stage of an NWO's career they would fulfil the Engineering HoD role. However, keeping inline with the USN model, it would be equivalent to an Operations Rooms Officer tour.

There has been a consistent inability to Force Generate enough NTO LCdrs to meet the preferred crewing level of the occupation due to retention challenges and a lack of ships to conduct HoD tours. The NTO occupation has taken several steps to remedy this, which has further eroded the technical credibility of the occupation. At first, HoD tours were reduced from 24 to 18 months and allowed Commissioned from the Ranks NTOs to bypass their HoD tour completely.[32] More recent changes place two MSE and two CSEO HoDs on each frigate, post NTOs as HoDs on the Kingston Class (a position previously held by a Petty Officer First Class), and create shore-based positions as equivalents to at-sea HoD tours.[33] In the years past, Engineering HoDs completed 24-36 month HoD tours and some even served a second HoD tour on other classes of ships.[34] Furthermore, recent changes have reduced sea time for NTO trainees down to 40 days.[35] From Rear-Admiral (Retired) Finn and Rear-Admiral (Retired) Page's warnings from 2002, there are dangers that reducing sea time will erode technical credibility:

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[32] *NCR Naval Technical Officer LCdr Recovery Plan Town Hall,* presented by JayThor Turner (Ottawa, Canada: 2021)
[33] NDHQ C NAVY OTTAWA, *NAVGEN - Launch of Naval Technical Officer (NTO) LCdr Recovery Plan* (Ottawa, Canada: 8 February 2020).
[34] Finn, Page and Comeau, "MARE 2020…, 7.
[35] Royal Canadian Navy, *NAVORD 4500-20: Naval Technical Officer Qualifications* (Ottawa: DND Canada).

> The complexity of the Head of Department position is such that we must maintain the emphasis on training at sea. The move to tiered readiness has impinged on that training by reducing sea time for engineers under training. Even though they may be posted to a ship, many officers get only minimal time at sea and often do not gain hands-on experience across the entire spectrum of engineering duties. The qualification of department heads should be tied to a minimum amount of actual time at sea (vice time on board) to ensure their competency is not eroded.[36]

With the complexities of a modern warship, an NTO cannot become a subject matter expert with 40 days at sea. The occupation needs to acknowledge this transition away from technical expertise and adjust accordingly. Eroding the technical credibility of NTOs undermines the HoD position and the trade. This supports the argument that technical training is not required to fill NTO sea positions and could easily be filled by NWOs, similar to what has been done in the USN.

It is also important to look at how the RCN employs NTOs across all classes of ships. Before the recent decommissioning of two other classes of ships, an NTO could do all their training on the Halifax Class and then be posted as the HoD on the Iroquois or Protecteur Class. Despite having drastically different equipment, no platform-specific crossover training to bridge the technical gap ever occurred. The same applies to posting NTOs on the Kingston and Harry DeWolf Class ships. The HoD will have little knowledge of the equipment on board, yet they still successfully lead the department. Moreover, on the Harry DeWolf Class, there is only one engineering department, called the Naval Technical Department, which is led by an MS ENG. In addition to marine systems, he/she is responsible for combat systems including “communications, weapons,

[36] Finn, Page and Comeau, "MARE 2020…, 6.

command and control, navigation, and naval information systems."[37] With the MS ENG having full responsibility for equipment normally given to an NCS ENG, it further amplifies the fact that Engineering HoDs do not require prerequisite technical training. NTOs are still able to manage these departments without issue because they rely on their NCMs for technical expertise because they are not technical experts themselves in the equipment under their responsibility.

Another factor to consider is the limited bunk space available on HMC Ships and the number of positions required to train NTOs. In previous years, the two engineering departments would sail with approximately six officers combined. To address the shortfall of NTOs at the LCdr rank, the occupation is planning to employ two to three Phase VI trainees, two Assistant HoDs, and two HoDs per department, for a total of 12-14 NTOs. With limited bunk spaces, taking so many positions for NTOs to train technical skills they do not require is not responsible, practical, or efficient. Furthermore, NTOs do not stand watch and are what the RCN calls dayworkers. Because NWOs stand watches at all ranks, even while under training, this incites animosity when NWOs feel their NTO counterparts do not contribute to the larger watch rotation of the ship. Employing NWOs in the engineering department, similar to the USN, would benefit the ship with fewer trainee requirements and more officers available to augment the watch rotation.

