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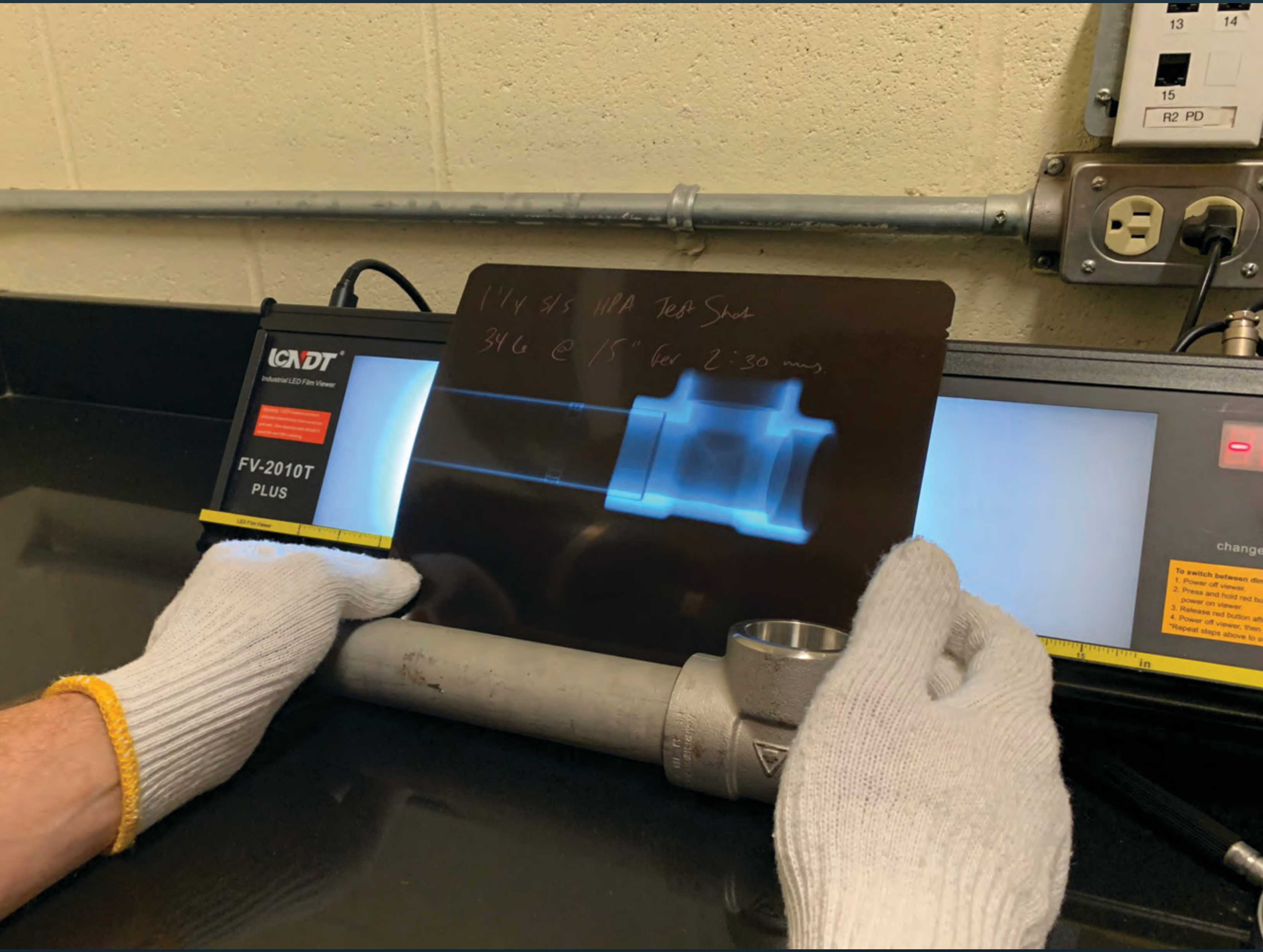

FMFCS photo by Gabrielle Brunette

Radiography technicians at Fleet Maintenance Facility Cape Scott in Halifax use X-ray and gamma-ray equipment to inspect critical shipboard systems and structures.

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Maritime Engineering Journal

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AI-generated image courtesy Pixabay.com

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COMMODORE'S CORNER

Commemorating the Sacrifices of the Past — Defending Peace and Security for the Future

By Commodore Keith Coffen, CD

Two recent commemorative events were sobering reminders of the cost of global conflict, especially in terms of the sacrifice and heroism of the soldiers, sailors, aviators and non-uniformed combatants who performed extraordinary service under the most dire of circumstances.

On June 6, 2024—the 80th Anniversary of the D-Day landings—many of us watched on television as, with HMCS *William Hall* (AOPV-433) standing off the coast of Normandy, dignitaries including some of the few remaining Canadian veterans of the Second World War gathered to acknowledge the monumental Allied effort that turned the tide of war against Nazi tyranny in Europe.

Then, on July 1, thousands gathered in my hometown of St. John's for a solemn event to mark the centennial of the Newfoundland National War Memorial, and the interment of a repatriated unknown Newfoundland soldier of the First World War. The soldier, who died in France in 1916, was laid to final rest with full military honours and the gratitude of a larger nation, there to represent all Newfoundlanders and Labradorians killed in conflict. As the Dominion of Newfoundland did not become part of Canada until 1949, special dispensation was received from the Commonwealth War Graves Commission for Canada to repatriate this pre-Confederation Newfoundlander to his home soil.

It is regrettable that, even today, armed conflicts continue to wreak havoc with people's lives around the world, but the events in Normandy and St. John's serve to remind us that when it comes to defending peace and prosperity, Canadians are always prepared to step up. As we commemorate Canada's past sacrifices, it is imperative that we continue to look forward to our future with an informed perspective on the importance of maintaining a modern and credible armed force that respects the rule of law, and can bring decisive effect to bear as and when needed.

To that end, three significant news announcements have recently been made that affect the RCN, the CAF, and DND: First, the Canadian Surface Combatant ships have been named as the Navy's new **River-class destroyers**, with the lead ships identified as HMC ships *Fraser*, *Saint-Laurent*, and *MacKenzie*. Construction of the Production Test Module for the class is underway, with construction of HMCS *Fraser* expected to begin next year. Next, **LGen Jennie Carignan** will leave her current job as Chief, Professional Conduct and Culture to take command of the Canadian Armed Forces. She will take up her new appointment as Chief of the Defence Staff on July 18. Finally, it was announced that MGen **(Ret'd) Nancy Tremblay** will become Canada's new Assistant Deputy Minister (Materiel), leading the Materiel Group that includes the Maritime Equipment Program Management division (DGMEPM).

Photo by Mona Ghiz, MARLANT Public Affairs

The Honourable Bill Blair, Minister of National Defence and Vice-Admiral Angus Topshee, Commander of the Royal Canadian Navy unveil the River-class destroyer.

I hope you will join me in celebrating these important milestones, which are all the more noteworthy in that both the new CDS and the new ADM (MAT) are the first women to occupy these posts.

As Prime Minister Trudeau noted recently, Canada's greatest strength is its people. The same applies to the RCN, the CAF, the MAT Group, and the wider Naval Technical support community. Canada's defence and security do not happen by accident, and the work we do, inasmuch as it may help ensure that future generations need not be subjected to the hardships of war, honours the service and sacrifice of generations past.

Keep up the great work; I wish you a safe and restful summer.

FORUM

The Challenge of Communicating Technical Guidance in an Operational World

By Cdr Helga Budden

As engineers and technicians, one of our key roles is to provide advice to commanding officers regarding the safe operation of their ships/submarines from the standpoint of material fitness and limitations. With the RCN's major fleet units getting on in years, it is imperative that the personnel who take these vessels to sea both understand and follow the measures necessary to protect them from unnecessary stress and damage.

To aid us in this, the Naval Technical community relies on various tests and trials to establish material condition against the documents that lay out the design intent and specifications to which the ship/submarine was built and delivered. However, when it comes to telling the persons holding command, control, and charge how to drive their ships within safe limits, the deck plates get a bit slippery. There are plenty of anecdotes out there of engineers being reminded of their place in the hierarchy of things, but a recent initiative seems to be creating a sea change in the way the two sides of Naval Operations — technical and operational — can communicate more effectively.

Photo: MCpl Manuela Berger, Canadian Armed Forces Photo

Maritime Coastal Defence Vessel HMCS *Moncton* (MM-708).

Cast your mind back to the early 2000s: The *Kingston*-class maritime coastal defence vessels (MCDVs) were new, and the RCN was really exploring the extent of their capabilities. Research was ongoing through the *Kingston Class MCDV Seaworthiness Study* to understand the capabilities of these new vessels in high seas. One dark and stormy night, HMCS *Brandon* (MM-710) was sailing in some terrible weather when a hull-slamming situation developed. From this incident it became clear that the class was vulnerable to slamming damage, particularly in the forward compartments (i.e. bow thruster, and sewage treatment plant), and the bilge keels. No one was seriously injured, and so the learning continued into what was a good engineering problem set.

The subsequent research carried out by the Engineering and Defence Science teams resulted in a well-written, and well-received technical bulletin (TB): *C-28-007-000/TB-001 Technical Guidance to Minimize the Probability of Slamming Damage on Kingston Class Vessels*. This document, with its straightforward language, and polar plots illustrating the recommended operational envelope regarding the ship's heading and speed limitations in various sea states, was included with every bridge emergency pack in the class. (An example of this type of guidance is illustrated in hydrodynamics specialist Michael Dervin's excellent 2006 article describing computer simulations of MCDV operational capabilities in heavy seas — see MEJ 60.)

With the passage of time, the change in the MCDV concept of operations, and the significant crewing changes from Naval Reserves to a largely Regular Force crew, this experience was lost, and the document disappeared from the day-to-day lexicon of the bridge and command teams. Unfortunately, this only came to light after a significant structural defect was discovered in HMCS *Kingston* (MM-700) following Op Reassurance in 2022. In the days and weeks following the ship's return to Halifax, it became evident that although the requirements for ballasting that were identified in the technical bulletin had been incorporated into the class Manual of Trim and Stability, the guidance for speed of advance and route planning had not made a similar integration in the operations and seamanship manuals.

