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THE CANADIAN AIR FORCE JOURNAL

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THE CANADIAN AIR FORCE JOURNAL is an official publication of the Chief of the Air Staff and is published quarterly. It is a forum for discussing concepts, issues and ideas that are both crucial and central to aerospace power. The *Journal* is dedicated to disseminating the ideas and opinions of not only Air Force personnel, but also those civilians who have an interest in issues of aerospace power. Articles may cover the scope of Air Force doctrine, training, leadership, lessons learned and Air Force operations: past, present or future. Submissions on related subjects such as ethics, technology and Air Force history are also invited. This *Journal* is therefore dedicated to the expression of mature professional thought on the art and science of air warfare and is central to the intellectual health of the Air Force. It serves as a vehicle for the continuing education and professional development of all ranks and personnel in the Air Force as well as members from other environments, employees of government agencies and academia concerned with Air Force affairs. ■

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THE CANADIAN

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THE CANADIAN AIR FORCE JOURNAL welcomes the submission of articles, book reviews and shorter pieces (which will be published in the Letters to the Editor, Points of Interest and Pushing the Envelope sections) that cover the scope of Air Force doctrine, training, leadership, lessons learned and Air Force operations: past, present or future. Submissions on related subjects such as ethics, technology and Air Force history are also invited.

JOURNAL SECTIONS

Item	Word Limit*	Details
Letters to the Editor	50-250	Commentary on any portion of a previous *Journal*.
Articles	3000-5000	Written in academic style.
Book Reviews	500-1000	Written in academic style and must include: • the book's complete title (including sub-title); • the complete names of all authors as presented on the title page; • the book's publisher, including where and when it was published; • the book's ISBN and number of pages; and • a high resolution .jpg file (at least 300 dpi and 5 by 7 inches) of the book's cover.
Points of Interest	250-1000	Information on any topic (including operations, exercises and anniversaries) that is of interest to the broader aerospace audience.
Pushing the Envelope	250-2000	Forum for commentary, opinions and rebuttal on *Journal* articles and/or issues that are of interest to the broader aerospace audience.

* Exclusive of endnotes

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- Submissions may be made in either official language.
- Authors must include a brief (one paragraph) biographical sketch which includes current appointment /position, telephone number and email address. Please include all professional and academic designations as well as military decorations.
- Selected articles that have been peer reviewed have a to the left of the title or at the beginning of the text of the article.
- The Senior Editor will notify contributors on the status of their submission. It may not be possible to publish all submissions.
- All text submissions must be digital, in Microsoft Word or rich text format. Files must not be password protected and must not contain macros. Files may be submitted by mail or email at the addresses provided below.
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- The Senior Editor may select images or have graphics created to accompany submissions.
- Authors should use *Oxford English* or *Petit Robert* spelling. When required, reference notes should be endnotes rather than footnotes and formatted in Chicago style. For assistance refer to *The Little, Brown Handbook*, *Le guide du rédacteur* or CFAWC Production Section at Francoise.Romard@forces.gc.ca
- Acronyms and abbreviations should be used sparingly:
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- The Senior Editor reserves the right to edit submissions for style, grammar and length, but will not make editorial changes that will affect the integrity of the argument without consulting the author.

FOR FURTHER INFORMATION OR TO MAKE A SUBMISSION PLEASE CONTACT THE EDITOR AT:

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For the **Spring 2011** issue: **30 January 2011**
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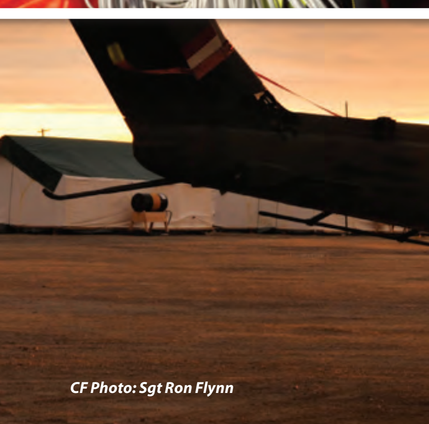

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POINTS OF INTEREST

EDITOR'S MESSAGE

As of September 2010, the Canadian Forces Aerospace Warfare Centre (CFAWC) acquired a new home (so to speak) when our building at 8 Wing Trenton was dedicated to Air Marshal Claire L. Annis, OBE, CD. We thought long and hard before we submitted his name to higher headquarters as our choice for the dedication. During his career, the Air Marshal served as a "bush pilot in uniform," defended Canada by flying anti-submarine patrols in Eastern Air Command, deployed overseas as a station commander within 6 (Royal Canadian Air Force [RCAF]) Group of Bomber Command, held staff positions within Air Defence Command (a forerunner of North American Aerospace Defence Command [NORAD]), and ended his career on a joint note within the newly minted Canadian Forces Headquarters. Impressive as his breadth of experience was, his service career did not clinch his nomination for CFAWC; instead, it was his vision of the Air Force as a learning organization that made him an ideal choice. In a very real sense, Air Marshal Annis gave us our marching orders during a presentation to the Canadian Club in Montreal on 17 March 1952, when he noted that "we... have done a poor job, so far, of presenting on a large scale and in comprehensive, coherent, interesting and easily grasped forms... [the] lessons of air power."

Now "Momma didn't raise no stupid navigators" (OK, I mean airborne combat systems officers). One of the first "lessons" of air power that I learned very early in life was to recognize an implied task in the musings of senior air officers. And perhaps the second "lesson" of air power that was drummed into me was that when given a task by a senior air officer, the correct response is a cheerful "ROGER, WILCO!" followed by an abrupt departure before another job is thrown my way.

Now "we" just have to figure out how, from a Canadian perspective, to make all the real lessons of air power comprehensive, coherent, interesting and easily grasped. It is a work in progress....

