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THE UNITED STATES NAVY'S COOPERATIVE ENGAGEMENT CAPABILITY: SOUNDS LIKE A GOOD IDEA, WHAT'S CANADA DOING ABOUT IT?

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Abstract

The United States Navy (USN) is in a process of transformation through the implementation of network-centric warfare (NCW) to leverage information superiority to improve combat effectiveness. The USN's cooperative engagement capability (CEC) is considered to be a major advance in enabling NCW for air defence at sea. CEC exploits the advantages of sensor nettting and data fusion to enable composite tracking, precision cueing, and coordinated and cooperative engagement. CEC would provide the Canadian Navy with an enhanced air defence capability and is expected to become an essential requirement for interoperability with the USN in future operations. The Canadian Navy has no plan to retro-fit CEC on the current fleet, but this position must be re-visited. Canada should not wait until the delivery of the next surface combatant, not expected until 2020, to insert a powerful NCW enabling technology like CEC into the HALIFAX class. A recommended first step is to conduct an analysis to determine CEC's cost-effectiveness in achieving the HALIFAX Class Modernization project's operational requirements to enable it to be prioritized amongst other competing naval initiatives.

Introduction

Many believe that the militaries of the world are undergoing a revolution in military affairs (RMA). In 1995, Admiral Owens stated that the U.S. had to rise to the challenge offered by the information age and undertake a "revolution in joint military affairs" that would enable military force to be used with greater precision, less risk, and more effectively.[1] He further stated that the interaction of the various sensor, command and control, and weapon systems must be considered together, under some form of overarching "system of systems" architecture to fully exploit all available synergies.[2] Admiral Owen's concept has evolved into what is now called network-centric warfare (NCW).[3]

Vice Admiral Cebrowski is equally emphatic in his view that we are experiencing the most important RMA in the past 200 years in the shift from platform-centric to network-centric warfare (NCW).[4] He contends that the United States Navy's (USN) cooperative engagement capability (CEC) is a key example of the advantages gained from moving from a platform-centric to a network-centric approach.[5]

CEC takes high quality track data from all participating sensors, spread out over many ships (platforms), and fuses the data to create a common air-defence tactical display that is then distributed to all participating ships.[6] This results in a common air

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[1] William A. Owens, "The Emerging System of Systems," *Proceedings of the United States Naval Institute* (May 1995): 36.

[2] Ibid., 37.

[3] John D. Zimmerman, "Net-Centric is About Choices," *Proceedings of the United States Naval Institute* (January 2002): 38.

[4] Arthur K. Cebrowski, and John J. Garstka, "Network-Centric Warfare: Its Origin and Future," *Proceedings of the United States Naval Institute* (January 1998): 29.

[5] Ibid., 34.

[6] Daniel Busch, and Conrad J. Grant, "Co-operative Engagement Capability," *Military Technology* (September 2003): 30.

picture based on all available sensor information, which is inherently superior to the air picture that could be created by a single ship.[7] At first glance some would say that this is not new, that this capability already exists through tactical data links such as Link 11 and Link 16, but CEC is significantly different—providing a more synergistic network-centric solution.

Canada's naval strategy for 2020, *Leadmark*, recognizes the importance of NCW for future naval operations and highlights CEC as an essential ingredient.[8] With all the available information regarding CEC widely known within the Canadian Navy, what is being done about it? No project currently exists to acquire CEC for retrofit on any existing class of ship. It is likely that future ship requirements, such as the Single Class Surface Combatant, will specify CEC in addition to the required NATO tactical data links, but must we wait fifteen years until this capability enters the fleet? This paper will contend that the Canadian Navy should act now to explore introducing CEC into the existing Canadian fleet or risk missing a cost-effective opportunity to improve air defence and interoperability capabilities and gain operational experience with this transformational technology.

This paper will first provide some background on the perceived on-going RMA and NCW in particular. The USN's vision and way ahead for NCW will then be presented followed by a detailed description of CEC. A critical analysis of the USN's NCW vision and CEC will also be included. The utility of CEC within the Canadian context will then be discussed followed by a discussion of the air defence and

[7] Ibid., 30.

[8] Department of National Defence, LEADMARK*: The Navy's Strategy for 2020* (Ottawa: Directorate of Maritime Strategy, 2001), 128.

interoperability capability enhancements that it will provide. Finally, a recommended approach for the introduction of CEC into the fleet will be presented.

