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# AGILE FORCE DEVELOPMENT FOR HIGH-TECH NAVAL SYSTEMS

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## AIM

1. The Canadian Armed Forces (CAF) have been directed by the Government of Canada (GOC) to generate an agile, modern force capable of conducting a broad spectrum of operations in support of the nation's military objectives.[1] Additional pressures to adopt advanced capabilities come from our membership in the Five Eyes (FVEY) alliance, the North Atlantic Treaty Organization (NATO) and as partners in a variety of multinational coalitions. In each of these partnerships, the CAF has a responsibility to maintain a high level of technical interoperability in order to remain operationally relevant.[2] Unfortunately, the ability of the CAF to develop and implement the new high-technology capabilities outlined in SSE and in support of allied interoperability, is hindered by constraints imposed by GOC procurement directives. As a result, the Royal Canadian Navy (RCN) must be prepared to adopt agility in Force Development (FD) processes and to maximize collaboration with our allies to improve procurement strategies in meeting the new realities of naval warfare in a network centric battlespace. Understanding that the procurement regulations imposed by the GOC must be followed, the intent in this service paper is not to counter those policies, but rather to demonstrate internal efficiencies that the RCN can adopt to improve the development cycle and delivery timelines for high-technology capabilities.

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[1] Department of National Defence, D2-386/2017E, *Strong Secure Engaged* (Ottawa: Canada, 2017), 67.
[2] Department of National Defence, D2-386/2017E, *Strong Secure Engaged* (Ottawa: Canada, 2017), 70.

**INTRODUCTION**

2. The GOC procurement process has been adopted by DND through the Project Approval Directive (PAD)[3]. This publication directs the process required for all capital projects above $5M in order to provide a consistent Whole of Government (WoG) approach for project approval. RCN projects under $5M are exempt from this process and follow internal directives for minor projects. The problem with the current development process for high technology capabilities is that the technology evolution cycle occurs more rapidly than the process intended to support procurement. For example, the current project lifespan for a capital project in the RCN is 16 years and the lifespan for a minor project is from 2-5 years.[4] Contrasted against the life cycle requirements of modern Information Technology (IT) systems at 5-7 years[5], it becomes apparent that current projects over $5M are at high risk of obsolescence before they are delivered. Clearly the minor project process is more agile and better able to support high technology capability development; however, the $5M cap makes it very difficult for the RCN to leverage, largely due to the significant costs of integrating high-technology capabilities in HMC Ships. Additionally, the preference for class-wide or fleet-wide engineering configurations, intended to promote platform commonality, further constrain the potential of smaller scale procurement.

3. The RCN is also facing a crisis in the Life-Cycle-Material-Management (LCMM) process for high-technology capabilities as industry is less willing to support aging systems that do not meet modern technical standards. This puts more pressure on Assistant Deputy Minister

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[3]The PAD is a DND publication, managed by the Chief of Programme (CPROG), which contains the internal direction for the departmental procurement process.

[4]Data obtained from the Directorate of Naval Requirements (DNR) annual update brief dated May 2017.

[5]Tianbiao Zhang, *Instrumentation, Measurement, Circuits and Systems* (Berlin: Springer-Velag, 2012), 501.

(Materiel) (ADM(Mat)), which is burdened by increasingly complex systems that they must support. Additionally, there is a trend in project management practices to reduce In Service Support (ISS) from industry partners in an attempt to reduce initial project costs. The consequence of reducing ISS funding in the short term, is that additional cost and complexity is placed on the LCMM process in the long run.

4. This service paper will propose methods in which the RCN can procure high technology capabilities more effectively without contravening current policy directives. It will also make recommendations on improving the LCMM process to be more efficient through the introduction of competitive sustainment processes. The technology scope of this paper will include priority capability areas from Strong, Secure, Engaged (SSE) that encompass Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) architectures. Recommendations for improvement will be made in the following areas; prototyping, allied capability development, the introduction of open competition throughout the project lifecycle and human resource management.