Major William March, CD, MA
Senior Editor

LETTERS TO THE EDITOR

2 Jan 2010

Dear Col Dabros,

I've recently reread the article "Leadership: The Air Dimension", in the 2009 Winter edition of the *Canadian Air Force Journal*. I'm still greatly disappointed to not learn from it how the Air Force today defines and develops leadership. I admit, the article told me a lot about what others think and preach but little, if anything, about our Air Force's leadership credo.

Anyway, having been so blunt and critical, and to spur your hormones, here's what I think leadership is.

Leadership is the ability some humans possess to inspire others to achieve goals. The leader may have played a role in establishing the goals, but often their achievement is not in his hands. Yet, in his exercise of leadership he may manage how they are achieved.

A great Leader may be a good manager. But some of the world's great leaders were lousy managers! Churchill, for example!

What do you guys think?

W. K. Carr Lt Gen (Long Retired)

Dear General Carr,

I would like to thank you for your letter of 2 January 2010, addressed to Colonel (Col)—now Brigadier-General Dabros, challenging us to define leadership in the Air Force. As the new commanding officer of the Canadian Forces Aerospace Warfare Centre (CFAWC), it falls upon me to tap dance on this issue. I believe you have hit the nail on the head. The more I read on Air Force leadership, the more I realize we are just starting to give this important topic its due consideration. We have, until recently, left the study of leadership to the joint realm, mostly ignoring the distinct culture of the Air Force, and thereby avoiding debate on the uniqueness of Air Force leadership.

In the article to which you refer, Col Bill Lewis doesn't commit to defining leadership in the Air Force, but rather starts the conversation. I believe his intent was to generate discussion around the topic. He points out that the Air Force has a unique culture that needs to be taken into account when we define our version of leadership, and more importantly, how we prepare our future leaders. Apparently, he was successful in starting this conversation.

In their book *Canadian Air Force – Leadership and Command*, Dr. English and Col Westrop (Ret'd) study how historical and contemporary operations have shaped the Air Force culture and thereby influenced our leadership styles and command structures. They note that Canada is at the forefront of studying leadership and command theories, but that we are lacking the important and complementary step of developing a learning environment in the Air Force through doctrine development and lessons learned analysis.

The work being done at CFAWC on Air Force operational-level doctrine and the Air Force Lessons Learned Programme will begin to bear fruit in the very near future as most of the keystone doctrine manuals are published in the next few months, and we run our first course for the Division and Wing Lessons Learned officers. The Canadian Forces School of Aerospace Studies is leading in the individual training of Air Force officers and non-commissioned members. The Air Force Officer Development Program (AFOD) will ensure future generations will have a better understanding of Air Force operations writ large based on the doctrine being written at CFAWC. This will help to elevate our newest Air Force generation past our current community stovepiped perspectives. These initiatives will contribute towards developing better pan-Air Force leaders, rather than great leaders in the fighter community or the air mobility community or the maritime air community.

While philosophizing on the definition of Air Force leadership is an interesting pursuit, I think the Air Force needs to concentrate on developing better leaders for Air Force and joint operations. Air Commodore Birchall's comment is very applicable here when he said that "leadership is not judged by your rank, but by whether your men are completely confident that you have the character, knowledge and training that they can trust you with their lives." Then again, his more concise description that "leadership is being able to tell someone to go to Hell and have them look forward to making the trip…" hits the mark for me as well. Sir, thank you again for continuing the Air Force leadership conversation!

Colonel D. W. Joyce, OMM, CD
Commanding Officer

Letters to the editor are welcomed and must include the author's name, rank and position. Include a phone number for verification. We reserve the right to edit while preserving the main objective of the writer. We cannot guarantee that any particular letter will be printed. Mail, e-mail or fax to the *Journal*'s Senior Editor.

For further information please contact the Senior Editor at: William.March@forces.gc.ca

17th Air Force Historical Workshop

15-16 June 2011, at 8 Wing Trenton, Ontario

CALL FOR PAPERS

"On the Wings of Peace: Aerospace Power in United Nations Operations"

Aerospace power has been an important element of United Nations (UN) peace operations. At first, aerospace power was limited to the provision of basic capabilities such as transport and observation, but the complexity of UN operations has increased the need for support from air and space-based assets. Mission requirements have expanded to include the provision of intelligence, surveillance and reconnaissance (ISR), and when required, application of force. This workshop will explore the evolution of aerospace power in UN operations past, present, and future.

Individuals wishing to submit a paper for consideration should address it to one of the co-chairs listed below no later than 31 March 2011. Proposals should be at least 200 words in length and include a curriculum vitae (CV). This conference will take place on 15 and 16 June, 2011, at the Canadian Forces Aerospace Warfare Centre (CFAWC), 8 Wing Trenton, Ontario, Canada.

