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EXERCISE/EXERCICE
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Altering the Course of In-Service Configuration Management Of the HALIFAX Class

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Abstract

The thesis of this paper is that the Canadian navy must implement a revised configuration management programme, which emphasizes audit, education, and accountability, if it is to regain configuration control of the HALIFAX Class. To support this argument, the author opens the paper with a description of a theoretically ideal programme. A review of the navy's existing programme, along with evidence of its failures are then provided. A comparison of the existing programme to the theoretical ideal is utilized to demonstrate that although the existing programme contains all of the key components, it does not properly execute them; nor is it supported by an educational programme or by policies that are upheld by senior leadership. Prior to concluding, the author provides a number of recommendations, which if acted upon, will allow configuration control of the HALFAX Class to be regained and maintained.

On 6 September 1870, nine months after her completion, HMS CAPTAIN heeled over and sank taking 472 men down with her. An inquiry revealed that her loss was attributed in part to instability, resulting from the fact that upon launch her freeboard, the measure from the waterline to the uppermost watertight deck, was 13 inches less than what her design had called for. This reduction in freeboard was caused by a failure to impose proper oversight and control on the incorporation of a large number of changes the vessel saw between the completion of her design and construction. In today's project management terminology, there was a failure in the configuration management programme.[1]

Configuration management is the discipline of producing documents which describe the configuration of an item, controlling and documenting any changes to that item, and conducting audits to ensure the item continues to be accurately reflected in the documentation that describes it.[2] The CAPTAIN incident is an excellent example of the consequence of not including proper configuration management in the design and construction of warships. Furthermore, the discipline of configuration management must continue after a ship has been accepted into service. The in-service configuration management programme must ensure that the salient features and characteristics that are designed into a ship are not degraded during its period of service. The programme must also require the recording and tracking of any approved changes that are made to enhance the vessel's capabilities.

For warships, the prominent features that must be configuration managed are those contributing to its essential capabilities of floating, fighting, and moving.[3] No matter how much apleron thacouldes care, maintenance, and operations of such a large and complex system as a ship to implement a realistic, credible, and effective in-service configuration management programme, which ensures that the delivered capabilities of a ship are maintained or improved upon in a controlled manner.

This task has proven to be a daunting challenge for the Canadian navy. Recent configuration audits have revealed that the existing configuration management programme has completely failed for the IROQUOIS Class and is failing for the HALIFAX Class.[5] This paper will show that regaining configuration control of the HALIFAX Class necessitates the implementation of a revised configuration management programme emphasizing audit, education, and accountability.

Support of this thesis will be accomplished by first providing an expanded definition of configuration management and its application to warships. To achieve this, a theoretical model of a configuration management programme will be presented, highlighting the components required for an in-service configuration management programme for warships. The paper will then move away from the theoretical to provide a review of the effort that the Canadian navy has made in area of configuration management, as well as the challenges that it has faced in the application of configuration management to the HALIFAX Class. To understand why, despite significant effort, these problems persist, a comparison of the navy's programme against the theoretical programme will then be conducted. The output of this analysis will then be used to develop recommendations to correct the deficiencies identified, and to suggest how a new comprehensive programme will allow configuration control of the HALIFAX Class of ships to be regained and maintained into the future.

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[5] This statement is supported by the findings of the Baseline Study conducted on HMCS ALGONQUIN in the spring of 1999. The study stated, "Several hundred unauthorized changes were identified throughout the ship." The changes varied from the relocation of a hose rack to the reconfiguration of an office area. Over 50% of these

changes were in the hull area of the ship. Similar audits conducted on HALIFAX Class vessels found only two hundred unauthorized changes, most of them minor in nature.