This wasn't the first time that direction contained in a TB had become lost to the operators, and the frustration behind this prompted the eternal question of why this type of direction has to be issued in the form of a technical

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bulletin in the first place. As a technical community, we cannot require that the operational community change their publications, nor can we be responsible for ensuring that every person who goes to a sea is aware of every single TB that impacts the safe operation of their ship. We know that the technical community provides guidance, and the operational community provides direction, so how to bridge that gap to ensure our corporate memory is not lost?

The answer may lie in a different style of interaction between the Naval Technical community and the Naval Warfare (operational) community through a cooperative "reinvigoration" of Fleet Orders. While no single ship or DGMEPM/Fleet Maintenance Facility (FMF) section can "enact" anything on the fleet, an order from the Fleet Commander certainly can.

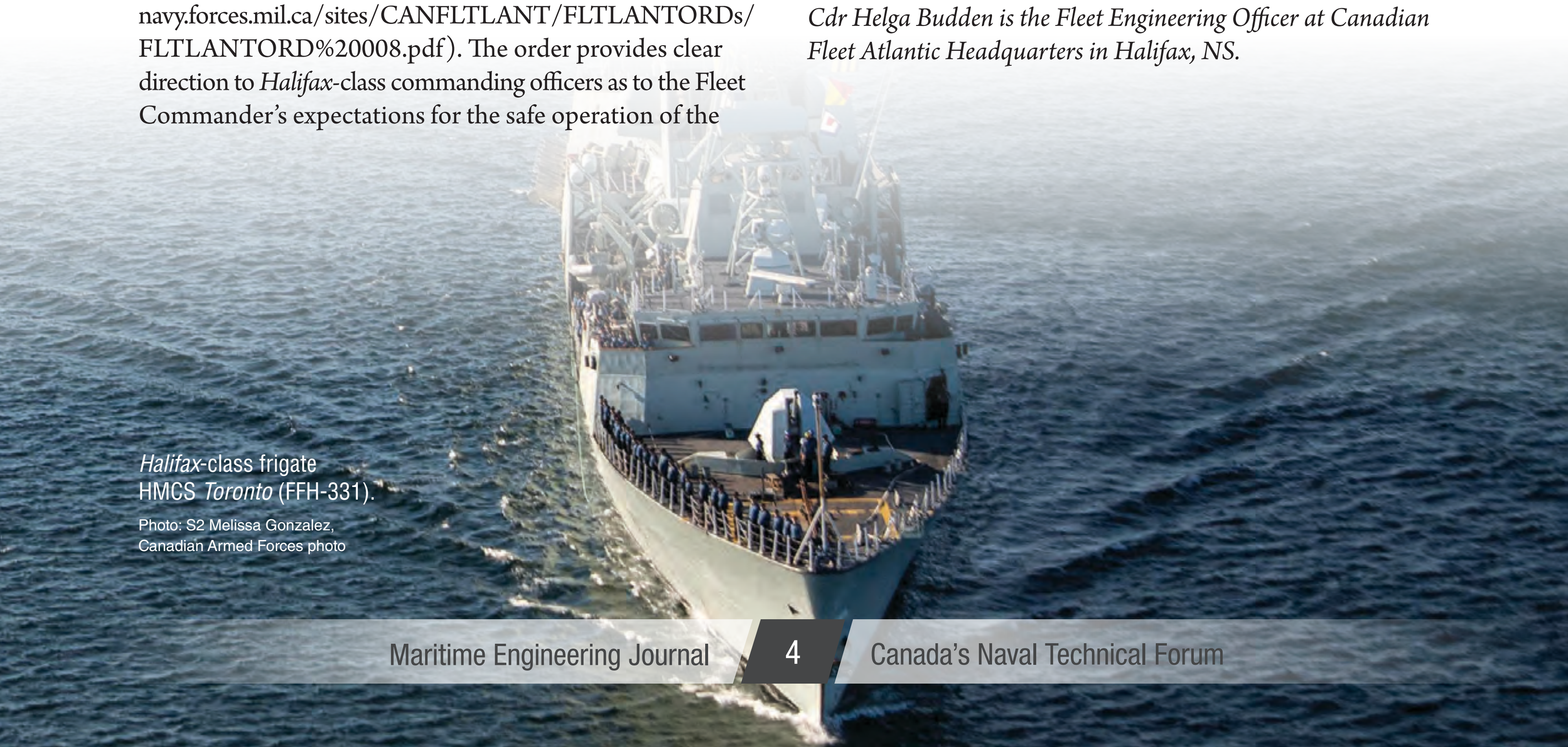
On Feb. 13, 2024, Commodore Trevor Maclean, Commander Canadian Fleet Atlantic, published *FLTLANTORD 004 Fleet Atlantic Order – Kingston Class Ship Restrictions* (https://collaboration-navy.forces.mil.ca/sites/CANFLTLANT/FLTLANTORDs/FLTLANTORD%20004.pdf). While the specific contents are not freely accessible to all readers of this journal, the order gives clear direction to *Kingston*-class commanding officers regarding route planning, and specifies when they are required to communicate with the Fleet Commander with respect to wind/wave states being experienced at sea. The order also makes clear that the safety of the MCDV vessels and crews remains the top priority.

Following this success a second order, pertaining to the *Halifax*-class frigates this time, was drafted for the Fleet Commander's signature: *FLTLANTORD 008 Fleet Atlantic Order – Halifax Class Ship Restrictions* (https://collaboration-navy.forces.mil.ca/sites/CANFLTLANT/FLTLANTORDs/FLTLANTORD%20008.pdf). The order provides clear direction to *Halifax*-class commanding officers as to the Fleet Commander's expectations for the safe operation of the frigates, and includes direction that specific reports be submitted to local and DGMEPM engineering authorities. It pulls together guidance from a message released by the Director of Naval Platform Systems (DNPS 2): i.e. *Halifax Class Displacement Guidance DTG 171420Z*, and translates it into direction from the Fleet Commander to the COs.

In all, *FLTLANTORD 008* rolls up the DNPS 2 message, two TBs (*C-23-HFX-000/TB-007 Guidance on Diesel Fuel Oil (DFO) Usage and GLM Updates*, and *C-23-HFX-000/TB-001 Guidance on Fresh Water Ballast (FWB)/Standby Diesel Fuel Oil (DFO) Tank Usage*), along with the requirements for completing the Stability Checklist, the usage/submission of logs including fuel reports, and bilge/oily water logs, and submission of GLM files to the Naval Architecture Officer (NAO) in FMF Engineering and DNPS 2 prior to sailing. The collection of this data will allow better management of each ship's stability and structure, as well as ensure specific and detailed support from shore authorities in the event of an emergency at sea.

The support of Commander Canadian Fleet Atlantic cannot be overstated. An eternal conundrum was addressed through an open mind, a willingness to accept the challenge, and the stroke of a pen. I expect that more FLTLANTORDs translating technical guidance into operational direction will be coming in the future. Although these first ones are out of the East Coast, the West Coast is looking at adopting the same approach in order to establish and maintain a culture and environment of knowledge sharing, and to ensure that our hard-won technical lessons learned are not lost.

Cdr Helga Budden is the Fleet Engineering Officer at Canadian Fleet Atlantic Headquarters in Halifax, NS.



Halifax-class frigate HMCS *Toronto* (FFH-331).

Photo: S2 Melissa Gonzalez, Canadian Armed Forces photo

FEATURE ARTICLE

Key Considerations when Seeking Digital Solutions

By LCdr Samuel Poulin

In his second article spotlighting DND's path to digital transformation (see MEJ 106), DGMEPM's Digital Program Coordinator offers a checklist for establishing a more effective, thoughtful approach to enabling digital solutions.

As with any large organization, procurement activity within the Department of National Defence (DND) is a complex process having many moving parts, not all of which may be operating in harmony with the bigger machine or even with themselves. Silo organizations looking for quick business solutions in an effort to be "agile" can create a sea of unmanageable "home-grown" tools that fail to meet acceptable standards of quality and sustainability.

Nowhere is this more obvious than with procurement relating to digital solutions. Whether we are talking about customized Microsoft Access databases stored on a common drive, small applications developed by a co-op student, or the obtention of multiple licences for an industry hosted application, well-intentioned "quick solutions" such as these invariably require users to duplicate data from other systems, and create more problems than they solve.

Fast-tracked initiatives might seem to be an innovative approach to "filling a gap" by quickly digitizing or automating a business process, but in most cases they have neither received Authority to Operate (ATO), nor fully considered issues relating to accessibility, usability and sustainment. The result can be a hampered ability to conduct maintenance and upgrading, install patches, deliver training, or offer general user support, which begs the question: What exactly were the business requirements the solution was meant to enable?

To succeed in a journey to digital transformation, individual digital solutions must be carefully enabled as part of an "architected ecosystem" of integrated applications that leverage the efficiency of technology in support of operations. An agile approach can still be taken to enable small pieces of the overall puzzle through an iterative, user-centric, approach, but it is important that certain factors be assessed from the outset.

This article discusses six key considerations from a business (i.e. client) perspective for clients who are looking to acquire viable digital solutions that satisfy not only their own individual business requirements, but those of the parent organization as well. A few starting points are also provided to help organizations get themselves on the right path.

To succeed in a journey to digital transformation, individual digital solutions must be carefully enabled as part of an "architected ecosystem."

Consideration No. 1: Business Requirements

The elicitation and endorsement of clear business requirements is a crucial step that is often missed. Organizations, especially engineering teams, quickly jump into technical requirements with a specific solution in mind. Business requirements should be almost completely abstract from the technical requirements, and focus on what the business needs to accomplish (functions and processes) rather than how it would accomplish it at a tactical, or, IT solution level. This is where a well-defined business architecture becomes extremely useful.