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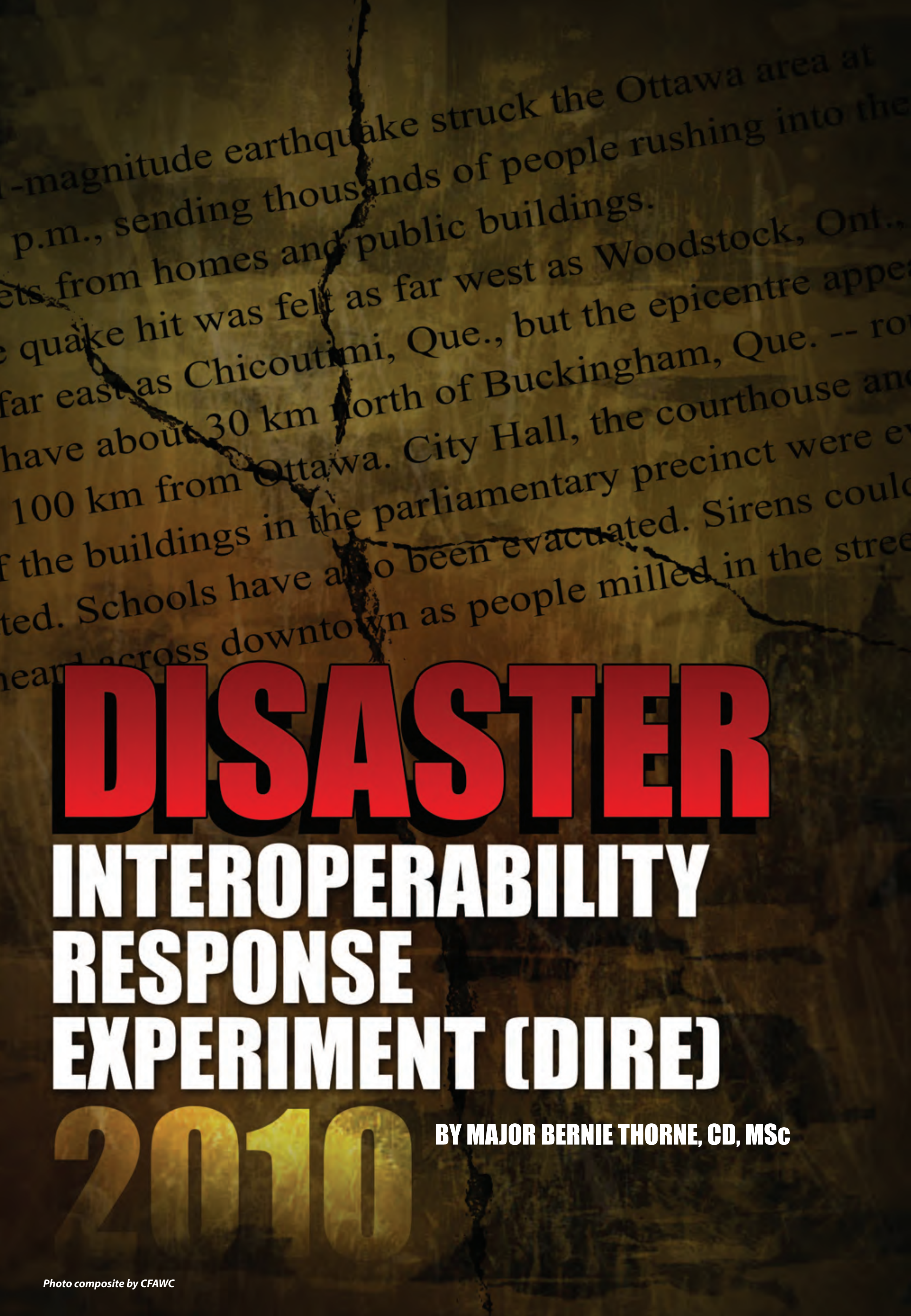
This Workshop is co-sponsored by the Canadian Forces College (CFC), Toronto, Ontario and CFAWC.



DISASTER INTEROPERABILITY RESPONSE EXPERIMENT (DIRE) 2010

BY MAJOR BERNIE THORNE, CD, MSc

Photo composite by CFAWC

A 5.1-magnitude earthquake struck the Ottawa area at 1:41 p.m., sending thousands of people rushing into the streets from homes and public buildings. The quake hit was felt as far west as Woodstock, Ont., and as far east as Chicoutimi, Que., but the epicentre appears to have [been] about 30 [kilometres] km north of Buckingham, Que. -- roughly 100 km from Ottawa. City Hall, the courthouse and all of the buildings in the parliamentary precinct were evacuated. Schools have also been evacuated. Sirens could be heard across downtown as people milled in the streets, but early indications were that there has been no major damage. A chimney collapsed at 112 Lisgar St. after the quake. There are several reports of power outages.

(*Calgary Sun*, 23 June 2010)

This report is true, but despite the tone it was a minor quake. The Geological Survey of Canada, however, estimates a 10 per cent likelihood the Ottawa–Gatineau area will see a quake that damages buildings in the next 50 years and is the third most risky urban area for earthquake following only Vancouver and Montréal.

Although it did not directly damage communications infrastructure, the 23 June 2010 quake resulted in such heavy demands on the cellular networks that loss of service was common. This loss of communications included emergency responders whose phones were granted higher priority on those networks. Disasters do not have to destroy infrastructure to cause a partial or complete loss of communications.

Communications during and following a disaster not only allow explanation of the extent of the disaster to the civil authority, they also permit the control of the response actions. Communications are critical to minimize the immediate impact of the disaster, protect safety and speed the recovery.[1] Military personnel immediately understand these concepts, although we use different terms: command and control (C2), the fog of war, situational awareness (SA), no plan survives contact, surveillance and reconnaissance, et cetera. Perhaps emergency responders who see what we do might think war is similar to a disaster.

BACKGROUND

Public Safety Canada (PSC) identified that notable incidents such as Swissair 111 and the Ice Storm of '96 provided public examples of inadequate emergency communications and showed that poor communications capabilities adversely affect response and recovery efforts. We had plenty of responders with plenty of radios—they just did not work with each other. Emergency communications consist of three primary elements: operability (does it work?), interoperability (can we work together?) and continuity (does it work after "it" hits the fan?).[2]

"One of the most important issues facing Canada's emergency responders is communications interoperability… this inability to communicate threatens the safety of both responders and Canadians."[3]

Federal, provincial and territorial governments have adopted a comprehensive approach to emergency management. They now strive to ensure all hazards are considered and all partners are engaged. Canada's emergency management framework states the need very clearly: "Emergency management requires collaboration, coordination and integration to facilitate complementary and coherent action by all partners to ensure the most effective use of emergency management resources and execution of activities."[4]

Voice communications interoperability is widely accepted as the first and single most important capability required for emergency response, but the longer-term vision seeks data interoperability, seamless access to systems of systems and beyond.[5] PSC has six priority initiatives to achieve communications interoperability, one of which is to "develop the ability to assess and evaluate voice communications capabilities."[6]

The aerostats employed for DIRE '10. The smaller lifts 16 kilograms (kg), the larger 91 kg.