**DISCUSSION**

5. <u>Prototyping</u>. In order to maximize Return On Investment (ROI) for complex technological system procurement, prototyping must be prioritized as a means of capability development. This analysis will include two specific prototype categories; production prototyping and functional prototyping to demonstrate the benefits of this development strategy. In production prototyping, systems are fabricated using the final design, integration and

manufacturing methods.[6] In functional prototyping, both function and appearance meet the intended design specification, but these prototypes are generated using bespoke processes that are intended to be flexible for both scope and intent.[7] A sub-set of functional prototyping specific to software development is horizontal prototyping which supports agile development based on end user interaction.[8] With these tools, the RCN can overcome some of the development costs for high technology systems and decrease project timelines by minimizing or eliminating the definition phase of the project cycle. To demonstrate how this could be achieved, it is necessary to examine recent projects that benefited from prototyping concepts.

6. The Maritime Satellite Communication Upgrade (MSCU) project is a recent procurement success for the RCN. The project was able to leverage the power of production prototyping to eliminate the definition phase of the project. The Short Term Satellite Communications Upgrade (STSCU) was a minor project that ultimately developed the production prototype for the MCSU capital project. This minor project was intended to meet the short term operational demands of the Fleet and was executed in a short time frame due to its low cost falling below the $5M threshold for a capital project. In this case, the technical specification development and integration engineering supporting STSCU was adopted as a proof of concept for the MSCU project. This eliminated the requirement for the definition phase of the MSCU project and

[6] Engineers Edge, "Production Prototypes Review," last accessed 4 February 2018, https://www.engineersedge.com/testing_analysis/production-prototype.htm

[7] Thomasnet, "Prototypes: General Categories," last accessed 4 February 2018, https://www.thomasnet.com/articles/engineering-consulting/general-prototypes

[8] Jakob Nielson, *Usability Engineering (Boston: AP Professional, 1993)*, 95.

ultimately reduced the overall project timeline by 4 years.[9] The MSCU project serves as an example where production prototyping, whether intended or not, led to a procurement success.

7. While the MSCU project is an example of unintended prototyping, the Command and Control Networks and Enterprise Services (C2NES) minor project was developed with the sole purpose of generating a functional prototype[10] that supports horizontal prototyping for software development. This system will be used as a pre-production prototype to test and manage multiple other C4ISR FD initiatives spanning; maritime evaluations, minor projects, capital projects and National Procurement (NP) life cycling activities. Effectively this functional prototype will support the development, integration and ultimately the production standards for the adoption of next generation capabilities (C4ISR and cyber defence systems), into the RCN's complex Naval Information System (NavIS) environment.

8. Traditional procurement methods used to acquire platform scale capabilities are simply not conducive to the procurement of rapidly evolving information based technologies. The recent cancellation of the Maritime Integrated Network Management System (MINeMS)[11] is an example where the lack of a working prototype for a large scale IT project led to an extended definition phase resulting in a capability that was considered obsolete before it entered the implementation phase. If the RCN is to support the development and integration of next

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[9]Data obtained from the Directorate of Naval Requirements (DNR) Project Management Board (PMB) Decision Brief dated November 2014.

[10]Data obtained from the Directorate of Naval Requirements (DNR) Minor Project Synopsis Sheet for the Command and Control Networks and Enterprise Services (C2NES) Project, dated 23 October 2017.

[11]The Vice Chief of the Defence Staff (VCDS) removed MINeMS from the Capability Investment Database (CID) in June 2016 due to project stagnation.

generation technologies, it must adopt a strategy for system architecture design through prototyping. This approach could produce efficiencies in the options analysis phase, the definition phase and in the integration phase of a capital project, while focusing life cycling activities and experimentation objectives to a known system end state.

9. Allied Interoperability. If the RCN is to remain relevant in the modern operating environment, it must maintain interoperability with multinational partners. While some may consider this a constraint to RCN FD efforts, this paper will demonstrate that allied engagement is critical to the success of technology integration in HMC Ships.