ISO/IEC/IEEE International Standard 29148 – *Systems and software engineering – Life cycle processes – Requirements Engineering* is an adopted standard explaining the difference

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between the multiple levels of requirements documentation for systems and software, starting with the Business Requirements Specifications.

Starting points:

1. Identify and engage the business function owner. This might seem trivial, but the office that is accountable for a business function or process should be the first one you consult before a digital solution is sought to digitalize their operations. The objective is to have them fully on board, as they should be the ones endorsing business requirements, or at the very least involved in the elicitation.
2. Have a well-defined, yet flexible, business architecture. This includes documented business functions and business processes using the DND Architecture Framework. The objective is to clearly understand how the execution, through functions and processes, supports strategic outcomes. It also serves to understand the different stakeholders, who in turn will become the users of the resulting solution. Flexibility is key, specifically in business processes, so as to not miss opportunities to leverage commercial off-the-shelf (COTS) products and out-of-the-box configurations that will help keep the complexity and cost of implementation and sustainment to a minimum. COTS solutions often present the opportunity to improve existing processes by leveraging industry best practices.
3. Elicit business requirements for which a digital solution is sought. The Business Requirements Specifications should be "solution agnostic," and focus on functions, processes, and desired outcomes. The objective is to capture what you want the digital solution to do in support of your business outcomes. This will be instrumental in the development of system and software requirements specifications, user acceptance tests, and in verifying that the resulting product provides value added to the business.

Consideration No. 2: Existing Options

Once you have your business requirements, reach out to your IT service organization, or the Directorate Enterprise Application Architecture (within the Chief Information Officer group) to see what is already available, or in the project phase. As noted, leveraging existing solutions, or platforms, can offer significant benefits. Should existing solutions not meet your needs, your IT service organization can help you determine whether the best option is to procure a COTS product, or develop a custom digital solution based on your business requirements, constraints, and funding.

How can we keep up with technology and be innovative?

You might ask how we can get things done quickly enough to keep up with the pace of technology development, while ensuring all of these key considerations have been addressed. How do we avoid deterring people from being innovative? Innovation, it has been said, is about transforming creative concepts into tangible outcomes that either improve efficiency and effectiveness, or address unmet needs. It is not about circumventing processes.

I would argue that the following examples are places where we might find efficiencies, and thereby allow ourselves to become more innovative in enabling digital solutions:

1. optimizing bureaucratic internal email-driven business processes through the use of automated service management digital solutions;
2. finding a better balance between fully centralized IM/IT authorities and functions (within the Digital Services Group group) and the completely decentralized ones across Level 3s (Directorates, Units), and establishing associated IM/IT delegation of authorities;
3. establishing and communicating clear processes within L1s (Groups, Branches) and L2s (Divisions, Formations) to request, prioritize, fund, deliver, and support digital solutions; and
4. making digitalization part of an organization's business plan by including clear objectives and key results to support the allocation of resources necessary to enable the implementation and support of digital solutions.

— **LCdr Sam Poulin,**
Directorate of Maritime Management Support

Consideration No. 3: Security

The Security Assessment & Authorization (SA&A) process must not be avoided. It is a necessary evil to ensure that a solution's residual risks related to confidentiality, integrity, and availability are identified and endorsed at the appropriate level. No digital solution is allowed to be used in a production environment (with real data) without having explicitly received the Authority to Operate (ATO). This ATO milestone is achieved when a letter identifying the residual risks is signed by both the DND IT Security Authority and the system's Operational Authority.

Starting points:

1. Fill out a Security Categorization Assessment Report (SCAR). The objective is to determine the target security risk profile based on answers to a series of questions within the report. It also serves to identify the system's Operational Authority.
2. Engage your unit's Information System Security Officer (ISSO) to identify and appoint a System ISSO. This individual will be the central coordination point on matters of IT security throughout the life cycle of the digital solution.
3. From there, your System ISSO and IT service organization should reach out to the Director Information Management Security to initiate the SA&A process that will identify a tailored list of security controls based on the solution's scope and security profile. Note that if you are procuring software, or even a Software-as-a-Service (SaaS) licence, there is information that you will need to include in the contract, and documentation you will need from the software provider. As such, security cannot be an afterthought. Also keep in mind that IT security is an ongoing matter, and does not simply stop once the ATO has been achieved.

Consideration No. 4: User Experience

Digital solutions must be people-centric, with intuitive user interfaces available in both official languages. User experience is more than just the interface, of course, but while it is easy to state in a technical bid evaluation that the software must be able to do X, it is much harder to elicit verifiable requirements on the efficiency and ease with which a user is able to perform X using the software.

Starting points:

1. Understand who your digital solution's users will be, and their level of digital literacy. The objective is to make sure the resulting solution considers the lowest levels of digital skill, confidence, and accessibility.
2. Consult the Government of Canada Digital Standards Playbook to understand how to interpret the policies and directives on how to deliver accessible, people-centric digital solutions. (https://www.canada.ca/en/government/system/digital-government/government-canada-digital-standards.html). In turn, this might affect your requirements and technical bid evaluation criteria.
3. If you intend on having a web application developed, consider using the Canada.ca Design System (https://www.canada.ca/en/government/about/design-system.html). This offers a common look and feel from an approved template that already complies with most accessibility and usability standards.

Consideration No. 5: User Access and Data Exchange

User access, data-exchange, and interconnectivity must be considered from the start to truly leverage the power of an ecosystem of interconnected applications—and avoid duplication of data. In most cases, there is a COTS product that can be relatively easily procured, enabling a defined set of functions for a specific group of users within an organization. Industry-hosted Software-as-a-Service makes this process even easier, as organizations can simply procure annual licenses using Vote 1 funding.

But what if the "source of truth" of a major part of the data required to perform said functions already resides in an in-house solution such as the Defence Resource Management Information System (DRMIS)? Integrating software through custom Application Programming Interfaces (APIs) is complex, costly, and not without security concerns, and is how we too often end up with duplication of data on different systems, and an inability to properly integrate solutions.

User access, data-exchange and integration can't be afterthoughts. They, along with the confidentiality level of the data, play an instrumental role in any decision regarding a solution's target environment.

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Starting points:

1. List all the different types of users, and how they would ideally access the solution (i.e. using which device, which credentials, and through which network). The objective is to understand the user access points for all potential users of the digital solution.
2. Identify the source of truth of data residing in existing systems supporting your business functions and processes. The objective is to identify the potential interconnection and data-exchange requirements for the new digital solution to avoid duplication.

Consideration No. 6: Operation & Sustainment

To echo the Sustainment Business Case Analysis (SBCA) process, when evaluating options to enable a digital solution, the costs associated with operation and sustainment must be considered regardless of the project's scope and value. This includes estimating annual costs for software licences, infrastructure (cloud or on-site), security monitoring, recurring training, and maintenance including additional configuration, and user support.

Another key operation and sustainment factor is the function of the technical support team and help desk. Who will perform administrative functions such as managing user access? Who will manage tickets raised by users to report issues, or request services? Who will coordinate and implement change requests? Who will install security patches?

You should not procure software with the expectation that an external IT service organization will automatically take care of these activities for you. Just as materiel should not be procured without having a life-cycle materiel manager (LCMM), software should not be procured without having a life-cycle application manager (LCAM) assigned to oversee its management. Ultimately, operation and sustainment costs can be reduced, and support functions optimized, by leveraging your organization's centralized IT services.

Starting points:

1. Identify an LCAM who will be responsible for coordinating all aspects of the digital solution throughout its life cycle.
2. Engage your IT service organization to establish how user support and technical support will be provided. Note that clear responsibilities and expectations from the IT service organization should be captured in a memorandum of understanding (MOU) or Service Level Agreement (SLA).
3. Consider the full life-cycle cost of different options. Depending on the complexity of the requirement, developing and maintaining a small in-house web application may well be the best route for achieving the desired result and avoiding having to pay annual licensing and maintenance fees, but do your homework. Hopefully, the key considerations discussed in this article will help.

Conclusion

Enabling digital innovation is not only about technology, but also about people, processes, and culture. It requires a clear vision, a collaborative mindset, and a willingness to experiment and learn. However, it also faces many barriers and obstacles, such as bureaucracy, resistance to change, and lack of resources. Therefore, it is important not to be discouraged by these difficulties, but to persevere and seek support from others who share the same goals.

Moreover, it is essential that you submit your ideas up the chain of command, and reach out to your IT service organization. These include Management Information Systems (within Director General Maritime Equipment Program Management (DGMEPM)), the Digital Navy team (within RCN HQ), and the Base Information Services organizations (within Maritime Forces Atlantic (MARLANT) and Maritime Forces Pacific (MARPAC)). By doing so, you contribute to the collective pool of knowledge and creativity, and help foster a culture of innovation that benefits everyone.

LCdr Samuel Poulin is the Digital Program Coordinator in the DGMEPM Directorate of Maritime Management and Support.

FEATURE ARTICLE

A Proposal to Install a Step Loading Circuit to the Heat Trace System Fitted on Arctic Offshore Patrol Vessels

By MS J.C.J. Blackwell
(Technical Advisor: PO1 Eric Lawrence)

[*Adapted from a November 2023 Naval Fleet School (Atlantic) Mar Tech RQ-PO2 0030 course student Technical Service Paper, which contains the author's full list of references.]

The Royal Canadian Navy's *Harry DeWolf*-class Arctic and Offshore Patrol Vessels (AOPVs) are fitted with a heat-trace system designed to heat and protect upper-deck fittings, rails, doors, hatches, and decks. This allows the AOPVs to operate in cold weather climates, and keep the upper decks free of ice build-up.

A consistent issue exists throughout the *Harry DeWolf* class when the de-icing system is switched on. A large inrush current-draw from the heating cables can trip the breakers on the feed panels, and in some cases cause the ships to suffer an electrical brownout or blackout, even when being fed from shore power.