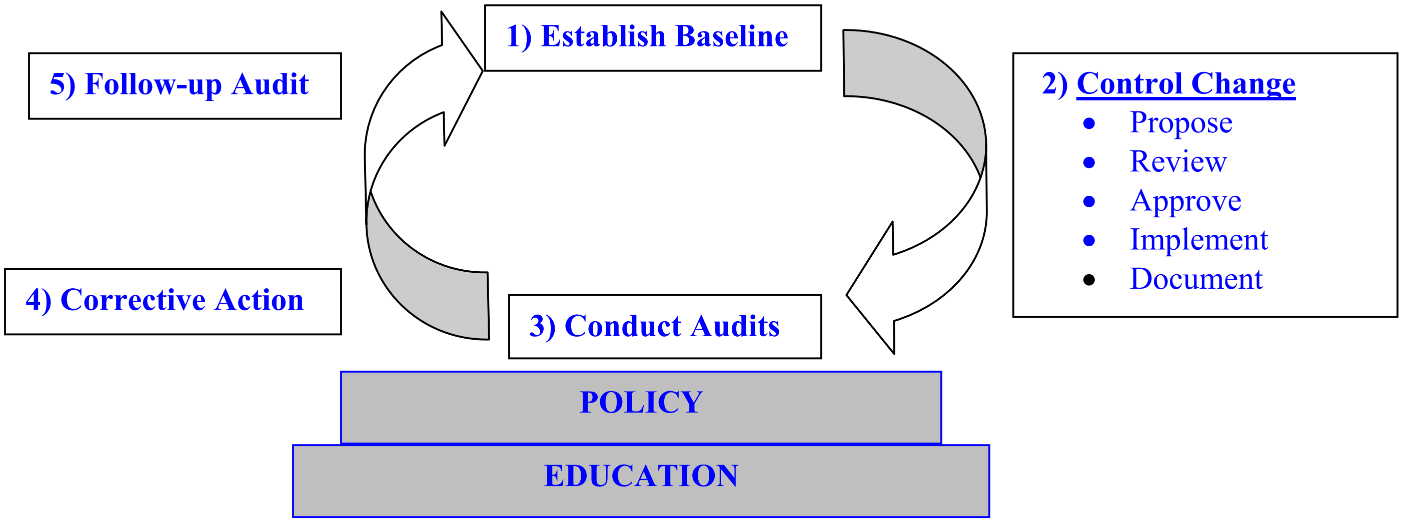

Figure 1 : Theoretical Configuration Management Programme

The Essence of Configuration Management

For warships, configuration management begins with the establishment of the baseline, the description of the physical characteristics of each item of interest on the ship in the form of drawings and publications. The essence of configuration management then is to ensure that any changes to these items are reviewed, approved, and recorded against this baseline. Audits are conducted to ensure that the change control process is working and that the baseline documentation continues to accurately reflect the configuration items. Discrepancies uncovered during the audit process must be corrected and a follow-up audit conducted. To make an effective programme, these processes must be supported by policy and education. Figure 1 depicts this theoretical programme.

The first step of this programme is the establishment of a baseline. To determine the baseline, it is necessary to understand the aim of the configuration management programme. Just as in the planning of a campaign, the determination of the aim must take into consideration the desired effect. The effect that an in-service configuration management programme for a warship must achieve is the protection of the ship's ability to carry out its core capabilities of floating, fighting and moving[6]. For each of these capabilities the following critical vulnerabilities must be considered in establishing a baseline.

To float, the ship must remain buoyant, displace a greater weight of water than the weight of the ship, and must remain stable, have the ability to float upright. To ensure that buoyancy and stability characteristics are not degraded, the baseline must consider weight and its location, and the maintenance of the watertight envelope of the ship. As a result, any changes that involve significant weight removal, addition, or re-location, or penetration of the watertight envelope of the ship can be controlled. This can be achieved by including the general arrangement drawings of the vessel in the baseline. In order to guarantee the ability of the ship to continue to float when damaged, damage control equipment, used to stop or control floods and fires, must be incorporated in the baseline. A proper weight control programme will protect the ship's stability characteristics so that except in extreme situations, it continues to remains upright when damaged.