The RMA and NCW

An RMA is defined as a significant change in warfare resulting from the combination of technological advances and changes in military doctrine and organizational concepts.[9] The introduction of a revolutionary new technology into the fleet alone does not constitute an RMA. To fully exploit the technology, changes must also be made to how a navy is organized and trained.

NCW leverages information superiority to optimize combat power through the networking of sensors, decision makers, and shooters to create shared awareness, increased speed of command, higher tempo operations, greater lethality, increased survivability, and a degree of self-synchronization.[10] A network consists of nodes—that sense, decide, or act—and the links among the nodes.[11] Metcalfe's Law states that despite the fact that the cost of deploying a network increases linearly with the number of nodes, the potential value of the network increases by a function of the square of the number of nodes connected to the network.[12] The word "potential" must be stressed, since no performance will be gained unless doctrine, organization, and training are changed to exploit any increases to the size of the network.[13]

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[9] Elinor C. Sloan, *The Revolution in Military Affairs* (Montreal: McGill-Queen's University Press, 2002), 3.

[10] David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority* (Washington: CCRP Publication Series, 2000), 2.

[11] Ibid., 94.

[12] Ibid., 250.

[13] Ibid., 104.

The US Department of Defence has identified four core tenets of NCW. First, that a networked force enhances information sharing. Second, that information sharing improves the quality of information and shared situational awareness. Third, that shared situational awareness facilitates collaboration and self-synchronization and improves sustainability and speed of command. Finally, that the combined effect results in increased mission effectiveness.[14] NCW does not claim to eliminate the fog of war, as some critics believe, rather it aims to develop an exploitable information advantage.[15]

USN's Vision and NCW

"Sea Power 21" is the USN's vision for facing the challenges ahead. It states that:

> Future naval operations will use revolutionary information superiority and dispersed networked force capabilities to deliver unprecedented offensive power, defensive assurance, and operational independence to Joint Force Commanders.[16]

The USN's future warfighting capability will be built around the following three interwoven operational concepts: Sea Shield, Sea Strike, and Sea Basing.[17] In addition, ForceNet will be the architectural framework that binds those three concepts together.[18] Together, Sea Shield, Sea Strike, Sea Basing, and ForceNet form the four interdependent and synergistic naval capability pillars.[19]

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[14] The information in the preceding paragraph was from: Office of Force Transformation, "The Implementation of Network-Centric Warfare," dated January 10, 2005; http://www.oft.osd.mil/library/library.cfm?libcol=6; Internet; accessed 7 February 2005, 7.

[15] Ibid., 16.

[16] Vern Clark, "Sea Power 21: Projecting Decisive Joint Capabilities," *Proceedings of the United States Naval Institute* (May 2002): 33.

[17] Ibid., 41.

[18] Ibid., 37.

[19] Secretary of the Navy, "2003 Naval Transformation Roadmap," dated April 20, 2004; http://www.oft.osd.mil/library/library.cfm?libcol=6; Internet; accessed 7 February 2005, 5.

The Sea Shield operational concept will provide a defensive umbrella against enemy missiles that can be used to protect either the homeland or coalition partners and joint forces in distant, contested littoral waters—extending deep inland.[20] CEC is identified as playing a key role in achieving the goals of Sea Shield. The offensive Sea Strike operational concept will leverage C^5ISR,[21] precision weapons, stealth, and joint strike power to create both lethal and non-lethal effects on enemy targets.[22] CEC is also identified as playing a key role by providing precise targeting data and intelligence to all levels of command.[23]

Sea Basing serves as the foundation for projecting and sustaining naval power—providing operational independence.[24] It provides capabilities that enable the control of the sea without the limitations imposed by reliance on foreign shore-based support.[25] ForceNet is the concept that will exploit the full potential of NCW in the information age.[26] ForceNet, therefore, is the key to the implementation of the USN's NCW vision. ForceNet is defined as:

> … the operational construct and architectural framework for naval warfare in the Information Age that integrates warriors, sensors, networks, command and control, platforms, and weapons into a networked,

[20] Mike Bucchi, "Sea Shield: Projecting Global Defensive Assurance," *Proceedings of the United States Naval Institute* (November 2002): 56.

[21] Command, Control, Communications, Computers, Combat Systems, Intelligence, Surveillance, and Reconnaissance.