10. Multinational cooperation for capability development allows Canada, as a middle power, to access the vast development resources of our allies. The Five-Eyes (FVEY) community maintains an aggressive standards development and experimentation program that spans capabilities across the Maritime Information Warfare (MIW) domain. The Australia, Canada, New Zealand, United Kingdom, United States (AUSCANNZUKUS) MIW forum leads the development of highly advanced technologies supporting naval networking, Intelligence, Surveillance and Reconnaissance (ISR), cyber capabilities and space based capabilities.[12] In NATO, the Conference of National Armaments Directors (CNAD) coordinates NATO objectives for defence investment leveraging both NATO common funding and national procurement mechanisms to achieve standardized capability investment. CNAD also has access to vast Science and Technology (S&T) resources inherent in the NATO substructure supporting

[12]Data obtained from the AUSCANNZUKUS MIW Handbook dated June, 2013.

advanced research and experimentation objectives.[13] While the RCN is active in both of the NATO and FVEY forums, it is not currently maximizing the potential for coordinated capability development with our allies.

11. The RCN must maintain its current level of investment with the AUSCANNZUKUS MIW organization, while increasing its presence in NATO organizations supporting C4ISR capability development. Only through engagement will the RCN fully leverage the resources and procurement vehicles that are available to NATO members. Furthermore, as a key member of both the FVEY alliance and NATO, the RCN is uniquely positioned to shape interoperability and capability development with a focus on technical convergence between the two organizations. To date, however, the RCN has not effectively assumed leadership in this important function, in contrast to the United States Navy (USN) and the Royal Navy (RN) who actively promote technology innovation and convergence in NATO.

12. The RCN can maximize access to C4ISR capability development in NATO by increasing participation in the Command, Control and Consultation Board (C3B) capability teams, the CNAD sub groups; Joint Capability Group for ISR (JGCISR) and the Joint Capability Group for Command and Control (JCGC2) and leverage the NATO Communications and Information Agency (NCIA) and Allied Command Transformation (ACT) for NATO project liaison.[14] The development and ratification of Standardization Agreements (STANAGs) produced in these

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[13]North Atlantic Treaty Organization (NATO), "NATO Organization" last modified 4 January 2017, https://www.nato.int/cps/su/natohq/structure.htm

[14]North Atlantic Treaty Organization (NATO), "NATO Organization" last modified 4 January 2017, https://www.nato.int/cps/su/natohq/structure.htm

forums are key to implementing interoperable solutions with allies. To address the RCNs current leadership disconnect between NATO and AUSCANNZUKUS capability development efforts, one of either the Director General of Strategic Readiness (DGNSR) or the Director General Naval Force Development (DGNFD) must be identified as the lead allied interoperability organization with the responsibility to direct resources for coordinated allied capability development.

13. Competitive Sustainment for Open Systems Architectures (OSA). For high-technology procurements, the RCN must generate requirements for industry that discourage proprietary system designs for hardware and software. The current trend in high-technology system development is towards open architectures incorporating commercial off-the-shelf (COTS) components and software. Proprietary systems impose constraints on LCMM processes and limit opportunities for competitive ISS solutions. In an OSA with no proprietary hardware or software, multiple vendors are able to tender competitive bids for the development, production and ISS phases of a capability lifecycle. In the long run, this strategy reduces costs, reduces complexity and supports agility for system modernization and interoperability.[15] With an OSA, competition can also be incorporated into the ISS phase of the capability cycle to drive innovation and reduce obsolescence risk, which are important factors considering the short lifecycles of modern high-technology capabilities.

[15]Software Engineering Institute (SEI), "Open System Archictures: Where and When to be Closed" last modified 19 October 2015, https://insights.sei.cmu.edu/sei_blog/2015/10/open-system-architecture-when-and-where-to-be-closed.html

14. An example of this methodology can be drawn from the USN Space and Naval Warfare Systems Command (SPAWAR), as it has adopted the practice of introducing competitive ISS into projects. The Consolidated Afloat Networks and Enterprise Services (CANES) project successfully bid multiple components of an open architecture network design to multiple vendors. Both Lockheed Martin and Northrup Grumman were chosen to develop competing Common Computing Environments (CCE) that would become the backbone of the CANES architecture. The winner of this initial competition was Northrup Grumman who received the production funding for integration testing and partial implementation in the Fleet.[16] This initial competition was not for full implementation in the Fleet, and a second round of competition was conducted to determine other vendors who could complete the Fleet wide integration. As the system was developed with open standards, five different vendors successfully competed and were chosen to complete the Fleet implementation of over 200 naval platforms.[17] The standards based implementation meant that the USN was able to maximize the number of vendors competing for the full implementation and ultimately benefitted from a highly competitive ISS contracting environment.[18]