The current system setup requires personnel to go to each panel to turn off all the heat-trace breakers, and then turn the individual breakers back on seven to ten at a time at 15-second intervals. Not only is this time-consuming, but if the breakers are turned on too quickly the main breaker could trip and the entire process would have to be restarted. There is also risk involved in doing this, as personnel are working inside a live 220-volt (V) panel where there is possibility of an arc flash.

Technical Background

The de-icing system on the AOPVs consists of two, independent feeder panels that each feed three de-icing heating panels. The main feeder panels are each fed from their own 440-V/220-V transformer, which in turn are fed from 600-amp (A) breakers on the port and starboard low-voltage switchboards. The system can either be operated remotely from the integrated platform management system (IPMS), or locally at one of the six cabinets.

Images by MS Jordan Blackwell

Figure 1. IPMS de-icing control screen as fitted in HMCS *Harry DeWolf.*

The heating cabinets are located:

a. two panels in No. 1 AC compartment on 04 deck;
b. No. 3 AC compartment on 01 deck;
c. No. 1 electrical equipment room on 1 deck;
d. sewage treatment compartment on 2 deck; and
e. the starboard steering gear compartment on 2 deck.

The system is used for cold-weather precautions when the outside air temperature is expected to be lower than five degrees Celsius for a period greater than 24 hours. The heat-trace system is strictly a resistive load that provides heat to all the upper-deck fittings by using heating cables. The IPMS control screen and cabinets and are shown in Figures 1, 2, and 3.

Current Configuration and the Problem

With the current system set up, when the system is turned on, the inrush current can be plus or minus 400A per de-icing heating panel. This inrush current can cause the ship's shore power breakers to trip if the feed breakers and switchboard breakers do not trip.

Restoring the heat-trace after the breakers trip is a lengthy process. Personnel must go to each of the six heat-trace panels spread throughout the ship, and physically shut off all the individual heat-trace breakers (Figure 3). When this is done, the main feed breaker at one of two main panels can be reset (Figure 2). One panel is in the bow thruster compartment, and one is in the starboard motor room

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upper level. Once these are reset, personnel can start to close the heat trace breakers (up to 10 breakers every 10-15 sec). A risk of an arc flash exists when the operator is accessing the panel.

The procedure just described does not include recovery if the ship blacks out. A separate blackout recovery procedure would need to be conducted first. Something to note, while on shore power, not all heat-trace breakers are in use due to the high demand of the system.

Criteria for the Solution

The following criteria were evaluated when determining the best option to rectify the problem with the excess starting load:

a. the solution must meet or exceed MARLANT safety and environmental regulations;
b. the solution must be compatible with existing systems;
c. the solution must allow the heat-trace system to be flashed without tripping the supply breakers;
d. the operational readiness of the ship must be affected as little as possible during implementation; and
e. the system must still function according to manufacturer's specifications.

Option A – Install a Contactor with a Programmable Logic Controller (PLC)

For course study purposes, two options were investigated. Option A involves modifying the current de-icing panels. The heat-trace breakers in the de-icing heating panel would be divided into groups of up to 10 breakers, depending on the load. A contactor would then be installed for each group of breakers, after which a PLC would be installed in the panel to step-load the groups of breakers. This would distribute the starting load of the panel over a longer period. Another advantage of the PLC is that it gives the option of having an at-sea mode and an alongside mode for flash-up. This feature could be controlled from either the IPMS, or the de-icing feeder panel.

Figure 2. Main 220-V aft de-icing feeder panel.

The PLC and contactor would use the same power supply and mounting system currently in the de-icing heating panel. The circuits would then be divided into groups of up to 10 breakers, each with a maximum inrush current of approximately 179A, which can easily be handled by the current configuration. The contactor would be mounted and connected to each group of breakers. The PLC would be mounted and programmed to close the contactors at roughly 15-second intervals, which is the time needed for the load to stabilize. Some additional cabling would need to be installed for the contactor and the PLC.

The programming of the PLC would be set up according to the number of breaker groups and the start time between them. This would increase safety by eliminating the requirement for personnel to be working inside a live 220-V electrical panel.

Option B – Install Breakers with a Higher Rating

Option B involves installing higher rated breakers for each of the de-icing heating panels. New cable runs that can support the higher current load would have to be run from the main panel to the six de-icing heating panel, and modifications would have to be made to the Standard Operating Procedures (SOP).

Figure 3. De-icing heating panel showing breakers.

Trials of the system would have to be done to write the new SOPs for the operation of the heat-trace system, with appropriate warning about the high inrush currents involved, and the blackout risk. The trial would include flashing the heat trace in stages, while monitoring the inrush current. Up to 10 breakers could be closed, while timing how long it takes for the load to stabilize.

Flashing the system would involve a minimum of two personnel: one at the panel, and one at the main controller to make sure the breaker doesn't trip. After closing the breakers, the person at the panel would have to wait the predetermined time before closing the next set of breakers. Multiple panels could be done simultaneously, but this would require additional personnel. Warnings and safety equipment concerning 220V and high current would have to be in place for personnel working in the cabinet. Communication would have to be maintained between each location.

Options Analysis

Both options meet some of the criteria for flashing the heat-trace system without tripping the supply breakers, or blacking out the ship.

Option A would allow the current-draw to be spread out over a longer period while the system was being flashed up. The PLC would distribute the load over a preset time for flashing the system. The PLC and contactor are compatible with the existing equipment. Finally, it would reduce the need for personnel to open and work in the 220V electrical panels. The SOP would not need to change.

Option B would not reduce the current-draw on flash-up, but be able to better handle the inrush current-draw without tripping the main supply breakers; however, if the SOP was not followed correctly, the system could still cause the panels to trip, or even black out the ship when on shore power. The cost for this option would be much higher than that for Option A, and there would still be continued risk of the breakers tripping, and risk of electrical shock to personnel. Table 1 summarizes this information.

	Option A	**Option B**
Time to complete	40 hours	78 hours
Material	• Ten 220-V contactors • PLC • 90 m of 16-gauge wire • 90 m of 2/0-gauge wire	• Six 350-A breakers • 215 m of 600-kcmil cable
Work Required	• Separate breaker groups • Install contactor and PLC • Program PLC • Trial system	• Install new breakers • Run cables from controller to the 6 heating panels • Trial and set new SOP

Table 1. Option Analysis

Summary and Recommendations

This technical service paper identifies issues with the *Harry DeWolf*-class heat-trace system when it is being flashed for cold-weather precautions. The two options described provide a solution to the breakers tripping due to the inrush current. Option A adds a step-loading circuit with contactors and a PLC to manage the starting load. This option removes the need for personnel to have to manually start the system from the heating panels, reduces the risk of blackout, and maintains the safety of personnel since they are not working inside a live 220-V panel. Option B involves installing breakers with a higher current rating and associated cables to handle the inrush current load, and requires writing new SOPs.

Option A best meets all the criteria with the installation of contactors and a control PLC to step-load the heating panels. The addition of the contactors and PLC would require very little modification to the existing systems. The PLC would allow for a more efficient start-up of the system by regulating the starting inrush current by closing the contactors over a set period. This would improve the safety of personnel since they would not have to work in the panels. The addition of the PLC also gives other options for control of the heating panels. The cost and installation time for this option is considered to be much less than that for Option B.

It is recommended that an Unsatisfactory Condition Report be submitted concerning the inrush current on the heat-trace system, followed by a single-vessel trial. If the trial is successful in solving the problem, an Engineering Change should be generated to make this available to the other *Harry DeWolf*-class vessels.

MS Jordan Blackwell is the Marine Technician Electrician/ IPMS Tech/Senior Electrical Specialist aboard HMCS Harry DeWolf (AOPV-430).

FEATURE ARTICLE

Earned Value Management: The System Integrator of the Project Management Domain

By Jonathan Shriqui, PMP

Like any other government department, the Department of National Defence (DND) has a duty to manage its publicly funded projects in a transparent and timely manner, using credible and verifiable information in its decision-making processes. Large, complex procurement projects, such as the National Shipbuilding Strategy (NSS), a project of unprecedented scale to renew Canada's fleet of ships for the Royal Canadian Navy (RCN) and the Canadian Coast Guard (CCG), come with significant risks. Therefore, best management practices must be employed.

One such practice that continues to mature is Earned Value Management (EVM), a project management performance methodology. It primarily relies on the integration of scope, schedule and cost to better control, and inform on a project's outcome.

The roll-out of EVM was endorsed by the Minister of National Defence in the *Department of National Defence and Canadian Armed Forces 2021-22 Departmental Plan*.[1] Furthermore, in response to the Office of the Auditor General's observations on NSS' schedule management weaknesses (2021[2]), DND, Public Services and Procurement Canada (PSPC), and CCG jointly committed to mature EVM to "ensure that cost and schedule are properly managed and to support oversight by governance committees at all levels." It is also a reporting requirement for the Future Aircrew Training (FAcT) contract that was awarded in May 2024.

With this enhanced ability, project managers are in a better position to lead proactive discussion regarding affordability, risks, and schedule impacts.

Employing EVM as a Standardized PM System

What sets EVM apart is that it enables the measurement of project progress without bias when properly implemented. The assessment of project performance and progress is achieved through the use of a series of standardized, objective metrics that are set against an integrated cost and schedule baseline, known as the Performance Measurement Baseline. For complex projects, EVM processes will typically undergo a compliance audit. This will either validate the credibility of the information being reported or facilitate an understanding of reporting deficiencies and their impacts. In the defence sector, EVM is generally governed by the EIA-748 standard which is overseen by the United States National Defense Industrial Association (NDIA), an affiliate of the Canadian Association of Defence and Security Industries (CADSI). This performance methodology has a long history in the project management culture of the United States Department of Defense (US DoD) since the 1960s, and is also well established within both the Australian Department of Defence (AUS DoD) and the United Kingdom Ministry of Defence (UK MoD).

While metrics such as the Schedule Performance Index (SPI) and Cost Performance Index (CPI) are the more commonly known output of this methodology, the lesser appreciated and most important aspect of EVM is its ability to integrate all of the subdisciplines of project management, including contract management, into a single performance management system. In practice, this is known as an Earned Value Management System, or EVMS. For clarity, EVM is the tool that provides the performance metrics, whereas an EVMS is the calibration process for that tool which ensures the metrics are credible and fit for decision-making purposes.