[22] Cutler Dawson, "Sea Strike: Projecting Persistent, Responsive, and Precise Power," *Proceedings of the United States Naval Institute* (December 2002): 54.

[23] Ibid., 55.

[24] Charles W. Moore, and Edward Hanlon, "Sea Basing: Operational Independence for a New Century," *Proceedings of the United States Naval Institute* (January 2003): 80.

[25] Secretary of the Navy, "2003 Naval Transformation Roadmap," … , 4.

[26] Richard W. Mayo, "ForceNet: Turning Information into Power," *Proceedings of the United States Naval Institute* (February 2003): 46.

> distributed combat force that is scalable across all levels of conflict from seabed to space and sea to land.[27]

To leverage the power of information, ForceNet will more effectively acquire, share, and exploit it.[28] CEC is identified as a key element for sharing information in the air and missile defence component. Ultimately, ForceNet does more than just provide more information; it is about providing the right information at the right time to aid decision making.[29]

Colonel Kuzmick provides a good analogy that helps explain ForceNet.[30] He explains that ForceNet will be a military version of the World Wide Web (WWW)[31]. He further explains how information overload will be avoided. This, he states, will be done by spatial and temporal filtering to extract and correlate the pertinent information from the huge database.[32] Tying together real-time sensor data, map information from a database, and the results from automated decision-aid software, and then referencing the mix to a single time/space coordinate system will provide great assistance to decision makers.[33] CEC does this with respect to air defence, while other elements of ForceNet cover other areas.

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[27] Ibid., 43.

[28] Ibid., 44.

[29] Ibid., 45.

[30] James J. Kuzmick, "It's Not Just the Information—It's the Correlation," *Proceedings of the United States Naval Institute* (February 2005).

[31] Colonel Kuzmick explains that a military WWW would enable users to have a reliable connection anywhere in the world and be able to post information and conduct searches on its contents. It would also provide the usual e-mail, chat, instant messaging, and be absolutely secure.

[32] Colonel Kuzmick explains that this process is similar to how a smart search is currently conducted on the WWW and will be enabled if all information posted on ForceNet has a tag, or metadata, that has a timestamp and other important information to enable smart searches.

[33] Colonel Kuzmick's analogy presented in this paragraph is from: Kuzmick, "It's Not Just the Information …, p 47-48.

Description of CEC

The successful Exocet missile attack on the USS Stark by an Iraqi jet on May 17, 1987, raised concerns in the USN regarding the poor level of fleet protection against airborne threats and led to the initiation of the CEC program.[34] The USN recognized that missile technology was rapidly advancing and proliferating and the ability to detect and defeat the emerging missile threat was reducing.[35] Moreover, operations were becoming more frequent in the littorals, where air defence was complicated by such factors as clutter from rough terrain, blockage from coastal mountains, and high density levels of neutral commercial traffic.[36] The events of 9/11 have only increased the urgency to improve the USN's fleet air defence to counter a potential missile attack by terrorists.[37]

CEC is currently used to improve the fleet's air defence system, but in the future it is hoped to expand this to the army and air forces to create a joint sensor netting system.[38] CEC is viewed by the USN as a major advance in enabling NCW at sea.[39] CEC will exploit the advantages of sensor netting to enable composite tracking, precision cueing, and coordinated and cooperative engagement.[40]

Composite tracking involves the fusing of sensor data from all participating units to create a common air-defence tactical display composed of composite tracks.[41] By fusing all available data and exploiting the geometric and frequency diversity of all

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[34] Brendan P. Rivers and Michael Puttré, "Victory at CEC," *The Journal of Electronic Defence* (September 2001): 40.

[35] Daniel E. Busch, "A True Single Integrated Air Picture," *Sea Power* (March 2002): 43.

[36] "The Cooperative Engagement Capability," *John Hopkins APL Technical Digest* 16, no. 4 (1995): 377.

[37] J.R. Wilson, "Making Sense of Sketchy or Incomplete Information," *Military and Aerospace Electronics* (November 2001): 20.

[38] Ibid., 20.

[39] Busch and Grant, "Co-operative Engagement Capability," ..., 26.

[40] "The Cooperative Engagement Capability," …, 378-379.