15. Proprietary systems are simply too expensive and restrictive for most rapidly evolving technologies. There are examples where proprietary solutions that cannot compromise on security or functionality have to be considered, but for most high technology applications, OSA

[16]Jessie Riposo, *CANES Contracting Strategies for Full Deployment* Technical Report Series (Santa Monica: Rand Corporation Technical Report for the US Navy, 2012), 13. https://www.rand.org/content/dam/rand/pubs/technical_reports/2012/RAND_TR993.sum.pdf

[17]Defence Systems, “Navy Adds 2 Vendors to $2.5 Billion CANES Contract” last modified 12 January 2015, https://defensesystems.com/articles/2015/01/12/navy-adds-two-vendors-to-canes-contract.aspx

[18]Defence Systems, “Navy Adds 2 Vendors to $2.5 Billion CANES Contract” last modified 12 January 2015, https://defensesystems.com/articles/2015/01/12/navy-adds-two-vendors-to-canes-contract.aspx

should be prioritized by the RCN. In adopting OSA capability development policies and by introducing competitive development, production and ISS contracting phases throughout a project lifecycle, the RCN can benefit tremendously from industry expertise and economies of scale that would otherwise not be available.

16. Human Resources. The current model of capability development in the RCN is hindered by the lack of continuity of Project Directors (PD) in the Directorate of Naval Requirements (DNR). Project management is not a skillset that is readily available in the military unless members have received specific training required for their position. Even then, short posting cycles and organizational posting priorities do result in an undesirable rate of turnover within naval FD billets. This turnover contributes to inefficiency in the project cycle that can only be mitigated by time in position and experience. A change to how FD billets for military members are managed is underway in the RCN, however, there are other viable means of alleviating this experience deficit by using civilians to support procurement processes.

17. The expansion of civil servant FD specialists into DNR would significantly increase continuity in the organization. These personnel could mentor military members in the processes involved in GoC procurement and support the generation and review of all staff work for policy compliance. This alone could raise productivity in DNR significantly and support the development of a cadre of mixed civilian and military FD specialists. That said the addition of civilian staff is not a simple matter as civilian positions, like military billets, are centrally

managed and regulated. This means there is limited flexibility for increasing an organizations establishment using public servants.

18. A possible solution to this lack of flexibility is the employment of contractors to perform a similar function. Contractors on short duration contracts are easier to establish, highly flexible and can be rapidly integrated to projects that require specialized skillsets. Contractors, however, are not the solution to the long term development of institutional expertise for FD. Contractors should only be pursued by DNR if they are filling a specialized function within a project that the organization cannot generate itself.

19. For high-technology procurement, skilled staffs are required. While the RCN is currently engaged in a staffing process to improve the productivity of military PDs in DNR, it should also focus on building institutional expertise for capability development by introducing civil servants into FD organizations. Where rare technical expertise is required, contracting specialists should also be considered as temporary project staff.

## CONCLUSION

20. The RCN is constrained in developing next generation high-technology systems by GoC procurement policy and regulations. That said, internal changes can be adopted to increase procurement efficiency within RCN FD organizations. Prototyping can be leveraged to accelerate the process for capital projects and can also support cost effective capability

experimentation and technology integration testing. By better leveraging the capability development structures inherent within our alliances, the RCN could accelerate the adoption of interoperable standards based capabilities and eliminate the requirement for internal investment for some high-technology capabilities. By adopting OSA approaches to capability development, the RCN can maximize competition with industry partners to improve efficiencies throughout the project process, including for ISS functions. Finally, by introducing new human resources strategies, the RCN could increase the productivity of PD staff in supporting a more agile FD strategy. The rate of evolution of high-technology capabilities will only increase in the future. The RCN must be prepared to create new policies and to generate efficiencies wherever possible in the procurement cycle, to ensure continued relevance in the future battlespace.

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