In the same way that a *Halifax*-class frigate is equipped with a combat management system to integrate disparate sensor information into a compiled "picture," project management can be equipped with EVM, the system integrator of the project management domain. The intrinsic value of this methodology lies not in the output of metrics, but in the outcome that the project management practice is executed as an integrated system, not as independent disciplines. As such, EVM effectively becomes a risk management and decision aid as it provides project leaders with the required situational awareness to make informed, defendable, and evidence-based decisions.

1. https://www.canada.ca/en/department-national-defence/corporate/reports-publications/departmental-plans/departmental-plan-2021-22.html
2. https://www.oag-bvg.gc.ca/internet/English/parl_oag_202102_02_e_43748.html (Para.2.36)

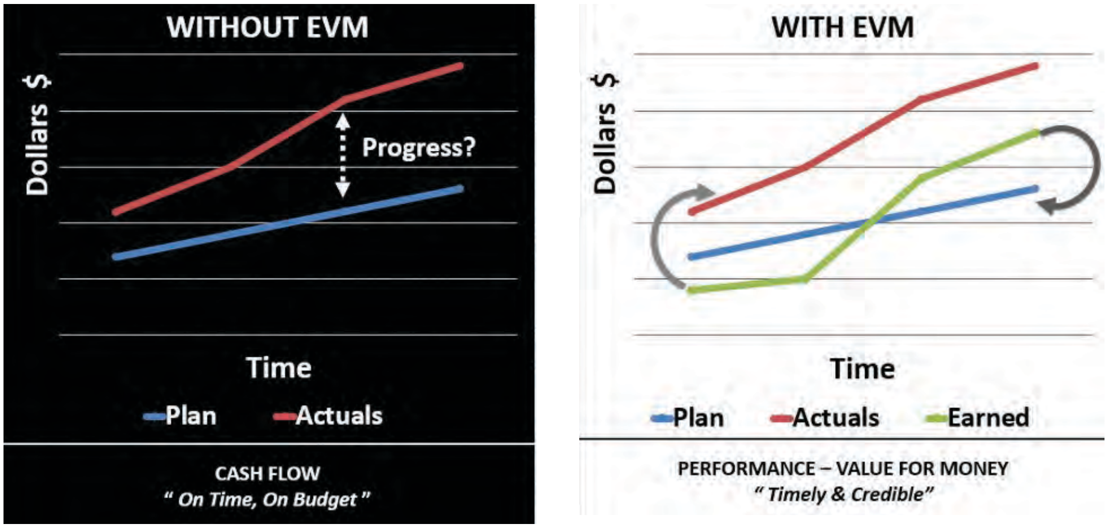


Chart by Jonathan Shriqui

Without EVM, projects typically compare planned expenditures to actual expenditures to assess progress. This measures cash flow, not actual progress. With EVM, better insight of value for money and progress is achieved.

With the effect of the COVID-19 pandemic still resonating on global supply chains, and the Office of Parliamentary Budget Officer's independent estimates highlighting potential cost pressures for the CSC project, now more than ever, will NSS project leaders need access to transparent information enabling them to exercise probity—i.e. accountability and integrity in the discharge of their managerial responsibilities as stewards of the public purse.

As Richard Smart, former Director Weapons at the UK MoD, stated: "As a result of applying earned value management to our work, people are now asking more insightful and intelligent questions of our supply chains."[3]

EVMS as an Enabler of Transparency

EVM metrics are an insightful source of performance information, but on their own are insufficient to meet the mandates of transparency and impartial decision-making. To achieve such a purpose, they should be analyzed concurrently with other sources of contextual performance information, such as schedule margin, undistributed scope (budget yet to be assigned within the project schedule), and the quantitative assessment of project risks. When analyzed with EVM metrics, a more comprehensive assessment of performance can be achieved, creating heightened situational awareness.

To increase transparency and ensure that decisions are based on a common source of information, the US DoD includes a variety of non-performance information requirements in its standardized EVMS reporting requirement, formally known as the Integrated Program Management Data Analysis Report (IPMDAR), or DI-MGMT-81861. This requirement not only includes information relevant to a project's performance, such as EVM cost and schedule metrics (e.g., SPI, CPI and more), but also contextual information such as resource utilization, schedule baseline changes, the results of a schedule risk analysis, the quantification of the scope of work not yet assigned within the schedule, and insight into upcoming change orders.

By mandating the use of this reporting requirement, the US DoD can ensure that contractors are meeting a standard of transparency, and that their EVMS data is consistent and comparable across contracts. This helps to promote accountability in project management, and enables the US DoD to monitor the value for money received from its contractors.

Consequently, by including information that goes beyond cost and schedule metrics, an EVMS provides a transparent source of information for informed and timely decision-making.

EVMS as an Enabler of Integrity

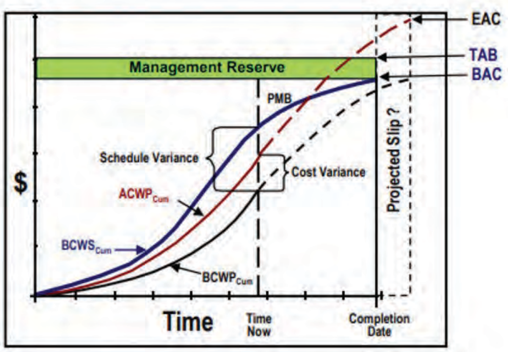
Even with a detailed and complete source of performance information like the US DoD IPMDAR, achieving probity remains a challenge. Accountability for a decision requires

(Continues next page...)

3. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/823055/August-desider-online-v1.pdf

not only transparency (i.e. *Was the information available complete?*), but also integrity (i.e. *Was all available information credible?*).

Understanding the framework, or system, which governs the process by which data and information are produced is a, if not *the*, fundamental pillar of both transparency and integrity. Within the context of EVM reporting, integrity resides within the EVMS. The rigour of an EVMS itself depends on the context and the environment in which it is being used. Organizations using the EVM methodology for internal projects, or projects where the customer is not privy to EVM information, may elect to develop their own EVMS. Such a system only needs to meet the mandate issued by their internal oversight and governance committees. In a contractor/customer relationship, best practice is to implement an EVMS in accordance with a standard that is proven, unbiased, auditable, and accepted as an industry standard such as EIA-748.



VARIANCES Positive is Favorable, Negative is Unfavorable

Cost Variance CV = BCWP – ACWP
CV % = (CV / BCWP) * 100
Schedule Variance SV = BCWP – BCWS
SV % = (SV / BCWS) * 100
Variance at Completion VAC = BAC – EAC
VAC % = (VAC / BAC) * 100

OVERALL STATUS

% Schedule = ($BCWS^{CUM}$ / BAC) * 100
% Complete = ($BCWP^{CUM}$ / BAC) * 100
% Spent = ($ACWP_{CUM}$ / BAC) * 100

EFFICIENCIES

Cost Efficiency CPI = BCWP / ACWP Favorable is > 1.0, Unfavorable is < 1.0
Schedule Efficiency SPI = BCWP / BCWS Favorable is > 1.0, Unfavorable is < 1.0

SCHEDULE METRICS (Selected)

BEI = Total Tasks Completed / (Total Tasks with Baseline Finish On or Prior to Current Report Period + Tasks without baseline finish dates)

Hit Task % = 100 * (Tasks in Denominator that Completed ON or Before Baseline Finish / Tasks Baselined to Finish within Current Report Period)

ESTIMATE @ COMPLETION = ACTUALS TO DATE + [(REMAINING WORK) / (PERFORMANCE FACTOR)]

EAC_{CPI} = $ACWP_{CUM}$ + [(BAC – $BCWP_{CUM}$) / CPI_{CUM}]
$EAC_{Composite}$ = $ACWP_{CUM}$ + [(BAC – $BCWP_{CUM}$) / (CPI_{CUM} * SPI_{CUM})]

TO COMPLETE PERFORMANCE INDEX (TCPI) § #

$TCPI^{Target}$ = Work Remaining / Cost Remaining = (BAC – $BCWP^{CUM}$) / (**Target** – $ACWP^{CUM}$)

§ To Determine the TCPI for BAC, LRE, or EAC Substitute TARGET with BAC, LRE, or EAC
# To Determine the Contract Level TCPI for EAC, You May Replace BAC with TAB

EAC: Estimate-at-Complete
TAB: Total Allocated Budget
BAC: Budget-at-Complete
PMB: Performance Measurement Baseline
ACWP: Actual Cost of Work Performed (i.e., Actuals)
BCWS: Budgeted Cost of Work Scheduled (i.e., Planned Value)
BCWP: Budgeted Cost of Work Performed (i.e., Earned Value)

https://acqnotes.com/wp-content/uploads/2014/09/DAU-EVM-Gold-Card-2020.pdf

When implemented in accordance with such guidelines and standards, an EVMS enables both parties to have a common understanding of the information's integrity and meaning. Consequently, the resulting information is free from bias, and provides an environment where trust, collaboration and joint governance can prosper.