[41] Busch and Grant, "Co-operative Engagement Capability," ..., 30.

participating units, the resulting radar picture is orders of magnitude better than what could be produced by any single ship.[42] The resulting radar picture is also significantly better than what can be achieved by utilizing a tactical datalink, such as Link 11 or Link 16.[43]

CEC's data fusion algorithm provides a real-time determination of a composite track made up of the input of all participating sensors, weighted according to their sensor accuracy.[44] This allows a unit to maintain a track even when its sensors are jammed, fail, or are adversely affected by the weather.[45] The composite track feature also includes the benefits of automated track number commonality.[46] The composite tracking capability is a significant breakthrough that when implemented by a large number of distributed participating units—exploiting Metcalfe's law—is capable of evading the best current stealth technology.[47] Many believe that sensor netting, combined with evolving sensors and processing power, will continue to defeat future stealth technology improvements.[48]

Precision cueing optimizes the sensor coverage on any track of interest.[49] This is accomplished by automatically initiating a unit that does not locally hold a track with its own radars to commence a local track, thus providing additional information for the composite track. The clever part is that due to the remote composite track data, the local

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[42] Rivers and Puttré, "Victory at CEC," ..., 41.

[43] Tactical links only share processed tracks developed by individual units. No fleet-wide sensor netting or data fusion is involved. CEC, through sensor netting and data fusion, develops a composite track. Tactical links on the other hand, through a mix of automated decision aids and human effort, just determine the best of all the processed tracks developed by the individual units.

[44] "The Cooperative Engagement Capability," …, 378.

[45] Rivers and Puttré, "Victory at CEC," ..., 41.

[46] "The Cooperative Engagement Capability," …, 379.

[47] Norman Friedman, "DoD Shifts to Capability-Based Procurement," *Proceedings of the United States Naval Institute* (May 2002): 101.

[48] Ibid., 2.

[49] "The Cooperative Engagement Capability," …, 379.

track can be formed very quickly by consideration of the quality of the composite track (i.e., is it of fire-control quality?) and the subsequent potential to advantageously set sensor settings, such as the default false alarm threshold, to accelerate the process.[50] This allows the cueing of a unit's fire control radar at the earliest opportunity to enable a unit to conduct a conventional engagement,[51] exploiting the range of its air defence missiles and providing an additional time margin for more launches.[52]

Coordinated and cooperative engagement enables a unit to fire a missile and guide it to intercept using the radar data of the target from a remote CEC unit, even if the firing unit never acquires the target with its own radars.[53] Furthermore, engagements can be coordinated, either conventionally or cooperatively, among all participating CEC units.[54] This is significant since it allows optimal overall CEC network management of engaging the right weapon for the right target at the right time.[55] Coordination could be conducted by CEC producing automated force-level engagement recommendations to the force commander.[56]

CEC is composed of two primary sub-systems: the Cooperative Engagement Processor (CEP) and the Data Distribution System (DDS).[57] The CEP receives as input all the shared sensor data and first processes each sensor's data through its own unique

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[50] Ibid., 379.

[51] A conventional engagement, as opposed to a cooperative engagement, involves a ship using only its own sensors—whether they were precision cued by CEC or not.

[52] "The Cooperative Engagement Capability," …, 387.

[53] Ibid., 379.

[54] Ibid., 380.

[55] The following is an illustration of the problems associated without having a coordinated engagement capability. Consider a task group facing a major missile attack. Each unit would act independently and the collective arsenal of air defence missiles would not be used efficiently—potentially leaving little in reserve for a subsequent second or third wave attack. This illustration was from: Rivers and Puttré, "Victory at CEC," ..., 41.

[56] Alberts, Garstka, and Stein, *Network Centric Warfare …,* 172.

[57] Busch, "A True Single Integrated Air Picture," ..., 43.

"adaptive layer"[58] and then uses common algorithms to fuse the data to ensure that each unit has the identical integrated air picture.[59] The DDS provides real time secure communications among all CEC units by using phased array antennas.[60] Precision timing is required to enable the fusion of fire control quality composite tracks and this is enabled by time stamping all sensor data by CEC net-synchronized cesium clocks.[61]

CEC has successfully passed numerous USN trials and is currently fitted on several USN surface ships and E-2C AEW aircraft. A fleet wide implementation plan is in place that extends to US Air Force AWACS, and the US Army's Patriot Air Defence system[62]—creating a truly joint system. In the future, it is hoped that CEC will be expanded to become a joint NCW system to support ground attack operations.[63] Another exciting future development is a new type of cooperative engagement known as forward pass remote illumination.[64] This would allow a unit to conduct a normal cooperative engagement, firing and guiding (illuminating) a missile based on radar data from another CEC unit, and then handing over the terminal guidance of the missile to a remote unit—either another ship or aircraft. This would drastically improve the potential to exploit the full range of air defence missiles. A logical extension of this new technology would be ground attack, transitioning CEC from just air defence to a joint land strike role as well.