To fight and move, the ship must have capable combat, propulsion, and auxiliary systems, as well as personnel to operate them. To preserve theses capabilities, the system level drawings of the combat and propulsion systems, as well as equipment manuals and data lists must be captured in the baseline. A critical factor for most warships is the electrical power and heating, ventilation, and air conditioning (HVAC) loads. Both of these are easily affected by configuration changes that on the surface can appear quite benign. Therefore, these auxiliary systems must also form part of the baseline. In addition, to maintain the safety of personnel, the material properties, such as toxicity and fire retardance, of the outfit and furnishings of the ship

[6] DMCM HALIFAX, FY 01/02 HALIFAX Class Plan (DND: DGMEPM), p 1-2, 2001. The aim of the HALIFAX CM programme indicated in the HALIFAX Class Plan is discussed in the Changes/Enhancements section. This is the only documented policy for the HALIFAX Class. It requires the vessel to be changed and updated to "maintain the elements of survivability, flexibility and tactical viability".

must be integrated into the baseline. Systems, such as replenishment at sea and lifting appliances, that involve a human-machine interface, must also be included so that any changes to them are reviewed with safety in mind to ensure that no unacceptable hazards are introduced into the interface.

The establishment of the baseline is significant; it must be complete enough to ensure that ship characteristics are not degraded, while at the same time it must make certain that the task of controlling change is manageable. The cost of implementing the configuration management programme and the ability to execute it in a timely manner must always be a consideration when defining the baseline. This leads us to the second step of the theoretical model, the control of change.

Throughout the life of a ship, numerous changes to the systems, structure, and furnishings will be made. It is extremely important that any change is controlled because the smallest change can impact spares provisioning, training, equipment manuals, safety, and ship operations.[7] The main vehicles that achieve change control are Engineering Changes (ECs) and Drawing Change Notices (DCNs). An EC, a change to some aspect of an established baseline, starts with an Engineering Change Proposal (ECP), a formal request for approval of a change. The ECP contains a clear description of the change to be made, the rational for the change, and the impact that it will have on the fit, form, and function of a configuration item, as well as the cost, weight, material composition, training, and documentation impacts. Should the change require a modification to a drawing, a DCN must also be generated when the change is approved. The process of submitting, reviewing, and approving ECPs ensures that that there is no degradation of the requirements to which the ship was built and accepted - its capability to float,

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[7] Eggerman, p 111.

to fight and to move. Once approved, changes are implemented and the baseline documentation is updated. It is in the steps that follow where assurance that this has been completed correctly is gained.

The third, fourth, and fifth steps of the theoretical programme are audit, corrective action, and follow-up audit. These steps provide assurance that there are no unauthorized or improperly installed changes, which have the potential to degrade ship capabilities or interfere with the implementation of approved changes. For a complex system such as a warship, these steps are vital to ensuring that the change control process is being correctly utilized, that changes are properly implemented, and that the baseline documentation is updated.

Effective application of configuration management requires those responsible for it to understand the importance of its processes, and to have the ability to apply them.[8] Hence, as shown in Figure 1, the foundation for a successful in-service configuration management is a comprehensive education programme that stresses not only the importance of the programme's success, but also the consequences of its failure. Equally, it must be supported by policies that ensure the programme is maintained.

A sound in-service configuration management programme therefore comprises a well-defined baseline, a change control process, audit, corrective action, follow up audit, a supporting education programme, and supporting policy. Configuration management can be a confusing subject and is not well understood by many companies,[9] the Department of National Defence, the navy in particular, is no exception as will become evident in a review of its configuration management efforts.

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[8] Eggerman, p vi.

[9] Eggerman, p vii.