The Benefits of EVM

When the artificial intelligence chatbot known as *ChatGPT* was asked to provide an assessment of the value of seeking compliance to the EIA-748 EVMS standard between two parties that have a contractual relationship, the following (partial) answer was provided:

> *"The EIA-748 EVMS standard provides a clear framework for managing project performance, facilitates communication and collaboration between project stakeholders, enables proactive risk management, encourages accountability, and enhances project control. These values make it a valuable tool in a contractual relationship, helping to ensure that project objectives are met and the contractual requirements are fulfilled:*
>
> 1. ***Provides a clear framework:*** *The EIA-748 EVMS standard provides a clear framework for both the project owner and the contractor to establish project objectives and performance measures, and to monitor and report on project progress.*
> 2. ***Facilitates communication:*** *The standard requires regular reporting on project progress, costs, and risks, which facilitates communication and collaboration between the project owner and the contractor.*
> 3. ***Enables risk management:*** *The standard requires the identification and management of project risks, which enables proactive risk management and reduces the likelihood of project delays, cost overruns, or quality issues.*
> 4. ***Encourages accountability:*** *The standard establishes clear roles and responsibilities for project stakeholders, which encourages accountability and helps to ensure that project objectives are met.*
> 5. ***Enhances project control:*** *The standard requires the use of earned value management techniques, which provides a structured approach to project control and enables timely and accurate decision-making."*

In a contractor/customer relationship, the EIA-748 EVMS standard provides the framework that enables all stakeholders to share a common, unbiased, and credible source of performance information. Additionally, because

Formula for Success—Explaining EVM

Traditional performance reporting is quite simple: Determine your budget, and compare it against incurred costs. The issue with this well-known and traditional perspective of "performance," is that it has nothing to do with performance at all, and is effectively and solely a measurement of cash flow. Essentially, this method only measures if the monies spent are in line with the budget, without an assessment of value for money.

This is where EVM can provide insight. With EVM reporting, there is never a comparison of the budget (i.e. Planned Value (PV)) to Actual Costs (AC). To enable metrics that are representative of a project's performance and progress, we need to add a third dimension to the equation—i.e. Earned Value (EV), which represents work that has been accomplished.

PV = The project plan; essentially a time-phased, costed schedule.
EV = Indicates how much work has been completed using budgeted rates.
AC = Costs incurred to achieve the EV.

By comparing a project's EV to its PV, (i.e. How much work was completed in comparison to the plan), we can establish a sense of schedule performance. In practice, we call this metric the Schedule Performance Index or SPI.

$$SPI = \frac{EV}{PV}$$

An SPI > 1.00 is an indication the project is ahead of schedule.
An SPI < 1.00 is an indication the project is late.
An SPI = 1.00 is an indication the project is progressing as planned.

It is important to understand that at the end of the project, the values of the EV and the PV will each equate to the budget. Hence, at the end of the project SPI will be 1.00.

By comparing a project's EV to its AC, (i.e. how much it cost to complete the work earned), we can establish a sense of cost performance. In practice we call this metric the Cost Performance Index or CPI.

$$CPI = \frac{EV}{AC}$$

The AC metric is independent of the budget, (i.e. PV), unlike the EV metric.

A CPI > 1.00 is an indication the project is underspending.
A CPI < 1.00 is an indication the project is overspending.
A CPI = 1.00 is an indication the project is on budget.

The CPI is quite literally a metric that can be used to empirically monitor value for money.

"Good decisions are based on knowledge, not on numbers."
— Plato

it is an auditable and industry accepted standard, a customer can objectively assess and, if required, challenge the integrity of the information being reported. In a contractual relationship, best practice is to audit the EVMS for compliance to a standard. Although compliance is desired and should be sought, a non-compliant system is still likely to continue to provide valuable information, albeit data analyses are likely to be more complex.

Conclusion

While the implementation of an EVMS is agnostic to any project type and size, it delivers best value when applied to complex, high-risk developmental projects which are typically contracted on a time and material basis, and as such bear significant cost risk. Examples of such projects are the Canadian Surface Combatant (CSC), Arctic and Offshore Patrol Ship (AOPS), and Joint Support Ship (JSS). The implementation of an EVMS in accordance with a recognized standard, such as the EIA-748, provides the confidence that the information required for decision-making has the necessary credibility to drive accountability. Since stakeholders are steered to act with higher levels of probity, project leaders can focus their efforts on managing risks, relationships, engaging in timely discussions, and achieving the project's intended benefits.

Although EVM is presented in the literatures of both the Project Management Institute (PMI) and the Association for Project Management (APM) as a performance methodology, the US Office of Management and Budget eloquently presents EVM as a pillar of risk management, stating that "a critical component of risk management on major investments is the use of EVM.[4]" Those who know, unequivocally agree.

(Continues next page...)

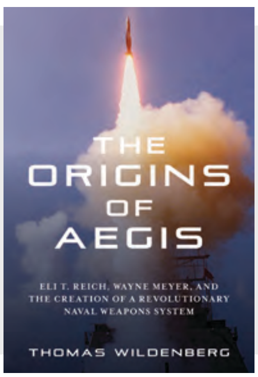
4. https://www.whitehouse.gov/wp-content/uploads/2021/01/capital_programming_guide.pdf See I.5.5.1

In December 2023, DND published a Request for Information (RFI) that presented its EVMS implementation strategy. It also included a survey to gather insight on Industry's project management best practices, including EVM, and proposed the establishment of a DND/Industry project management forum to jointly lead the advancement of integrated program management through industry and government partnership. The information gathered in the RFI represents the foundation upon which DND can build to achieve EVM maturity with Industry's support.

The successful implementation of an EVM culture in the Canadian defence sector rests solely on the principle of mutual collaboration. Industry will have to adapt to a new level of integrated and transparent reporting, whereas DND, along with PSPC, must forsake the once golden rule of "*on time and on budget,*" and foster an environment which will welcome and promote a mentality of engaging in "*timely and credible*" discussions. Enabling transparent discussions about the right stuff at the right time represents the apex of Earned Value Management.

Jonathan Shriqui is a DND Senior Procurement Officer for the Canadian Surface Combatant project in Ottawa.

Titles of Interest



Origins of Aegis:
Eli T. Reich, Wayne Meyer, and the Creation of a Revolutionary Naval Weapons System

By Thomas Wildenberg

Published (2024) by U.S. Naval Institute Press
ISBN-10: 1682479234 / ISBN-13: 9781682479230
Hardcover; 296 pages; Illustrated

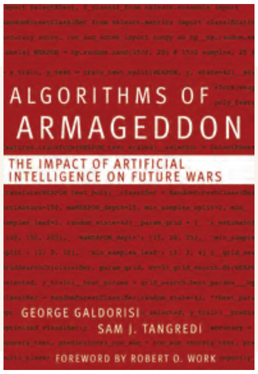
This new release by the U.S. Naval Institute Press in Annapolis, Maryland, provides readers with an in-depth understanding of the professional development of two notable and highly accomplished naval officers, and their contributions to the development of the Aegis Weapons System.

Historian Thomas Wildenberg's main argument is that there was no single career path or set of formal qualifications for achieving excellence in the naval profession as characterized by selection for flag rank. One of his major points is the revelation that a combination of essential personal traits and qualities, and important operational and technical experiences fundamental to the nature of naval warfare, are critical to developing highly competent and confident officers. Wildenberg, an award-winning scholar with special interests in aviators, naval aviation, and technological innovation in the military, contends that such officers are needed to lead major acquisition programs capable of delivering innovative weapons systems for a twenty-first century Navy facing new age threats.

In *Origins of Aegis*, Thomas Wildenberg tells the inspiring story of how ordnance experts Eli T. Reich and Wayne Meyer, former USN flag officers, overcame various challenges on the technical and bureaucratic fronts to create the Aegis Naval Weapons System. The book details an important chapter in Cold War history, describing the development of guided missiles, and the still formidable weapon system that will form the cornerstone combat capability in Canada's next generation of surface warships.

As RCN Cdr Bobby Gilpin wrote in his article, "Aegis Integration in Canada's Surface Combatant Program—A Revolutionary Increase in Maritime Capability," (MEJ 107), "the US Navy's Aegis Combat System is "an emblem of technological advancement, and a strategic cornerstone in fortifying Canada's naval operational capabilities for a modern warfare environment. Its incorporation into the CSC program signifies not just a leap in technology, but a paradigm shift that promises enhanced operational effectiveness, technological superiority, and seamless cooperation with the US Navy."

Titles of Interest



Recent releases from USNI Press:

Algorithms of Armageddon:
The Impact of Artificial Intelligence on Future Wars

By George Galdorisi and Sam J. Tangredi

Published (2024) by U.S. Naval Institute Press
ISBN-10: 161251541X / ISBN-13: 9781612515410
Hardcover; 256 pages

In yet another timely release from the U.S. Naval Institute Press, authors George Galdorisi and Sam J. Tangredi, both retired USN captains, question whether U.S. policy makers and military leaders fully realize that they have already been thrust into an artificial intelligence (AI) race with authoritarian powers. Today, the United States' peer adversaries—China and Russia—have made clear their intentions to make major investments in AI and insert this technology into their military systems, sensors and weapons. Their goal is to gain an asymmetric advantage over the U.S. military.

The implications for U.S. national security, and by extension that of other nations, are many and complex. *Algorithms of Armageddon* examines this most pressing security issue in a clear, insightful delivery by two experts who are national security professionals who deal with AI on a day-to-day basis in their work in both the technical and policy arenas. Captain George Galdorisi, U.S. Navy (Ret.) is Director of Strategic Assessments and Technical Futures for the Naval Information Warfare Center Pacific; Captain Sam J. Tangredi, U.S. Navy (Ret.) is the Leidos Chair of Future Warfare Studies and Professor of National, Naval and Maritime Strategy at the U.S. Naval War College.

Opening chapters explain the fundamentals of what constitutes big data, machine learning, and artificial intelligence. The authors investigate the convergence of AI with other technologies and how these systems will interact with humans. Critical to the issue is the manner by which AI is being developed and utilized by Russia and China. The central chapters of the work address the weaponizing of AI through interaction with other technologies, man-machine teaming, and autonomous weapons systems. They also cover in-depth debates surrounding the AI "genie out of the bottle" controversy, AI arms races, and the resulting impact on policy and the laws of war.

Given that global powers are leading large-scale development of AI, it is likely that use of this technology will be global in extent. Will AI-enabled military weapons systems lead to full-scale global war? Can such a conflict be avoided? The later chapters of the work explore these questions, point to the possibility of humans failing to control military AI applications, and conclude that the dangers are real.

Neither a protest against AI, nor a speculative work on how AI could replace humans, *Algorithms of Armageddon* provides a time-critical understanding of why AI is being implemented through state weaponization, the realities for the global power balance, and more importantly, U.S. national security. Galdorisi and Tangredi propose a national dialogue that focuses on the need for U.S. military to have access to the latest AI-enabled technology in order to provide security and prosperity to the American people.