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[58] An adaptive layer is software unique to each type of sensor that is required to enable the sensor to interface with CEC.

[59] Ibid., 43.

[60] "The Cooperative Engagement Capability," …, 381.

[61] Ibid., 381.

[62] Robert Kerno, "CEC and the Interoperability Challenge;" available from http://www.navyleague.org/seapower/cec_and_the_interoperability_cha.htm; Internet; accessed 29 January 2005, 5.

[63] Wilson, "Making Sense …, 20.

[64] "The Cooperative Engagement Capability," …, 394.

The USN, appreciating the benefit of coalition navies possessing CEC, has entered into discussions regarding the acquisition of CEC with several foreign navies—Canada included. To date, however, only the Royal Navy (RN) has committed to procure CEC. The RN plans to buy up to 17 systems for retrofit on their existing Type 23 class and for their new Type 45 class.[65] The RN have further stated the possibility that they might extend the purchase of CEC for their new aircraft carrier, its future embarked E-2C AEW aircraft, and their land based air defence system.[66]

Critics of CEC

The USN is committed to CEC as part of their vision, however support is not universal, even within the USN. Critics of CEC can be roughly grouped in one of three camps. The first camp is supportive of NCW and the capabilities that CEC provides. Their criticism focuses on the technical solution. They champion competing sensor-netting and communication technologies, stating that CEC is not taking the best approach to provide the needed capability. The second camp is neither supportive of NCW nor CEC. They believe that too much money is being spent on a concept that is flawed. They do not accept the arguments that expound the benefits that NCW will provide. As always, there is a middle ground. The people in the third camp occupy this middle ground and agree that the NCW concept is valuable and will improve the USN's future warfighting abilities. They, however, believe that the virtues of NCW are being oversold and that the USN is overly optimistic about the benefits that systems such as CEC will provide. They support CEC, but are less optimistic about the degree to which the fog of war can be eliminated.

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[65] Wilson, "Making Sense …, 27.

[66] Ibid., 27.

Regarding the first camp, the CEC project office is still evolving the CEC ship package (hardware and software) and as processors continue to improve they will be adopted into new versions of CEC. Similarly, as the navy works with the air force and army on a joint sensor netting capability, joint standards will be agreed on and CEC will be adjusted accordingly. This camp, therefore, are critics of the delays involved in CEC's evolution, and in particular of the project's reluctance to adopt the technologies that they champion. Terry Pierce argued that the navy, due to a bureaucracy that stifles innovation, is stubbornly rejecting new sensor netting technologies to CEC's detriment.[67] This gets at the heart of how reactive CEC can be to emerging and competing technologies. The business of warfighting—firing multi-million dollar missiles, and protecting fleet assets worth billions of dollars combined with their crew of several hundred sailors—is a serious one that requires a commensurately greater level of rigor than many other projects regardless of their project costs.[68] A high degree of due diligence, including extensive fleet testing, is required before a new version of CEC can be developed and introduced.

Regarding the second camp, they scoff at the notion that visionaries, such as Admiral Owens, believe that NCW can eliminate the "Clausewitzian" friction and fog of war.[69] They believe that eliminating the fog of war is a ridiculous notion and that going down that path is riddled with problems. One postulated problem is that the resulting

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[67] Terry C. Pierce, "Sunk Costs Sink Innovation," *Proceedings of the United States Naval Institute* (May 2002): 32.

[68] Mike Mathis, "Comment and Discussion: Sunk Costs Sink Innovation," *Proceedings of the United States Naval Institute* (June 2002): 14.