NTOs receive very little training to effectively handle post-HoD employment challenges such as design, acquisition, and support of ships. NTO training is conducted very early in their career and is focused on technical aspects and HoD responsibilities,

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[37] Royal Canadian Navy, *Ship's Standing Orders…,* 235.

doing little to help NTOs with project management, expenditure management, contracting, life-cycle materiel management, etc. With NTOs left to figure out best practices as they navigate through post-HoD positions, the result is often poor performance and higher attrition due to lower job satisfaction.[38] This was recently acknowledged in the Problem Definition Paper for the NTO Occupation:

> A thoughtful investigation of the "right training, right time and right method" philosophy is required for the NTO occupations. It is believed that the current training provided to the NTO does not maximize the above philosophy. Much of the early phase-coursing for NTOs is geared towards the seagoing HoD position. An analysis of this training is required to ensure that NTOs are also prepared for post-HoD employment, within the various organizations in which they are employed.[39]

Having a model similar to the USN, where NWOs manage engineering departments, would allow NTOs to focus their training on design, acquisition, and maintenance of HMC Ships, an area the occupation has struggled with in the past.

Another failure of the NTO occupation is that, unlike USN EDOs who are employed in streams to develop expertise, NTOs are pushed to become generalists. The NTO occupation places incredibly high importance on receiving a technical master's degree. However, after paying for the master's degree, which also takes the NTO away from the workforce for 18 to 24 months, with only a few exceptions, the NTO occupation will only employ that member in the area of their expertise for one posting (two or three years). Afterward, the NTO will likely never work in this specialized area again because of the perceived need to acquire a greater breadth of experience. This does not provide a good return on investment and does not leverage NTO areas of expertise. Much like the

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[38] Desormeaux, *Problem Definition Paper…*, 5.
[39] *Ibid*., 3.

USN model, the RCN would benefit greatly from having more specialized NTOs instead of the cadre of generalists.

CONCLUSION

Continuing to train NTOs with the intent to gain technical proficiency is a juice not worth the squeeze, especially when considering the changes that have created an occupation that is lacking in-depth technical knowledge. The NCMs that work for NTOs possess far superior technical expertise, a fact recognized by the RCN and Transport Canada. The role of Engineering HoDs is focussed on leadership and management, having technical proficiency provides little benefit. Furthermore, once NTOs complete their HoD tour, the remainder of their career will focus on the design, acquisition, and maintenance of HMC Ships, something that they receive little to no training on. With the recent decisions that have eroded the technical credibility of the NTO occupation, it is easy to see why the value of NTOs is in question.

Employing the USN model of having NWOs fill the role of Engineering HoDs and having NTOs drawn from a lateral transfer from experienced NWOs would remove the requirement of having NTOs serve on board ships. This would in turn allow the NTO occupation to restructure and create experts in its shore-based support positions. Furthermore, NTOs, like their USN counterparts, will never Command at sea; therefore, the NTO occupation should also reconsider the importance placed on breadth of experience and create streams of expertise in its place. This plan will ensure the RCN is best positioned to effectively maintain its current ships and procure extremely capable and cost-effective ships for its future fleet.

Bibliography

Boston University Division of Military Education. "Surface Warfare Officer (Engineering Duty)," accessed 1 April 2021, https://www.bu.edu/rotc/navy/careers/surface-warfare-officer/surface-warfare-officer-engineering-duty/.

Croucher, Danny. 2015. "Turning the Tide: The Naval Engineering Officer's Future." Canadian Forces College.

Department of National Defence. 2013. *NaMMS Policy and Procedures: Naval Materiel Management System Manual*. Ottawa, Canada: Chief of the Defence Staff.

———. 2011. *Naval Engineering Manual: NEM Direction and Guidance*. Ottawa, Canada: Chief of the Defence Staff.

———. *Strong Secure Engaged: Canada's Defence Policy*. Ottawa, Canada.

Desormeaux, Chantal. 2019. *Problem Definition Paper - Naval Technical Occupations*. Ottawa, Canada: Director Naval Personnel & Training.

Ditrapani, Anthony R. and John D. Keenan. 2005. *Applying Civilian Ship Manning Practice to USN Ships*. Alexandria, Unites States: The CNA Corporation.

Engineering Duty Officer School. "EDO School Transitions to Modernized Delivery of its Basic Course Curriculum." Naval Education and Training Command., last modified 7 February 2021, accessed 29 April 2021, https://www.netc.navy.mil/Media-Center/News-Stories/News-Stories-Display/Article/2444448/edo-school-transitions-to-modernized-delivery-of-its-basic-course-curriculum/.

Fee, Jerome J. 2001. "Evolution of the Engineering Duty Officer in the United States Navy." *Naval Engineers Journal* (Winter): 103-112. https://onlinelibrary-wiley-com.cfc.idm.oclc.org/doi/epdf/10.1111/j.1559-3584.2001.tb00017.x.