The Canadian Forces Aerospace Warfare Centre (CFAWC) is involved in capability development through work with Chief of Force Development (CFD) and the Director Air Strategic Plans (D Air SP). CFAWC also works with the other warfare centres via the Joint Warfare Centres Community of Practice, which is chaired by the commanding officer of the Canadian Forces Warfare Centre (CFWC). Acknowledging the importance of comprehensive interoperability for disaster relief at home and abroad, the Air Force Experimentation Centre (AFEC) section of CFAWC volunteered to coordinate the Disaster Interoperability Response Experiment (DIRE) series on behalf of all stakeholders. The newly created joint CFWC is charged with capability development in the joint and comprehensive realms and supported DIRE '10 with funds from the Strategic Experiment Reserve.

AIM

The capability development problem of no clear path to technical interoperability between the Canadian Forces (CF) and the many other agencies who respond to disasters is a tough problem that has been taken up by AFEC. As this problem is between peer agencies and even individual Canadians, the CF cannot mandate the solution. The experiment called DIRE is a large part of developing the knowledge and consensus required to share a way ahead. With soft problems, it is easy to lose focus; the focus of DIRE is CF approval of comprehensive technical interoperability standards.

The disaster interoperability concept has taken the task of leading comprehensive interoperability within CF capability development. Identifying appropriate capabilities and standards in concert with PSC and emergency measures organizations (EMOs) and bringing these for approval by policy and decision makers is the selected means to achieve the task. A significant portion of this concept is progressed through the annual series of experimentation called DIRE.

DIRE provides a venue that includes a range facility, technical expertise to identify potential solutions, funding and procurement to obtain test systems, and experience to build field experiments to test and evaluate these potential solutions in operation. A secondary aim of DIRE is to build relationships that allow us to be a partner with a voice in identifying the capabilities and standards that may be required for Department of National Defence (DND) assets to interoperate at disaster scenes.

The United States (US) SAFECOM Interoperability Continuum (Figure 1) considers five areas, or "lanes," for interoperability: Governance, Standard Operating Procedures (SOPs), Technology, Training and Exercise, and Usage. DIRE's focus is technology; it will not tackle the remaining problems.

OBJECTIVES FOR 2010

DIRE is an annual experiment that supports the overall goal of comprehensive interoperable capability development. The specific objectives will be negotiated with stakeholders each year. The objectives for 2010 were necessarily selected before the stakeholders were consulted, as we needed a focus for building interest and relationships. AFEC selected a field experiment that used aerostats and unmanned aerial vehicles (UAVs) to provide

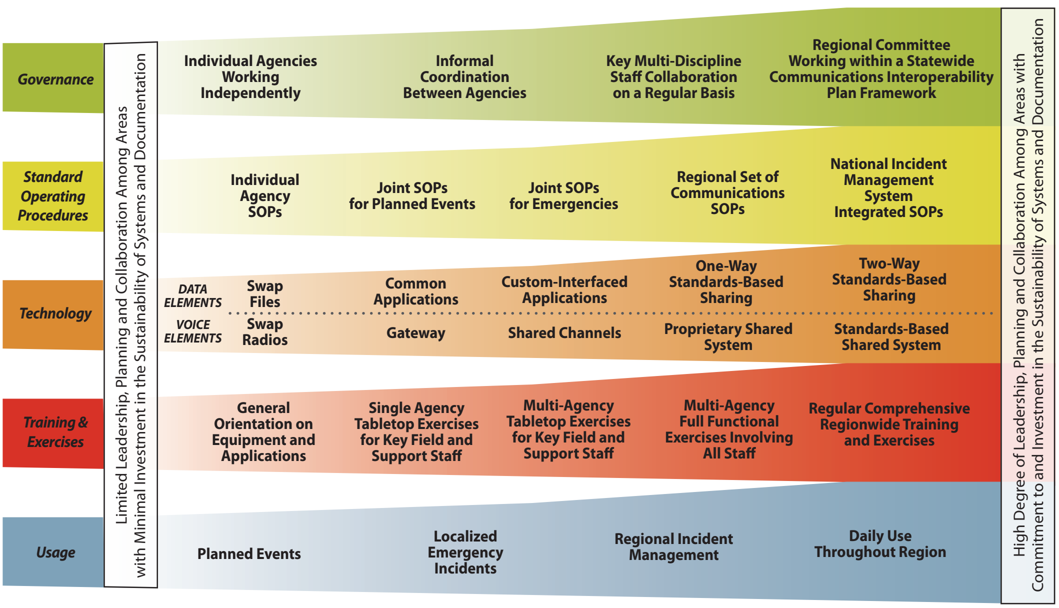


Figure 1: SAFECOM Interoperability Continuum[7]

PSC has identified technical capability hurdles or gaps moving toward communications interoperability. These gaps provide guidance for DIRE research and experimentation:

- voice and data standards for real-time exchange;
- informed decisions allowed by testing and evaluation of technology;
- radio availability based on voluntary standards;
- a rapidly deployable and movable network; and
- affordable options to smaller agencies.[8]

disaster scene communications relay and video camera for SA. The selected scenario was an earthquake that resulted in the loss of communications and allowed us flexibility to create vignettes as relevant to our EMO partners.

The objectives for this year were to:

- initiate and develop relationships with PSC and disaster standards organizations;
- engage local EMOs to participate in the experiment;
- demonstrate/discover the potential value of the generic capabilities under test (aerostat, UAV, communications [comms] relay, video);

Maintaining SA around the disaster scene.

- discover capability gaps and potential solutions for assessment in following years through the experiment and the relationships; and
- bring appropriate stakeholders into formal contact with DND standards and capability development (CFD).

RESULTS

DIRE '10 comprised two phases. The first phase culminated in August 2010 with a technical trial that allowed Defence Research & Development Canada (DRDC), Directorate of Land Command Systems Project Management (DLCSPM) and AFEC to test all the systems on the Connaught Ranges. As the communications and surveillance systems were integrated purposely for DIRE '10, this was an important step for risk reduction and to fine-tune the vignettes.