[69] Mark F. Cancian, "Seeing Through the Fog of War," *Proceedings of the United States Naval Institute* (February 2004): 50.

information overload will saturate commanders with a "flood of indigestible data".[70] CEC, however, is a perfect example of how netted sensors and automated decision tools can make sense out of a deluge of information and improve a commander's situational awareness and decision superiority. Another postulated problem is that the control of warfare will become too centralized, and as one critic observed: "NCW describes a technological method of military micromanagement—not an operational-level leadership tool."[71] Technology alone will not save the day and the members of the third camp cannot be faulted for being sceptical. Technology accompanied by doctrinal and organizational change is needed to enhance operational effectiveness. The challenges that lie ahead to get this right are immense and are still being worked out within the USN through extensive debate, development, and fleet testing. CEC has made great strides in this regard, but further work is required to fully exploit this transformational technology and extend CEC to joint operations and a land strike role.

Canadian Context

The Canadian Navy operates two classes of major warships: the general purpose frigate (HALIFAX class), and the command and control anti-air warfare destroyer (IROQUOIS class). The next forecast major warship—the Single Class Surface Combatant (SSC)—will replace both the HALIFAX and IROQUOIS classes, but is not planned to be operational until 2020. It is likely that CEC will be a requirement for the SSC project, but it would be desirable to fit CEC on both the HALIFAX and IROQUOIS

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[70] Milan Vega, "Net-Centric is Not Decisive," *Proceedings of the United States Naval Institute* (January 2003): 55.

[71] John P. Springett, "Network Centric Without the Art," *Proceedings of the United States Naval Institute* (February 2004): 60.

classes before 2020. Due to the age of the IROQUOIS class, it is unrealistic that any major investment—such as CEC—would be contemplated for her. That leaves the HALIFAX class that is approaching her mid-life upgrade and refit under the auspices of the HALIFAX Class Modernization (HCM) omnibus project. The first refit is planned to commence in 2010, and represents an ideal opportunity to fit CEC. The HCM project, however, is relatively mature with an approved capital budget and a host of well established capital projects vying for inclusion. CEC is not currently one of them, but in 2004 it was the subject of a briefing note[72] to the Chief of Maritime Staff to determine its applicability for inclusion in the HCM project.

The cost estimate, provided in the briefing note, for a class-wide installation of CEC on the HALIFAX class is $100M. This consists of $54M for hardware costs, and the remaining $46M for trainers, integrated logistic support, installation, and software integration. It was estimated, irrespective of the number of CEC units purchased, that approximately $30M is required for software integration, which primarily consists of the development of an adaptive layer for the main HALIFAX class' sensors. Since the price tag of $100M was not included in the HCM project, the briefing note stressed that either new funding would need to be approved or CEC would need to displace other earmarked projects within the existing HCM budget. To date, no formal decision has been made—denying the HALIFAX class of the prospect of achieving capability enhancements in air defence and interoperability. Both will now be discussed.

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[72] Department of National Defence, *Briefing Note for CMS on Co-Operative Engagement Capability (CEC).* Director of Maritime Requirements Sea, 1 June 2004.

Interoperability Issues

Interoperability with our allies, and especially the USN, is an important objective for the Canadian Navy. This is clearly stated in *Leadmark*, the Navy's strategy for 2020, where CEC is singled out as an enabler in this regard.[73] The briefing note to CMS further stressed this point:

> Interoperability with our key allies, particularly the USN, is a stated long term priority for the Canadian Navy … [and] … If Canada wishes to continue to be an effective member when operating with the USN, a CEC capability is likely to be required.[74]

Since the RN is acquiring CEC, this strengthens the importance of acquiring CEC to ensure allied interoperability. This view is echoed by Norman Friedman's observation that while Link 11 is currently a prerequisite for operating with the USN, CEC will soon also become essential.[75]

The USN's vision states that ships must pass three criteria to be able to operate within their envisioned ForceNet architecture: they must integrate smoothly with joint force packages, they must enhance the strategic impact of the USN team, and they must be adaptable.[76] CEC will ensure that the Canadian Navy satisfies those demanding criteria, including the stringent joint integration criteria since it has been developed with this as a design requirement. Furthermore, by adding another node in the CEC network, a Canadian CEC-enabled ship operating with the USN will inherently add operational value to a USN task force. The improved interoperability that CEC will bring to operations with the USN is not, however, without complications. The development of

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[73] Department of National Defence, LEADMARK …, 128.

[74] Department of National Defence, *Briefing Note for CMS …* .