The Canadian Navy's Configuration Management Programme

The identification and implementation of an efficient in-service configuration management programme has proven to be a significant challenge for the Canadian navy. The in-service configuration management programme utilized by the navy for the IROQUOIS Class controlled change via a formal board known as the Configuration Modification Review Board (CMRB). This board, composed of very senior representatives of the operational and engineering communities, ruled on the acceptability of changes to the vessels based on presentations made to them. The changes presented were classified as Shipalts, for major changes to the ship, and Shipmods, for less significant changes. The process was well documented; however getting a change through the board was lengthy, often requiring six to nine years. This time lag resulted in a number of changes being implemented unofficially.[10]

The findings of surveys conducted on each of the IROQUOIS Class ships, prior to their entering the Tribal Update and Modernization Programme (TRUMP), in the late 80s and early 90s revealed that in-service configuration management had failed; instead of a single class of ships, there were in fact four separate ships with varying configurations. Because of the failure of the configuration management programme prior to the project, the ships entered it heavier and less stable than planned. As a result, the ships emerged from the modernization with no future growth potential and a lower survivability capability than originally designed.

In the same time frame, the refit of HMCS PRESEVER, an auxiliary oil replenishment ship, was plagued with over 5000 extra charges as the ship did not conform to the baseline

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[10] LCdr Brent Hobson, former Maritime Command Deputy Chief of Staff Engineering and Material, Staff Officer Trials and Configuration Management, Interviewed 25 Mar 02.

documentation and drawings upon which the refit contract was based.[11] These issues, coupled with the arrival of new ships, the HALIFAX Class, prompted the navy to place renewed emphasis on configuration management and, in particular, change control.

During the 1990s, significant efforts were made to improve configuration management by concentrating on streamlining the change control process, referred to in the navy as the Engineering Change (EC) process. It was strongly believed that non-adherence to the EC process was a direct result of the fact that once an ECP was submitted it would take several years for the change to be installed. It was hoped that shortening the time to staff an ECP would encourage use of the process. To affect this, the CMRB was eliminated, and in its place a Change Review Group (CRG), whose composition was made up of operators and engineers at the middle management level, was utilized to approve ECPs. This reduced the staffing effort involved and, in consequence, the time to staff an ECP dropped to between two and three years .[12] In an attempt to streamline the process further, the coastal engineering units were removed from the review cycle, allowing ECPs to go directly from ships to the Formation HQs and then to NDHQ. As a result of the absence of vetting by the engineering units, the system soon became flooded with a large number of ECPs. Although most contained good ideas, they were not based on capability deficiencies, and failed to support operational requirements. During a time of fiscal restraint, these unaffordable 'good ideas' consumed design resources, clogged the system, and hampered the staffing of ECPs that needed to be completed to maintain class capability.[13] In an effort to combat this, a streamlined Minor EC process, which included the coastal engineering units, was introduced in 1997. Minor ECPs, those changes that could be developed by the

[11] LCdr Brent Hobson, Interviewed 25 Feb 01.

[12] LCdr Brent Hobson, Interviewed 25 Feb 01.
[13] L.T. Taylor, "The Equipment Change Dilemma", Maritime Engineering Journal, p.5, Oct 97.

coastal engineering units and installed at a total cost of less than $100K, addressed the majority of the minor items. The time from initiation to installation of these changes was measured in months[14]. In March 1999, a renewed commitment to configuration management was made by the Commander of Maritime Forces Pacific, who deemed that "no configuration change will be made to MARPAC ships, other than by the approved Engineering Change Process".[15] In the spring of 2001, efforts were made by the Formation Technical Authorities (FTAs) and the Director General Maritime Equipment Programme Management (DGMEPM) to clarify those changes that do not require an EC. However, the draft direction has yet to be finalized and issued.[16] Despite these efforts, the in-service configuration management system for the navy continues to experience difficulties. Over several hundred unauthorized changes have been discovered on the IROQUOIS Class, and thousands have been identified on the PROTECTEUR Class. These classes of vessels are both nearing the end of their lives, and can be considered to have lost configuration control.[17] However, the HALIFAX Class will serve the Navy for the foreseeable future and it is important to maintain its configuration.

HALIFAX Class Configuration Management Problems

The challenges of the in-service configuration management system for the HALIFAX Class have been evident in the areas of personnel safety, ship survivability, maintenance costs,

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[14] DMCM HALIFAX, p 3-1-13. Minor changes are those that apply to only one class of ships, have a negligible weight impact, are simple to install, utilize material in inventory, do not change operational capability, and do not exceed $100K to develop, install on the Class and update the TDP.