The second phase, conducted from 4–8 October 2010, was a discovery (or demonstration) experiment that included members of Ottawa police, fire and paramedic services as players in a unified command post (CP). A major earthquake in the Ottawa region formed the base scenario, and three realistic vignettes forced the players in the CP to use the capabilities provided to respond together to the emergencies.

Objective 1 – Initiate and develop relationships with PSC and disaster standards organizations.

The willingness to trust and work together is a large part of advancing interoperability and there are burgeoning relationships between PSC, EMOs and DND. It is important to note that DND does not lead in this area, but when we are called to assist in a major disaster, we must be prepared to interoperate to speed the response and subsequent recovery. In simpler words, we have to be prepared to work together to protect the safety of Canadians.

The members of AFEC have developed working relationships with the Interoperability Policy and National Exercise Divisions of PSC. The people at PSC are dedicated to driving interoperability and were excited to have assistance in advancing their agenda. PSC provided contacts with the local EMOs and invited AFEC to participate in the national forums that are progressing interoperability standards across Canada and cross-border (Canada-US).

The goal of comprehensive interoperability requires efforts beyond experimentation. What is learned must be successfully passed to the most appropriate decision makers. The Canadian Interoperable Technology Interest Group (CITIG) includes PSC and the associations of chiefs for police, fire and paramedic, as well as other applicable groups who wish to participate.

This CITIG is the best entity to progress comprehensive interoperability and they have initiated focus on voice communications. AFEC is assessing the maturity of standards being proposed in these national forums and their applicability to the CF.

Objective 2 – Engage local EMOs to participate in the experiment.

To conduct a field experiment and identify roles and capability gaps, DIRE '10 needed input from EMOs. PSC provided AFEC with contact with the Ottawa police, fire and paramedic services. Members of these organizations were proactive in attending the planning meetings, participating in DIRE '10, and providing benefit of their experiences in identifying potential roles for these capabilities, and offering expert opinions on the most important capabilities to assess for next year.

Objective 3 – Demonstrate/discover the potential value of systems under test (aerostat, UAV, comms relay, and video).

Aerostats: Two classes of aerostats were employed during DIRE '10. The 17-metre aerostat was capable of lifting 91 kilograms (kg) and is built to fly indefinitely at winds of up to 100 kilometres (km) / hour (h). To both deploy and deflate, this very capable aerostat required a large open area, winds below 20 km/h, approximately six personnel for 5–6 hours, and a large volume of helium. The high cost of the system requires 24/7 monitoring. The entire aerostat kit fits on a trailer that can be shipped in a standard 20-foot-long (6 metres) sea container. In comparison, the smaller aerostat lifts only 16 kgs but could be carried in a truck or perhaps even in the trunk of a car and launched by one or two personnel. It was observed barely sustaining winds of about 50 km/h while soaking wet (extra weight means less available lift). Full environmental suitability testing was not conducted. Able to be inflated in small spaces, such as a modular tent or a garage, it can be prepared in almost any weather and deployed/retracted as quickly as weather demands.

The EMO personnel did not consider that the large aerostat was suitable for use by them in an emergency response situation. They were much more interested in the smaller aerostat for reasons of price, deployability, and low


AFEC Photo

Members of Ottawa Paramedic Services assess video from aerostats during DIRE '10.

training costs, while still delivering the communications footprint they required.

The author assessed that response to major disasters by large agencies, such as the DND response to the earthquake in Haiti, could easily justify the dollar and logistic cost of the larger system. The biggest factor in favour of the use of the larger system is the value of increased assuredness of communications during a lengthy response and recovery.

Experimenting with different classes of aerostats side by side certainly gave an appreciation for how any system must be carefully selected to meet the anticipated role. Bigger aerostats may be more capable in terms of lift and sustaining winds, but the slow launch and recovery time means they are most suitable for fixed locations where logistic and personnel supports are available.

be launched to relay communications with the team in the field (e.g., an urban search and rescue [USAR] team behind buildings) or to send back images of the area of interest (e.g., to determine if the orphanage out in the countryside is still standing).

Communications Relay: Both analog voice and digital data relay capabilities were provided from the air platforms. As all agencies are not yet interoperable, AFEC emulated full interoperability by placing an analogue transceiver on the air platforms and swapping handheld radios with the players. Data modems with on-board embedded controllers on the air platforms allowed networking between ground stations and transmission of video.

The concept of operations here is to rapidly provide an alternative to destroyed or overwhelmed communications infrastructure

The 17-metre aerostat when docked can survive 140 km/h winds (100 km/h in flight).

UAV: The Kahu Hawk UAV was developed and flown by DRDC. The concept of operations in disaster scenarios is if communications or SA is required in an area outside the footprint of the aerostat, then the UAV could

using aerostats as rapidly deployed "towers." If agencies that work side by side on disaster scenes can agree on a standard for voice and data communications, then one agency could roll in and rapidly provide communications to all cooperating agencies in an area of 50–70 km, depending on user density and selected standards. If standards are not accepted, a single agency can still deploy this capability; they just need to carry radios to lend to other agencies.

"During the G20 in Toronto, there was one street, in particular, where we had to place squad cars along a street just to provide radio relay to a critical site. An aerostat with a communication relay range of even 5 km would have been a great help."[9]

Video: As the aerostat is cheap to keep in the air, it provides an opportunity to maintain SA in the immediate vicinity. DIRE '10 utilized a small, low-end, steerable video camera as well as a professional, high-resolution still camera to maintain SA around the CP. The concept of operations here is for detecting issues around the CP such as fires, mass movements, initial status of structures, rioting/looting, and so on.

In summary, EMOs saw price, ease of transport, ease of launch, and simplicity setting up the smaller aerostats as especially valuable for confined major events (G20, Canada Day, etc.), extending communications outside normal operational areas, providing communications for any use in rugged terrain, searching for lost persons with infrared and cell phone, contacting persons stranded by disasters such as Hurricane Igor, employing forest fire SA and communications, and deploying disaster management involved with massive casualty or USAR. The EMOs did note that they believed video from an aerostat would be less useful in urban environments due to buildings blocking the view.