[75] Norman Friedman, "Are We Already Transformed?" *Proceedings of the United States Naval Institute* (January 2002): 36.

[76] Mike Mullen, "Global Concept of Operations," *Proceedings of the United States Naval Institute* (April 2003): 68.

rules of engagement and doctrine related to coalition operations will raise issues that must be assessed and resolved before optimal coalition operations can be achieved.

Air Defence Issues

A key goal of the HCM project is to upgrade the class' air defence capability to better respond to the evolving missile threat. Three key established projects to accomplish this are: the radar upgrade (RU) project, the enhanced sea sparrow missile (ESSM) project, and the modernized command and control system (HMCCS) project. The combined total for these three projects is over $1B, and represents a significant proportion of the overarching HCM project's capital budget.

The addition of CEC to the HCM project would provide numerous advantages, such as: improving situational awareness; extending the engagement envelope, thereby better exploiting the range of the new ESSM; reducing the amount of time to detect, track, classify, and engage targets[77]; improving the ability to detect low-observable objects[78]; and providing automated decision aids to coordinate and assign linked shooters to engage targets. These advantages, however, will only be realized if CEC-enabled ships are operating in a task group composed of other CEC-enabled ships—a valid criticism against only fitting CEC on a small fraction of the ships that would compose a Canadian Task Group. This concern is mitigated, however, by the realization that a Canadian naval ship will typically only be in a high air threat environment during hostilities if it is part of a coalition task force consisting of predominantly USN and RN CEC-enabled ships.

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[77] Alberts, Garstka, and Stein, *Network Centric Warfare ...,* 170.
[78] Ibid., 170.

The RU project is seeking additional funding and one concern is that operational analysis studies are being conducted to support a "best bang for the buck" argument without consideration of CEC. The HCM project was only recently stood up to, among other things, ensure that a balanced set of class requirements was in place and to prioritize the numerous projects vying for scarce funds. It is a point of concern that CEC is not one of the competing projects.

Proposed Way Ahead

How should the Canadian Navy proceed, given the evidence on the table and the fiscal constraints being faced? Three broad options exist. First, make a decision to acquire CEC for the HALIFAX class now, based on the available information, and either get more money for the HCM budget or displace existing earmarked programs of lower priority. Second, conduct a phased approach, similar to the RN's, that first conducts a detailed analysis to quantify CEC's cost-effectiveness in achieving the HCM's operational requirements—thus enabling it to be objectively prioritized amongst competing projects. If this analysis reveals that CEC offers the best "bang for the buck," then a decision should be made to install it on the HALIFAX class. This will likely be after the implementation of the HCM project due to the time to conduct the necessary analyses. Therefore, implementation in a limited manner, or in the form of a single ship operational evaluation to ramp up for the SSC project must be explored. Third, decide against fitting CEC on the HALIFAX class and focus on the SSC, deferring further work on CEC until the SSC project is stood up. The third option is effectively the status quo, since no decision has been made to progress any CEC related activity, despite the recommendations made in the briefing note to the Chief of Maritime Staff.

Regarding the first option, since Canada has only received unclassified information from the USN CEC project office and has had no formal discussions with the RN regarding their procurement decision, we do not have sufficient information on CEC's cost-effectiveness to displace an established project or secure new funding in the current fiscal environment. Also, it would be exceedingly difficult to successfully manage a project to install CEC during the first HCM refit in 2010 given the tight timeline, but that should not rule out fitting CEC on the HALIFAX class. The third option is clearly the worst with respect to the timeliness of providing the Canadian Navy with enhanced air defence and interoperability capabilities. The second option, therefore, is assessed as the preferred option and should be pursued to ensure that the HALIFAX class remains relevant for future coalition operations. Under the current SSC project's timeline the HALIFAX class will only be replaced on a one ship per year basis commencing in 2024, so five HALIFAX class ships could remain in service past 2030. Therefore, due to the significant remaining service life it makes sense to invest in the HALIFAX class to install CEC even after the HCM refits.

If option two is pursued, and the phase one analysis finds that CEC is cost-effective, CEC must be prioritized amongst all other prospective naval programs within the naval apportionment of the Strategic Capital Investment Plan. As a minimum, funds should be secured for a single HALIFAX class installation—likely cost constrained to a limited number of sensor adaptive layers—as an operational evaluation to gain experience with the technology and to start the process of co-evolving doctrine with technology and to commence tackling the thorny questions raised earlier concerning this transformational NCW enabling technology.