[15] Letter: Configuration and Weight Control of MAPAC Ships, MARP: 11900-DDH/IS-570 (N00 COMD), 30 Mar 1999.

[16] Draft Letter: Amplifying Information - Naval Configuration Management, 10040-1(DGMEPM), May 2001, Draft 2 05/14/01, and Draft 2 08/16/01.

[17] This statement is supported by the results of the ALGONQUIN's audit and the extras during PRESERVER's refit. The details of this are captured in footnotes 5 & 11.

and baseline maintenance. The most significant incident was the death of a sailor on HMCS REGINA in 1995. In this incident, the replenishment system utilized on the HALIFAX Class was modified without going through the configuration management process and as a result an unsafe change was put in place. Unfortunately, the modification failed and a block in the system became loose, striking, and killing a sailor[18]. Another safety problem surfaced in 1997 when it was necessary to order the immediate removal of poly vinyl chloride (PVC) deck matting and mattress pads that had been installed into the HALIFAX Class. These materials, if burned, produce toxic gases.[19] If this had been left unrectified, a fire in a ship could have resulted in catastrophe.

Yet another example of unauthorized change was the alteration to a non-structural bulkhead on HMCS CALGARY that relocated both the entrance to the main cafeteria and damage control equipment. Had this deviation not been corrected, sailors trained to work in a darken ship situation, could become disoriented or injured.[20] Pre-sailing trials of HALIFAX Class ships have revealed unauthorized changes that significantly increase the infrared signature of the vessels[21] and, ultimately, its vulnerability.

The differences that exist between HALIFAX Class ships, as a result of unauthorized change, require the navy to expend up to 40 hours of engineering effort to update each developed

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[18] Board of Inquiry into Accident on HMCS REGINA, Oct 1995: MARC: 1080-0097-2/96/N11-131-SO Admin, 2 April 1996, p 1.

[19] MARPAC SSO NA, LCdr Wood. From 1996-2000, LCdr Wood served as the Maritime Command Pacific Senior Staff Officer Naval Architecture, as well as the Fleet Maintenance Facilities Naval Architect Officer. In this position, I was actively involved in the identification and removal of PVCs on HMC ships, as well as the identification and rectification of unauthorized changes to the ships.

[20] MARPAC SSO NA.

[21] Presentation by DMSS 2 to CFC Maritime Component on Ship Survivability, 25 Feb 2001.

EC work package, prior to their installation.[22] The HALIFAX Class in-service configuration management problems are not limited to ships; the maintenance of an accurate baseline has also posed challenges. Audits of the HALIFAX Class uncovered that the baseline has not been updated to reflect a number of changes that were implement via the approved process.[23]

In 2001, the weight monitoring process for the HALIFAX Class indicated that the class has grown above the expected rate; this was attributed to 65-80 tonnes of unauthorized change, including the carrying of unauthorized stores. This growth represents 20-25% of the ship's through-life growth margin, that margin incorporated in the design to allow for the future insertion of new technologies and capabilities. This is of concern, as the HALIFAX Class's end of life (EOL) displacement, comprising displacement at delivery plus through-life growth margin, is defined by her structural strength capacity.[24] Once EOL displacement is reached, no future growth can be allowed and operational restrictions may have to be placed on the ship until her displacement can be reduced. The degree of unauthorized change on the HALIFAX Class will increase the cost of the Frigate Life Extension Project (FELEX), and the ability to insert new technology into the vessels during the project, scheduled to occur in 2007.[25] In fact, the consumption of weight has already meant that Active Phased Array Radar (APAR), a capability improvement that was planned for FELEX, cannot be installed.[26] The above examples are all symptoms of failures in HALIFAX Class's configuration management programme. It is the

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[22] MARPAC SSO NA.