Objective 4 – Through the experiment and the relationships, discover capability gaps and potential solutions for assessment in following years.

The problem of the lack of emergency communications interoperability has been clearly identified by multiple reports over the past decade. As we noted above, the CITIG with PSC are working towards standards. Voice communications are the first priority. No agency has legislative power over all stakeholders, but endorsement by appropriate authorities to fill

Scanning the horizon for fire from the aerostat.

for a range of local emergencies and events. Larger agencies with longer commitments to a larger disaster may be well served to accept the increased cost and complexity in return for greater capabilities.

The potential roles seen for these capabilities included providing communications and SA the vacuum is a workable solution. CITIG endorsement with PSC would be well-followed with endorsement from the joint standards process in CFD.

"It is essential that the voice communications equipment used … is fully interoperable (uses open standards)."[10]

For voice communications, the P25 standard (see CITIG link below) is the clear front-runner for North America, having received endorsement by the Department for Homeland Security south of the border and at the CITIG. Assessing a P25 transceiver on an aerostat or DND use of P25 radios to work with EMOs would be good goals to advance voice interoperability for next year.

Communications with civilians who are lost in remote areas or where infrastructure has been destroyed (e.g., as with Hurricane Igor) would not be established with P25. The obvious choice to establish communications with civilians is via the ubiquitous cell phone. Several companies sell deployable cell phone packages. Loosely referred to as "cell phone in a box," this capability was demonstrated during Operation (Op) NANOOK and a loan was offered to AFEC for the next DIRE.

The lack of a rapidly deployable emergency communications infrastructure was clearly noted by PSC as a capability gap. The lack of communications during the first two weeks of the response in Haiti and the lost communications to some towns during Hurricane Igor are good examples of this gap. We have demonstrated that aerostats are rapidly deployable and effective at establishing a communications network. Next year we can work with EMOs and DND agencies (such as Disaster Assistance Response Team [DART], or regional engineers) that are charged with readiness for responding to disasters, both domestic and deployed, to ensure their requirements are captured in the interoperability discussion and that their commands are well informed for capability development in this area.

The participants identified the following needs as top of the list for next year: low costs, more communication channels, better video quality, infrared, high-resolution still photos, electronic SA tools, automatic force tracking, and plume dispersal analysis. From this, AFEC has a few ideas for demonstration or assessment at DIRE next year, including: demonstrating a P25 transceiver on the aerostat, demonstrating cell phone in a box on the aerostat, assessing current generation satellite phones, providing a mid-range electro optics (EO) / infrared (IR) camera, and perhaps demonstrate EMO asset tracking such as currently employed by the Ottawa Paramedic Service and discover the state of standards in this area.

Objective 5 – Bring appropriate stakeholders into formal contact with DND standards and capability development (CFD).

Each region sees emergency measures organizations advancing interoperability within the region. The Ottawa–Gatineau area, for example, regularly conducts meetings called Op INTERSECT to plan long-term interoperability or to create specific plans for upcoming exercises/events. Although local DND agencies that may be called to work with EMOs (Military Police, local combat engineers, etc.) can immediately benefit from working at this level, it is inadequate for CF-wide capability development.

Air Force assets can be called to deploy and fly anywhere in Canada in response to a disaster. It is inadequate if a Chinook can talk to Ottawa Paramedics for medical evacuations (MEDEVAC) but not to the RCMP to conduct evacuations caused by forest fires outside Kelowna. Local agreements and workarounds are not adequate when assets can deploy anywhere across Canada. Similarly, DART can deploy anywhere in the world and needs national or international standards to lead capability development for communications.

At the national level, PSC is working with the CITIG towards standards endorsed by appropriate agencies. At the bi-national level, PSC is working with the Department of Homeland Security in a cross-border interoperability workshop to keep standards aligned across the border. As our southern neighbour is usually the largest provider of support during international disasters, interoperability with the US would largely equate to interoperability in our hemisphere.

Through discussions with PSC, AFEC has been invited to the national (CITIG) and bi-lateral working groups. We are actively trying to get appropriate members from the CFD Standards Working Group to participate and bring appropriate standards for endorsement to the capability development board. Comprehensive interoperability is one of the roles that have been tasked to the newly formed CFWC. As AFEC received financial support from CFWC to conduct DIRE '10, we hope this funding continues to encourage joint and comprehensive development, and we further hope that CFWC assumes a role in championing comprehensive standards and capabilities within CFD.

CONCLUSION

"The way forward for emergency communications is with: open standards, security, multiple seamless networks, dedicated voice and data spectrum, and inclusion of images and video."[11]

Everyone who considers these systems sees them as an effective and efficient way to rapidly deliver communications and SA to a disaster or emergency area. Implementation of a comprehensive capability for Canada is hindered only by a lack of agreed standards.

"We have seen too many paper studies and reports saying that this needs to be done, it is [heartening] to see an experiment, but this has to carry through to implementation of the capability."[12]

The systems demonstrated can easily be carried over to the real players on regional or national exercises. Increased visibility will help raise awareness of the urgent need for agreed standards and thereby speed implementation of the capabilities that can help keep Canadians safe.

The EMOs at DIRE had much different perceptions on the role of these systems as compared to the military participants. Where the EMOs wanted to use these systems to quickly and cheaply solve problems in their daily response to emergency situations, the DND participants were largely considering greater long-term capability provision to the major disaster situations. There is room for all perspectives to be employed when looking at this kit during DIRE. To develop and maintain comprehensive interoperability, indeed, we must consider as many stakeholders and roles as possible.

"Sharing of information contributes to trust between individuals and organizations and leads to shared situational awareness, a critical element of safety and coordinated response."[13]

Members of AFEC's disaster interoperability team will be attending several working groups that work to advance interoperability, including CITIG. The goal is to identify the progress of agreed standards in the non-DND world. This information will be returned to the CFD Standards Working Group. AFEC will also confirm ideas for DIRE '11. Those wishing more information or to participate can find information and contacts on the CFAWC Defence Wide Area Network (DWAN) webpage in the link section below. We can lead change. ■

AFEC Photo

Participants in DIRE '10 break for a "photo op."