Finn, Pat, Simon Page, and Randy Comeau. 2002. "MARE 2020 — Models for the Future of the Maritime Engineering Occupation." *Maritime Engineering Journal* 21 (1): Director General Maritime Equipment Program Management, 5-10.

Government of Canada. "DAOD 5031-8, Canadian Forces Professional Development." accessed 28 April 2021, https://www.canada.ca/en/department-national-defence/corporate/policies-standards/defence-administrative-orders-directives/5000-series/5031/5031-8-canadian-forces-professional-development.html.

———. "Marine Systems Engineering Officer." Royal Canadian Navy., accessed 1 April 2021, https://forces.ca/en/career/marine-systems-engineering-officer/.

———. "Naval Combat Systems Engineering Officer." Royal Canadian Navy., accessed 1 April 2021, https://forces.ca/en/career/naval-combat-systems-engineering-officer/.

Greenwood, Richard W. 2014. "An Engineer's Outline of Canadian Naval History, Part III (1970-2014)." *The Northern Mariner* 24: 273. https://www.cnrs-scrn.org/northern_mariner/vol24/tnm_24_34_273-295.pdf.

Hau, Rock. "Military Occupation and University Degree Compatibility." Royal Military College of Canada., accessed 28 April 2021, https://www.rmc-cmr.ca/en/Registrars-office/academic-programmes-and-occupation-compatibility.

J. Thie, Harry, Margaret C. Harrell, Kevin Brancato, Jefferson P. Marquis, Clifford M. Graf II, Roland J. Yardley, and Jerry M. Sollinger. 2003. *Aft and Fore: A Retrospective and Prospective Analysis of Navy Officer Management*. Santa Monica, CA: The RAND Corporation.

McGrath, James P. 2019. "Engineer-Warriors Or Engineers and Warriors?" *U.S. Naval Institute* 145. https://www.usni.org/magazines/proceedings/2019/january/engineer-warriors-or-engineers-and-warriors.

Navy Personnel Command. "Engineering Duty." My Navy HR., accessed 1 April 2021, https://www.mynavyhr.navy.mil/Career-Management/Community-Management/Officer/Active-OCM/Restricted-Line/Engineering-Duty/.

———. "Engineering Duty Qualification Program (EDQP)." My Navy HR., accessed 1 April 2021, https://www.mynavyhr.navy.mil/Career-Management/Detailing/Officer/Pers-44-Staff-RL/Engineering-Duty/Qualification-Program/.

———. "Graduate Education." My Navy HR., accessed 1 April 2021, https://www.mynavyhr.navy.mil/Career-Management/Detailing/Officer/Pers-44-Staff-RL/Engineering-Duty/Graduate-Education/.

NDHQ C NAVY OTTAWA. 2020. *NAVGEN - Launch of Naval Technical Officer (NTO) LCdr Recovery Plan*. Ottawa, Canada.

Office of the Chief of Naval Operations. 1976. *Report of Study Group to Determine Navy Requirements for Engineering Duty Officers and the Actions to Satisfy those Requirements*. Washington D.C.

Paris, Jon. "The Virtue of Being a Generalist, Part 1: A Day in the Life of Sub Lieutenant Snodgrass." Center for International Maritime Security., accessed 1 April 2021, https://cimsec.org/tag/officer-of-the-watch/.

Powers, Rod. "Navy Commissioned Engineering Duty Officer." The Balance Careers., accessed 1 April 2021, https://www.thebalancecareers.com/engineering-duty-officer-3356593.

———. "What You Need to Know About Becoming a Naval Engineering Duty Officers." The Balance Careers., accessed 1 April 2021, https://www.thebalancecareers.com/engineering-duty-officer-3356593.

Royal Canadian Navy. *NAVORD 4500-20: Naval Technical Officer Qualifications*. Ottawa, Canada.

———. 2020. *Ship's Standing Orders AL 11*.

Sylvester, J. R. 2001. "Commodore's Corner: MARE Branch Restructuring." *Maritime Engineering Journal* 20 (1): Director General Maritime Equipment Program Management, 3.

The Canadian Armed Forces. 2019. *Occupational Specification Marine Systems Engineering Officer (MS ENG - MOS ID 00345)*. Ottawa, Canada: Department of National Defence.

———. 2010. *Occupational Specification Naval Combat Systems Engineering Officer (NCS ENG - MOS ID 00342)* Department of National Defence.

Transport Canada. 2007. *The Examination and Certification of Seafarers Revision 5*. Ottawa, Canada: Minister of Transport.

———. 2011. *Marine Personnel Regulations*. Ottawa, Canada: Minister of Justice.

United States Navy. 2012. Chief of Naval Operations. *Standard Organization and Regulations Manual*.