[23] Letter: "Results of Baseline Configuration Audit Conducted In HMCS OTTAWA In May 2000", FMF CB: 11900(ENG/NA) Feb 2002. The results of this audit, conducted in May 2000, as well as that of HMCS VANCOUVER in July 2000 documented this problem.

[24] DMCM HALIFAX, p 3-1-6.

[25] DMCM HALIFAX, p1-1.

failures, and not the symptoms, that must be addressed if configuration control of the HALIFAX Class is to be regained and maintained into the future.

Analysis of the HALIFAX Class Configuration Management Programme

To understand and identify the failures of the HALIFAX Class's configuration management programme requires an analysis of the existing programme against the theoretical ideal. First, a comparison of the aim of the programme and the baseline established to meet that aim must be examined. The HALIFAX Class Plan should define the aim of the HALIFAX Class configuration management programme. The plan documents the need to "maintain the elements of survivability, flexibility and tactical viability" and the need to retain the "current level of combat capability", but most importantly it addresses the "direction of class changes/enhancement".[27] Although this aim is consistent with the theoretical one discussed, the above statements of intent are very general and can be interpreted to suit the individual submitting an ECP. This makes screening out non-essential changes that much more difficult, which leads to the overload of the ECP system.

The baseline defined in the HALIFAX Class Plan is adequate, containing all of the required drawings and publications to describe the configuration items in the ship. The second step of the theoretical model presented is the control of change, this is one area which the navy has expended significant time and effort in an attempt to streamline the process.

The EC process is documented and is under a continuous improvement programme;[28] however, its main area of weakness is that it does not clearly define when a change proposal is

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[26] LCdr M. Burke: former Capital Project Coordinator, Director General Maritime Doctrine and Operations, 25 Mar 02.

[27] DMCM HALIFAX, p 1-2.

[28] "Engineering Change (EC) Development", Http://admmat.dwan.dnd.ca/dgmepm/services/Eng_change_process/index.asp

required. The process defines how to submit a change and how it is staffed, but does not clearly define when it must be submitted. There is no checklist that can be utilized to confirm that an ECP is, or is not required. Direction that determines when an ECP is required is contained in the Naval Maintenance Management System (NaMMs) documentation, the HALIFAX Class Plan, and finally the HALIFAX Class Technical Data Package (TDP). NaMMs is very vague and defines the requirement for an EC as "an alteration in the configuration of a Configuration Item (CI), after formal establishment of its configuration identification through the Technical Data Package (TDP)."[29] The HALIFAX Class Plan has slightly greater clarity, and defines the requirements to submit a ECP as when any changes are contemplated that affect "hardware, firmware or software performance, physical or functional characteristics, as defined in equipment [or system] specification and drawings", as well as "any change whereby an item of equipment, outfit or furnishing, or system is added, removed or repositioned so as to entail the alteration of the Structure, General Arrangement, Compartment Arrangement, or Key Plan drawing".[30] This direction for change control in a very general sense requires an ECP for any modifications to the baseline. It therefore, with one exception, achieves the requirements discussed for the theoretical ideal. The exception is that it does not appear to capture changes to the material composition of an item, such as the use of toxic substances as replacements for original material. Having reviewed the first two steps of the programme, the HALIFAX Class configuration management programme appears for the most part to match the theoretical model, and therefore meets configuration management requirements, and should work. It is in the next steps concerning audit, corrective action, and education that the programme begins to fall down.

[29] C-03-005-012/AM-001, Naval Maintenance Management System Volume 1, Part 16, Advance Notice Copy 1999-01, p 16-1-1.

[30] DMCM HALIFAX p 3-1-14.

The Problem

Audit, corrective action, and follow up audit, the third, fourth, and fifth steps of the theoretical programme, are major weaknesses for the Canadian navy. It was only recently, after over a decade of service, and not through any established plan, that audits of the HALIFAX Class were conducted[31]. Even then, defect rectification and follow up audit have not been conducted since. In conformance with the theoretical ideal, there is a written policy in NAMMs that requires audits to be conducted periodically, and that provides direction on corrective action and follow-up audit. However, it does not stipulate a minimum frequency of audit.[32] The failure to mandate, at some frequency, these vital steps that would document and curtail non-adherence to the programme, as well as the failure to take corrective action following audits, are major downfalls of the navy's configuration management programme.