This approach would be consistent with how the USN has transformed their fleet—through the Sea Trial concept. The USN has learned the hard way that simply "grafting new technology to old processes will not work."[79] Sea Trial embraces the philosophy that to fully leverage the advantages that a new technology can bring, it is essential to introduce it in a timely manner, speeding the process of technological innovation through the concurrent development of new operational concepts and doctrine.[80] If CEC is first introduced in the SSC with no previous experience, except for some USN lessons learned, the navy will face the risk of at best not fully exploiting the technology and at worst creating significant doctrinal challenges that will adversely impact on the quality of Canada's contribution to future operations.

To implement option two's initial analysis phase, the following recommendations developed in the briefing note to the Chief of Maritime Staff should be pursued: initiate formal discussions with the USN at the secret level, and initiate an information request from the RN to determine lessons learned from their CEC acquisition.[81] Canada should conduct an analysis similar to the RN's to quantify the operational advantage that CEC will provide.[82] Upon completion of the above activities, sufficient information will be available to make a decision on the future of CEC for the Canadian Navy. Based on the existing evidence in open literature, it is expected that CEC will prove to be cost-effective and should be installed on the HALIFAX class without deferring the issue to the SSC project.

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[79] Robert J. Natter, "Sea Trial: Enabler for a Transformed Fleet," *Proceedings of the United States Naval Institute* (November 2003): 62.

[80] Ibid., 62.

[81] Department of National Defence, *Briefing Note for CMS* … .

[82] The RN, in addition, conducted their own operational evaluation to confirm the analytical study prior to deciding to acquire CEC for either the Type 23 or Type 45. This information was in: Busch and Grant, "Co-operative Engagement Capability," …, 32.

Conclusion

In 1995, Admiral Owens challenged the USN to undertake an RMA to exploit the opportunities offered by the information age. Since then, the USN has risen to that challenge and is in the process of transformation through the implementation of NCW to leverage information superiority to improve combat effectiveness. "Sea Power 21" is the USN's vision, which discusses four interdependent and synergistic naval capability pillars. ForceNet, is the capability pillar that will exploit the full potential of NCW in the information age.

ForceNet will be a military version of the World Wide Web, providing the architectural framework for naval operations in the information age. CEC is a component of ForceNet that deals with air defence—tying together real-time sensor data and the results from data fusion and automated decision aids to provide commanders with information and decision superiority. CEC exploits the advantages of sensor netting to enable composite tracking, precision cueing, and coordinated and cooperative engagement. CEC will also be used by the US Army and Air Force as well as the RN, making it a powerful enabler for combined and joint operations in littoral waters.

CEC does not claim to eliminate the fog of war, as some critics believe, rather it aims to develop an exploitable information advantage. Furthermore, despite the fact that CEC is operational within the USN, it is still evolving—continuously assessing the stream of emerging technologies and joint operational standards. Despite CEC's success to date, the USN are still progressing the doctrinal and organizational challenges to fully exploit this transformational technology.

The Canadian Navy can benefit from introducing CEC to the fleet through achieving capability enhancements in air defence and interoperability. The HALIFAX class' mid-life upgrade provides an opportunity to insert this technology in the 2010 timeframe, or alternatively the SSC project could insert this technology in the 2020 timeframe.

Three broad options have been proposed for how Canada should proceed to exploit CEC, ranging from introducing CEC into the HALIFAX class under the HCM project, to deferring further work on CEC until the start of the SSC project. The recommended option lies between these two extremes and involves a phased approach that first involves conducting a detailed analysis to quantify the operational effectiveness that CEC will provide. After the results of this analysis are known, Canada will then be in a position to decide whether CEC should be fitted on the HALIFAX class or future combatants. If there is a strong desire but insufficient funds for a class wide fit, then it is recommended that as a minimum an operational evaluation be conducted to position the navy to best acquire and exploit CEC for the SSC. CEC is at the heart of the on-going information age driven RMA, and Canada should not delay a decision to exploit advances made by the USN in this field. The Canadian Navy, therefore, should act now to explore introducing CEC into the existing Canadian fleet or risk missing a cost-effective opportunity to improve air defence and interoperability capabilities and gain operational experience with this transformational technology.

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