Submissions to the *Journal*

The *Journal* welcomes unclassified submissions in English or French. To avoid duplication of effort and ensure suitability of subject matter, contributors are asked to first contact the production editor at MEJ.Submissions@gmail.com.

Titles of Interest

The Rescue Ships and the Convoys: Saving Lives During the Second World War

By Vice Admiral B.B. Schofield; Edited and expanded
By Victoria Schofield

Published (2024) by Pen and Sword Maritime
ISBN-10: 1036102661 / ISBN-13: 978-1036102661
Paperback; 224 pages; Illustrated; Appendices and end notes.

The Rescue Ships and the Convoys tells the story of one of the least known aspects of Second World War maritime history. Despite the threat of heavy losses of ships and lives, no hospital ships, which had to be lit, could accompany the convoys as they would betray a convoy's position.

The solution was to create a fleet of 30 small Merchant Navy vessels of about 1,500 gross tons, mostly from coastal trade. These 'Rescue Ships,' commanded and manned by Merchant Navy personnel, carried medical teams, and life-saving equipment including operating theatres, hospital beds, Carley floats, and hoists. Undeterred either by enemy action or atrocious weather conditions, these vessels accompanied close to 800 convoys and saved 4,194 lives from ships sunk in the North Atlantic and with the Arctic convoys. During their service, seven Rescue Ships were lost.

This is a story packed with suspense, danger, achievement and tragedy. As the author, Vice Admiral Brian Betham Schofield, CB, CBE (1895-1984), who was closely involved in the establishment of the fleet, writes, it is a record "of great humanitarian endeavour, of superb acts of courage, of a display of seamanship of the highest order, of a devotion to duty by medical officers under the most arduous conditions imaginable, of great deeds by men of the Merchant Navy in little ships on voyages they were never designed to undertake."

VAdm Schofield had a distinguished naval career serving in both World Wars, and was closely involved in the planning of naval operations for D-Day. His insider view is told in Operation Neptune (republished by Pen and Sword Maritime in 2008). His daughter, Victoria Schofield, a historian and author in her own right, updated her father's original 1968 manuscript in time for the 80th anniversary of D-Day.

As Victoria writes in her Editor's Note, "From a twenty-first-century vantage point it is staggering to think that, given the vast number of convoys operating on routes throughout the world, only 30 ships...were ever available to pick up survivors. It truly is a record of great deeds in little ships."

The book includes several appendices detailing the stories of the individual Rescue Ships, the convoys they escorted, the lives they saved, the nationalities of survivors, and an explanation of the Convoy Medical Code merchant ships used to request urgent medical assistance from Rescue Ships or escort vessels that had medical officers on board. Together with the extensive end notes and rarely seen vintage photographs, this information adds another layer of context to the impressive record of these remarkable ships.

Rescue Ship *Empire Rest.*
Courtesy Captain George N. Glass

News Briefs

D-Day 80th Anniversary

Story courtesy Veterans Affairs Canada

Ship photos courtesy of the Naval Museum of Halifax Collection

On 6 June 1944, Allied troops stormed the beaches of Normandy (France) to open the way to Germany from the West. Victory in the Normandy campaign would come at a terrible cost. The Canadians suffered the most casualties of any division in the British Army Group.

The Royal Canadian Navy provided 109 vessels, and 10,000 sailors as its contribution to the massive armada of 7,000 Allied vessels that went to sea on D-Day. Battling choppy waters and rain, they kept the German fleet bottled up in its ports. Canadian minesweepers assisted in the tricky but crucial job of clearing a safe path across the English Channel for the invasion fleet. The guns of Canadian destroyers like HMCS *Algonquin* and HMCS *Sioux* silenced enemy shore batteries and continued to fire in support of ground attacks in the days to come. The armed merchant cruisers HMCS *Prince Henry* and *Prince David* carried Canadian troops and the landing craft in which they made their run to the beaches; they later returned to England with Canadian wounded. RCN flotillas of landing craft transported infantry and tanks to shore and provided additional fire support for them.

The V-class destroyer HMCS *Sioux* (R64).

The Bangor-class minesweeper HMCS *Caraquet* (J38).

Juno Beach photos by Jacqueline Benoit

Canadian troops board LC276 in Portsmouth for the D-Day landings.

News Briefs

The Steel Doctors: Radiography at FMF Cape Scott

By Gabrielle Brunette

[Adapted from an article that first appeared in the December 2023 issue of the FMFCS newsletter.]

Fleet Maintenance Facility Cape Scott (FMFCS) in Halifax is filled with skilled personnel who work tirelessly to ensure the structural integrity of Royal Canadian Navy vessels, and the non-destructive testing (NDT) technicians are no exception.

The NDT shop is made up of six technicians, three of whom are qualified radiographers who use X-ray and gamma-ray technology to inspect critical parts of the ship, such as high-pressure air systems, to ensure they are operating as intended. Using these radiographic sources, they are able to evaluate the integrity of welds and detect any defects in material that cannot otherwise be identified.

"It's no different than what you would do if you were going to the doctor to find out if you had a broken bone," said **Scott Sanford**, lead radiographer at FMFCS. "Except we're doing it with steel."

All radiation work done by FMF personnel is conducted either aboard a ship, or inside a specially shielded room at the maintenance facility. While X-rays are an electrically produced form of radiation, gamma rays are produced by a radioactive material. Once an X-ray machine is unplugged from its source of electricity, Sanford explained, it no longer emits any form of radiation. "With the radioactive or gamma side," he said, "you don't have that luxury."

Radiography technician Scott Sanford examines X-ray film of a pipe connection at Fleet Maintenance Facility Cape Scott.

Photos by Gabrielle Brunette

The "vault" is a small shielded room at FMFCS where all radiographic equipment is stored, and where testing of smaller structural components at the facility is conducted. Radiographic technicians have portable equipment, such as the yellow gamma-ray device shown on the cart, which they can transport safely to conduct in-situ inspections aboard ship.

Since gamma rays are always active, the radiography technicians have to be especially careful in handling this technology. When a portable gamma device is used aboard a vessel, it is transported safely to contain the radiation to a safe level, and the work is conducted outside of regular work hours to limit exposure to other personnel.

When working with radiographic technology at the FMF, all work is conducted inside the shielded room the technicians call the vault—a small space constructed entirely of 70-cm-thick reinforced concrete, and designed to contain radiation. FMFCS also has its own dark room, where the radiographers can develop and inspect film.

"We end up doing a lot of field work, but we also write a lot of reports that engineering can use to evaluate the integrity of structures, or the components of structures," Sanford said. "It's a really interesting trade."

Sanford has been part of the radiography team since 2009, long before it was part of FMFCS. Up until 2018, the radiography departments at FMF Cape Scott and FMF Cape Breton in Victoria fell under the umbrella of Defence Research and Development Canada.

News Briefs

For Sanford, being part of FMFCS has many advantages. Being in-house has allowed the radiographers to build trust and strong relationships with the other trades, making it easier to operate as one unified team.

"We have good working relationships with the hull survey department, mechanical engineering, and the shops themselves," he said. "There's a lot of mutual respect between what we do, and what they do."

Working with radiographic sources can be extremely dangerous, which is why safety is always a top priority for the FMF technicians. To mitigate the risks, the radiographers follow the guiding principle of radiation safety by using the minimum level of radiation energy required for a job, abiding by the DND's nuclear safety regulations, and working closely with the Canadian Nuclear Safety Commission. Radiographic technicians also wear personal monitors that track the radiation levels they are exposed to on a daily basis, and this data is reported to Health Canada every two weeks.

"We have to make sure that we're doing things safely, not just for ourselves, but for all the other people we work with," Sanford said.

Gabrielle Brunette is the Communications Officer at Fleet Maintenance Facility Cape Scott in Halifax, NS.

A Rare Dry Ice Motor-Generator Cleaning on HMCS *Windsor* (SSK-876)

By Gabrielle Brunette

[Adapted from an article that first appeared in the May 2024 issue of the FMFCS newsletter.]

At Fleet Maintenance Facility Cape Scott in Halifax, a team of dedicated technicians and engineers execute a wide range of unique jobs, ensuring our fleet and sailors are safe at sea.

On the evening of Feb. 26, the Submarine Electrical shop conducted a dry-ice cleaning procedure on HMCS *Windsor*'s 140-Kilowatt motor-generator (140 MG). The 140 MG, which is powered by batteries, is responsible for generating power to the air-conditioning systems on board the submarine.

"The batteries are recharged by diesel-driven generators when a submarine is on the surface or snorkelling," explained Submarine Electrical Work Centre supervisor **Ryan Pettipas**. "The 140s are the link from turning the batteries' direct current output into usable alternating current output."

Over time, the system accumulates a build-up of carbon residue, and requires cleaning. Dry-ice cleaning is like sandblasting, except less abrasive. Pellets of recycled solid carbon dioxide (i.e. dry ice) are blasted at supersonic speeds, and sublimate from a solid to a gas (CO_2) on impact, explosively lifting dirt and contaminants away without damaging the material underneath.

Photos by Gabrielle Brunette

FMF Cape Scott Submarine Electrical technicians conduct dry-ice cleaning of an MG unit in the cramped confines aboard HMCS *Windsor* (SSK-876).

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Technicians from the FMFCS Submarine Electrical shop prepare the dry-ice pellets (right) in the open air, jetty-side.

The chemical- and water-free process is environmentally sustainable, and offers several advantages over other methods for machinery cleaning and surface preparation. It is non-conductive, non-toxic, and non-flammable, and does not create secondary waste streams. Most of the carbon and CO2 that is released is drawn away through the temporary ventilation system set up by the team, who wear chemical suits and other standard PPE. Full face respirators are worn to protect the eyes, and filter any contaminants.