Another, equally important failure is the lack of configuration management education. There is no formal training on configuration management either for operator or for engineers[33]. Nor indeed, as indicated above, is there any document one can turn to for self-education. Information is spread over a website, NAMMs, Class Plans, and the TDP. Not even a road map, which indicates that all of these documents must be visited for a complete picture, exists. Instead, it is only through job experience in either the Formation HQ or NDHQ that officers become fully aware of the configuration management programme, its benefits, and the impact of its failure.

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[31] Audits were conducted on HMCS HALIFAX (Jun 99), HMCS ST JOHN (Jul 99), HMCS TORONTO (Jul 99), HMCS CHARLETOWN (Nov 99), HMCS OTTAWA (May 00), HMCS MONTREAL (May 00) and HMCS VANCOUVER (July 00). Source: Emails from MARLANT N42-4 &MARPAC SSO NA., Mar 02.

[32] C-03-005-012/AM, Naval Maintenance Management System, 1994-02-03, Vol 1 Part 17.

[33] LCdr M. Burke: Interview, Feb 2002. Early in an Officer's career, some training on the EC Process is provided, but there is no training, which fully explains the essential elements of configuration management, and the consequences of not invoking it.

As a result of ignorance of the goals and components of the configuration management programme, combined with a frustration with the unresponsiveness of the system in the early 90s, commanders at unit level have often openly disregarded the policies. The most extreme example of this occurred on the IROQUOIS Class where bulkheads were removed to reconfigure the ship's offices.[34] This highlights a further failure in the HALIFAX Class configuration management programme, the lack of adherence to policies. This disregard has lead to a culture that only pays lip service to the aim and procedures of the configuration management programme, with no evident consequence for failure to adhere to policy.[35] Furthermore, it can be argued that members are rewarded for non-adherence. A large number of unauthorized changes are for comfort issues, for items that improve fighting efficiency, and for administrative efficiency. Implementation of these types of items, authorized or not, are often viewed as indicators of good initiative and personnel are rewarded for this in their evaluations.

In summary, the configuration management programme will never succeed if the programme is not documented in a single source, if personnel are not trained on it, if there is no regular audit process in place, and if failure to follow the underlying policy is openly accepted and goes unchecked. It is now appropriate to look at how the failures of the existing system can be resolved.

Recommend Way Ahead

As critical as the discussion has been, all is not lost. Audits have confirmed that we have not yet lost total configuration control of the HALIFAX Class. Only 200 unauthorized changes

[34] MAPAC NAO: Unauthorized reconfiguration of ship's offices occurred on both HMCS ALGONQUIN and HMCS IROQUOIS in 1999.

[35] For example, on the IROQUOIS Class complete bulkheads within the ship were removed, significantly altering the ship's baseline configuration. The only public result of this was the issuance of a letter from CMS to the Navy indicating that "there are no EC Free Zones" in the IROQUOIS Class. No specific mention of the incident was made. IROQUOIS Class Weight Growth, MARC: 3294-09 (DMMPD), 14 February, 1999.

have been found on each of the HALIFAX Class ships, and of these, only 12 to 14 of them can be considered significant[36]. The problems and deficiencies of the existing system can be corrected, but only with the support of senior management. In order to regain and maintain configuration control of the HALIFAX Class, the navy should establish a configuration management education programme, create a single configuration management programme document, include material changes in requirements for ECs, improve the screening of ECPs at unit level, establish an audit process at a regular frequency, correct deficiencies identified during audits, and address individuals who fail to follow the programme.