Major Bernie Thorne joined the Canadian Forces in 1987 from Newfoundland/Labrador. Graduating from the Royal Military College, Saint Jean, Quebec, with a BSc in 1992, he carried on to Air Navigator training in Winnipeg. Posted to Greenwood to fly on the CP140 Aurora, he flew all Navigator (now ACSO) seats, finishing as Tactical Navigator and Crew Commander. Flying operationally for six years at 405 Squadron (Sqn), training five years at 404 Sqn, and Operational Test & Evaluation (OT&E) for four years at Maritime Proving and Evaluation Unit (MP&EU), he has flown in support of many other government departments (OGDs), including over several major disasters. While on tour at Kandahar Airfield he received his current posting to lead the Air Force Experimentation Centre (AFEC), a section of CFAWC, where the team works to identify, assess, and push the potential of new technologies to improve the effectiveness and/or efficiency of the Air Force mission. He recently completed his MSc, from Leicester, United Kingdom, through the Advanced Degree Completion Plan.

List of Abbreviations

AFEC	Air Force Experimentation Centre	DND	Department of National Defence
CF	Canadian Forces	DRDC	Defence Research and Development Canada
CFAWC	Canadian Forces Aerospace Warfare Centre	h	hour
CFD	Chief of Force Development	kg	kilogram
CFWC	Canadian Forces Warfare Centre	km	kilometre
CITIG	Canadian Interoperability Technology Interest Group	PSC	Public Safety Canada
COMMS	communications	SA	situational awareness
CP	command post	UAV	unmanned aerial vehicle
DART	Disaster Assistance Response Team	US	United States
DIRE	Disaster Interoperability Response Experiment	USAR	urban research and rescue

Links

Canadian Association of Chiefs of Police http://www.cacp.ca/index/main

Canadian Association of Fire Chiefs http://www.cafc.ca/home/home_e.php

Canadian Disaster Database http://www.publicsafety.gc.ca/prg/em/cdd/srch-eng.aspx

Canadian Forces Aerospace Warfare Centre http://trenton.mil.ca/lodger/CFAWC/Index_e.asp

Canadian Interoperability Technology Interest Group http://www.citig.ca/

Natural Resources Canada: Earthquakes http://earthquakescanada.nrcan.gc.ca/

Provincial EMO Links http://www.publicsafety.gc.ca/prg/em/ges-emer-eng.aspx

Public Safety Canada http://www.publicsafety.gc.ca/index-eng.aspx

Telecommunications Industry Association - Project 25 http://www.tiaonline.org/standards/technology/project_25/

Notes

1. Public Safety Canada, *An Emergency Management Framework for Canada*, 2010 (hereafter cited as *Emergency Management Framework*), http://www.publicsafety.gc.ca/prg/em/emfrmwrk-eng.aspx (accessed November 2, 2010).

2. *Canadian Communications Interoperability Plan: Draft v3.0*, presented at the 2nd Annual Cross-Border Interoperable Communications Workshop, Windsor, ON: Public Safety Canada, September 13-15, 2010 (hereafter cited as *Canadian Communications*).

3. Ibid., 1.

4. *Emergency Management Framework*, 7.

5. Public Safety Canada, *Canada Voice Communications Plan: The Way Forward*, 2008 (hereafter cited as *Canada Voice*), www.npstc.org/meetings/SM_Black_PS-Canada%2020080915.pdf (accessed November 2, 2010).

6. *Canadian Communications*, 15.

7. Ibid., 10.

8. Ibid., Tables 2 & 4.

9. Member of Ottawa Police Service, interview with the author, n.p., n.d.

10. *Canada Voice*, 4.

11. Ibid.

12. Member of Ottawa Fire Service, interview with the author, n.p., n.d.

13. *Canadian Communications*, 7.