In total, the dry-ice cleaning takes roughly 12 hours per MG. FMF purchased the dry ice from a local manufacturer, as it is difficult to store. On the night of the cleaning, FMF personnel set up on the jetty next to HMCS *Windsor*. Buckets of dry ice were fed through their Cold Jet® unit, which supplied the pressurized pellets through hoses down to the engineering spaces where the work was being conducted. Dry ice provides an extremely thorough cleaning, and does not require the generator to be taken apart and reassembled. After using the dry ice to remove the carbon build-up and clean the areas beyond easy reach, the team continued cleaning the generator by hand.

"It is a rare job," Pettipas said. "The last time we did this type of work was around eight years ago."

FMF Cape Scott is the only RCN maintenance facility with the capability and training required to conduct dry-ice cleaning. Because this type of work is so infrequent, training the next generation of submarine electrical technicians is incredibly important, especially as the senior members on the team approach retirement.

"A good portion of our experience comes from the generations who have handed down their knowledge from one to the next," Pettipas said.

Pettipas added that they are training as many people from the Submarine Electrical shop as they can, and expects everyone to have some experience with dry-ice cleaning by the time they finish up their work on HMCS *Windsor*.

Gabrielle Brunette is the Communications Officer at Fleet Maintenance Facility Cape Scott in Halifax, NS.

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Mark the plot! The RCN's Operations Room Plotting Tables

Recollections of Pat Barnhouse, Ken Bowering, and Brian McCullough

The CNTHA's support to DND's Directorate of History and Heritage (DHH) involves a team of energized volunteers whose efforts are laser focused on preserving Canada's naval technical heritage for future generations of researchers. Regular online meetings, email discussion threads, recorded oral history interviews, and an increasingly well-populated website (www.cntha.ca) are used to capture and present information that might otherwise easily be lost. This includes details of historical naval programs, technical systems and equipment, and the role industry played in their development.

The undertaking is extensive, and the team of naval, industry, and academic volunteers does its best to chronicle the major waypoints of the topics of interest through personal recollection, and an infectious spirit of collaboration. One of the recent endeavours has been to profile the role and evolution of the Operations Room plotting tables that first saw RCN service in the 1940s/1950s.

The *Prestonian*-class frigates had one Admiralty Research Laboratory (ARL) plotting table, the original 205-class destroyer escorts (pre-DDH *St. Laurent*) had two plotting tables: one an ARL, and the other a completely manual table. In all ships, the ARL was used as the ASW Action Plot, and the other table was used as the Local Operations Plot. The ARL tables were somewhat automated in that they could — with operator assistance — develop a real-time paper rendition of the evolving tactical situation. On the other hand, the LOP covered a larger geographical area but was completely manual. The ARL tables originally fitted in the 205 class were replaced with the Canadian-developed AN/SSA-502 plotting table during their DDH conversion refits. Follow-on classes were also fitted with these tables.

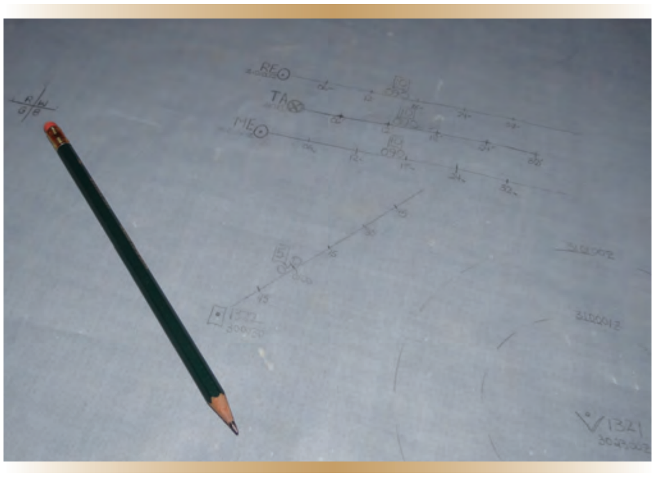
Photos by Brian McCullough with the kind permission of the CFB Esquimalt Naval & Military Museum.

While the early ARL tables were based on mechanical gears and cams, the synchro-driven, Canadian-developed AN/SSA-502 design that came later (built by Marsland Engineering Ltd. of Waterloo, ON)[i] was a vast improvement. The following is an extract from Capt(N) Jim Knox's paper in Chapter 18 of Jim Boutilier's book, "The RCN in Retrospect: 1910-1968."

> The synchro tape gyro repeater and plotting table developed in conjunction with the St. Laurent programme were Canadian accomplishments of particular note. These developments were initiated by the electrical engineer-in-chief when the potential of a Sperry, Montreal, gyro re-transmission unit, which gave multiple synchro outputs using a magnetic amplifier, was recognized. The specification for the table was written around the use of magnetic amplifiers. A target plot attachment was included as an integral portion of the projection head. The developer, Marsland, later requested the substitution of what was then a novel transistor amplifier. This became the first piece of transistorized equipment in the RCN and was probably the first such equipment available to any navy at that time (1955). The initial production run was for about 130 tables and ultimately some 500 tables were produced, including orders for the USN.

(Continues next page...)

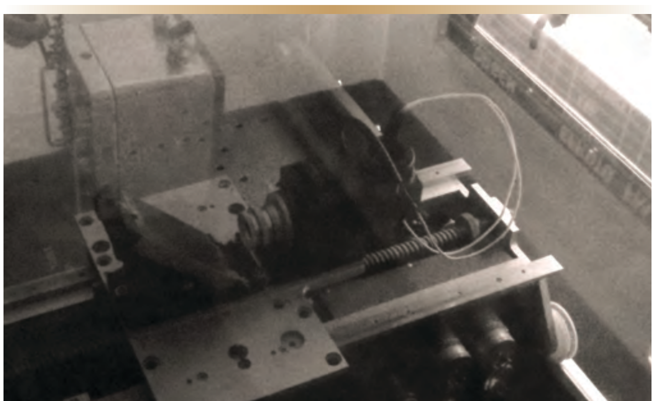
i. "Marsland" started out as Marsland Radio Services and later changed its name to Marsland Engineering Limited. The company was purchased in 1969 by Leigh Instruments of Ottawa and Leigh was later purchased by Spar Aerospace. Subsequently, Spar Aerospace was taken over by DRS Technologies. Leigh Instruments was also the company that developed the Canadian Navy's original SHINCOM systems.



The Action Plot tables had a Target Plot Attachment (TPA), driven by own ship course and speed, that projected a graticule upward to the underside of the table to mark own-ship position in real-time. The TPA was used to project red and green spots of light marking a target's range and bearing (sent to the table by the ship's radar or sonar). These red and green spots could represent a variety of parameters — e.g., another surface ship, a submarine, or even a weapon entry point.

The Action Plot table facilitated command and control during close ASW action. The glass-topped plotting tables combined an analogue/synchro feed of sonar, gyro compass, and speed-log information that was projected to the upper surface of the table, and on which the Operations Room team could build the evolving tactical situation.

Translucent paper was spread across the table surface, and Radar Plotters would trace the movement of the graticule and the TPA spots. Updates would be annotated with the time. Thus, a real-time picture of the battle would be created, and the CO could determine the optimum time to fire weapons. In the DDE/DDH-205 class ships, through the Canadian Integrated Sonar Control System, the WO/OpsO could select which sonar had the best target data, and what the TPA was assigned to — i.e. a ship in company, a submarine's current position, and/or a submarine's future position where it would encounter ASW Limbo Mortar MK-10 depth charges, or vectored helicopter or maritime fixed-wing aircraft-delivered torpedoes. In Improved Restigouche (IRE) ships, ASW action and firings of ASROC-launched torpedoes and mortars were controlled from the Sonar Remote Indicator (SRI) station. The plotting table was still used to plot the broader action picture.



The battle could run to the edge of the table and, when that happened, a clean sheet of paper would be taken from the roll, and the position of "own ship" could be moved to the other end of the table. Alternatively, for ARL tables, instead of using paper to create the plot, the battle was plotted on 12''x 12'' Perspex tiles. These had the advantage that, when the battle reached the edge of the table, the graticule could be reset and the tiles moved. This allowed the picture to evolve more or less seamlessly, but there wasn't a historical record.

The multifunctional tables were also capable of maintaining a situational picture for blind pilotage navigation, and were useful during man overboard evolutions. Upon hearing the man overboard alarm raised, the officer of the watch could call down to Ops to "mark the plot," thereby establishing a datum to guide the ship back to the estimated recovery point. The plotting tables proved extremely effective in all of their roles.

Introduction of the DDH-280 class brought an end to the Action Plot tables, though they remained in the last of the 205-class ships, and the three AOR replenishment oilers, until they were paid off.

NC2 Plot Table Fire

By Pat Barnhouse

I joined HMCS *Haida* (DDE-215) as Electrical Officer in December 1959, just as the ship was completing a fairly extensive refit that saw major changes made to the Operations Room equipment in conjunction with an update to the gun fire-control systems. One piece of equipment new to the Ops Room was the NC2 plot table which was an early, if not the first item of equipment in the RCN to be of solid state (transistor) design.

To visualize the mechanical operation of the plot table, it can best be thought of as an upside-down gantry crane; in other words it consisted of two parallel rails on which a carriage rolled back and forth. On the carriage was a light projector that indicated ship's own position on the overhead plotting surface, along with a device called the Target Plot Attachment (TPA) that was used to project the position of two targets (sonar/radar) relative to own ship. Unfortunately, not enough thought was given to the layout of the flexible wiring to this projector and its associated TPA. One day during operation of the plot table, the combination of carriage and projector movements conspired to catch the wiring around the edge of a rail and pull it tight enough to bare the wires. The resulting short-circuit caused a fire that burnt most of the wiring interior to the plot table.

Fortunately, the ship carried similar spare wiring, and one of our petty officer electricians was able to repair the damage, a job that occupied him for a considerable number of hours. Subsequent to my submission of an Unsatisfactory Condition Report, two CANAVMOD (Canadian Naval Modification) instructions were issued. One dealt with an improvement to the flexible wiring layout, and the other inserted fuse protection in the flexible wiring circuit.