The first step is education; a configuration management programme can only be successful if it is fully understood. Early in an officer's career, during the common officer phase of training, extensive instruction on the aim and mechanics of a configuration management programme must take place. An abridged version of this training should be repeated during the Technical Officer, Executive Officer and Commanding Officer refresher courses to ensure that prior to assuming a position of responsibility onboard ship, officers charged with the care, custody, and maintenance of the vessels would fully understand the configuration management programme.

To support the education process, a single document should exist that outlines the main components of the HALIFAX Class configuration management programme and explains the process that support it. Resident in the document should be a restatement of the HALIFAX

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[36] Audits conducted on HMCS OTTAWA (May 00), the newest of the HALIFAX, and HMCS VANCOUVER (July 00), the second oldest of the HALIFAX found approximately 200 unauthorized changes on each of these ships. Of these changes, only 12 on VANCOUVER and 14 on OTTAWA were deemed to be significant. Data was received from the MARPAC NAO, 25 Oct 01. Similar audits were conducted on the East Coast HALIFAX ships with a comparable number of unauthorized changes. (HALIFAX Jun 99: 135, ST JOHNS Jul 99:214, CHARLETOWN Nov 99: 179, MONTREAL May 00: 170). Data provided by MARLANT N42-4, Mar 02. Again, the majority of these changes were not of major significance o the critical float, fight and move criteria.

baseline, as well as specific direction on when an ECP and a Minor ECP are required to be submitted. In addition to the existing requirements for submission, a change to the material properties of an item should require an ECP. There should be a clear explanation of what conditions are required for an EC to be considered for acceptance, so that in today's resource limited environment enhancements that are beyond design requirements, or are not supported by an operational deficiency, are screened out at the unit level.[37] This should result in only those changes that warrant serious consideration being forwarded to the Formation HQ and NDHQ.

To date, most of the navy's efforts have been focused on improving the change control step; emphasis must now be placed on the other steps of the configuration management programme. To accomplish this, regularly scheduled audits accompanied by corrective action and follow-up audit needs to be programmed into the ship's life cycle. Ideally, this should take place every two to three years, at change of command, so that the commanding officer is held accountable for the delivered state of his/her ship. To be effective, audit and corrective action must have the full support of the leadership. It must be recognized that some problems will continue to occur; however, when they are a result of blatant disregard they must be dealt with appropriately.

Conclusion

In summary, this paper has provided an overview of configuration management by first defining the major concepts of baselines, change control, audit, and corrective action for a theoretical programme, and then specifically for the warship application.

The discussion then focused on the effort that the Canadian navy has made since the early 1990s in an attempt to establish an effective configuration management programme. It was

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[37] LT Taylor, p 5.

shown that despite this effort, numerous significant configuration management issues arose throughout the 1990s, the most serious of these resulting in the death of a sailor. These problems, that endanger personnel and continue to consume scarce resources, are symptomatic of failures in the construct and application of the HALIFAX configuration management programme.

Dismissing the IROQUOIS Class situation, the paper focused on identifying the failures of the HALIFAX Class through a comparison of the theoretical ideal and the navy's programme for this class. The analysis revealed that although the navy's configuration management programme contains the major components described in the theoretical model, its audit and education processes are deficient. The audit process is not properly utilized as it is not mandated at any frequency. Furthermore, when audits have been conducted, corrective action and follow up audit have not taken place. Equally important, the navy's programme does not include an effective education component. Insufficient training is provided to both operational and engineering communities, who are tasked with the application of the configuration management programme at the ship level. The final area of failure is the lack of tangible support for the configuration management programme from the leadership of the navy. No consequence for blatant disregard of configuration management policies is evident.

To address these failures, recommendations were put forward which, if acted upon, will correct the deficiencies identified, and result in a comprehensive programme that will allow configuration control of the HALIFAX Class to be regained and maintained into the future. To date, the Canadian navy has been fortunate that only one fatality has resulted from the deficiencies of the existing configuration management programme. Peacetime operations can mask the dangers of a flawed programme, often only making evident cost and administrative problems. It is when a ship is deployed into a war zone, and damage is taken, that the true cost of the failure of a configuration management system will be realized.

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