★ EXERCISE ★ VIGILANT EAGLE 2010

GROUND BREAKING ENGAGEMENT WITH RUSSIA

BY COLONEL TODD BALFE

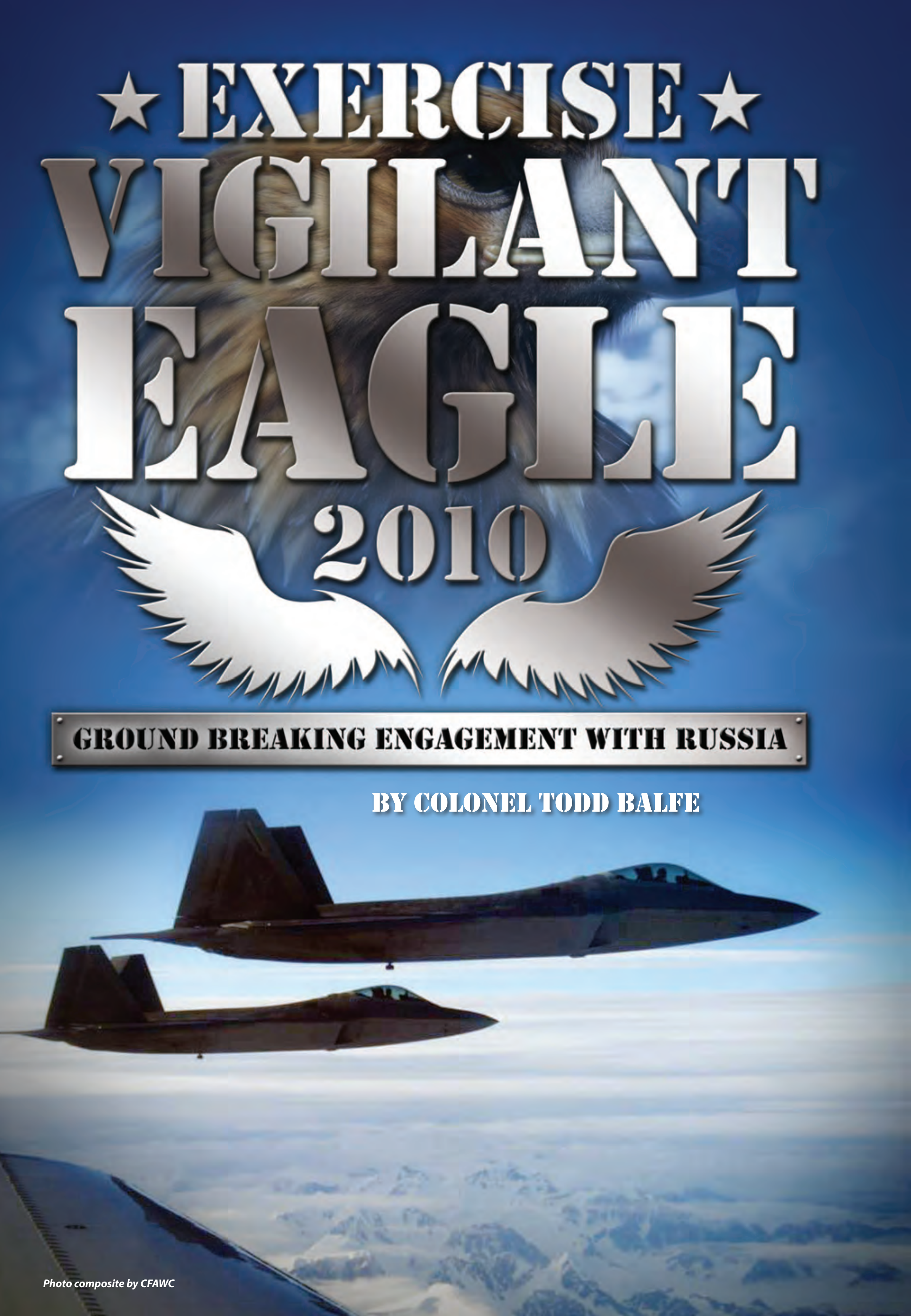


Photo composite by CFAWC

Following three years of collective planning, the Russian Federation Air Force (RFAF) and the North American Aerospace Defence Command (NORAD) finally executed a groundbreaking exercise named Vigilant Eagle in August 2010. This was the first live flying exercise between the United States (US) and Russia since the Second World War. While a three-year planning timeline seems unnecessarily long, it must be noted that the original exercise, scheduled for 2008, was cancelled by the US following the Russian-Georgian conflict.

This exercise was remarkable in many ways, not the least of which was its occurrence so quickly after the condemnation of Russia for its military intervention in Georgia. Notably, much of the planning for the original exercise had already been completed, and a comprehensive command post exercise, including the exchange of liaison officers between the US and Russia, had already occurred prior to the 2008 cancellation. Importantly, this cancellation did not invalidate the premise of the exercise; to the contrary, threat warning and direct communication between Russia and the US remain important in reducing the threat of transoceanic air piracy.

Although the exercise was specifically crafted to build US-Russian cooperation to counter air terrorism, post-2008, it gained the secondary purpose of furthering President Barack Obama's administration's goal of enhancing engagement with Russia. Accordingly, a measure of uncertainty and a perceptible note of suspicion were evident to military planners as the exercise was resurrected. This situation was unintentionally exacerbated by the active participation of several Canadian Forces members by virtue of their assignment to key positions within NORAD. It was challenging, for example, to explain to Russian officers the bi-national nature of this organization and to fully convince them that air defence was indeed a shared US-Canadian responsibility. Moreover, all were fully aware of the Canadian government's position on the issue of Russian long-range aviation incursions into NORAD's air defence identification zones, and specifically into the Arctic. It was with this recent backdrop, and of course with the memory of decades of antagonism and confrontation during the cold war, that planners from both sides set about to achieve a common goal—to build cooperation and communication between the US and Russia to counter air terrorism, while involving inter-agency partners such as the Federal Aviation Administration (FAA) and its Russian equivalent.

Not surprisingly, communication between former cold war adversaries was an immense obstacle. In addition to the obvious language barriers, exercise planners were also challenged by the markedly different professional cultures, most notably by highly process-driven and top-down Russian decision making. Thus, a minor complication such as obtaining diplomatic visas that would take days in the US or Canada, took months to obtain on the Russian side. Ultimately, communication challenges were resolved through patience and the extensive use of translators, generously provided by the US Air Force (USAF), and through now universally available internet technology, including Skype and Yahoo Chat. Further, unclassified commercial phone lines were installed at Russian and NORAD command centers and standard messaging formats were introduced to ease the burden on translators.


U.S. Army photo by Maj Mike Humphreys
http://www.norad.mil/Images/Index.html

The exercise's specific military objectives clearly focused on military-to-military communication, and included:

- initial threat warning at the strategic level between Headquarters NORAD at Colorado Springs, Colorado, and the RFAF Command Center at Khabarovsk;
- track of interest (TOI) position reporting every 20 minutes at the tactical/operational level between the Alaskan NORAD Region (ANR) and the Petropavlovsk Air Operations Center;
- positive transfer of military tracking responsibility at the tactical/operational level between the ANR and the Petropavlovsk Air Operations Center; and
- TOI leaving/entering area of operations at the tactical/operational level between the ANR and the Petropavlovsk Air Operations Center.

The tactical employment of forces was a national decision; as such the exercise was kept unclassified, with no need to share sensitive information. This was especially important for the ANR, tasked to execute the exercise with their assigned forces, as they employed the advanced F-22 Raptor, whose capabilities the USAF understandably wished to guard closely.

To validate the mission construct and to test communication procedures, another command post exercise was held in April 2010 with liaison officers dispatched to each nation's respective command centers. It was here with face-to-face interaction, combined with exercise planning conferences at NORAD Headquarters, that the tension began to recede as the planners focused on a common goal and developed a level of mutual trust. Keeping many of the same players involved since 2008 greatly facilitated this relationship and was key to exercise success. Interestingly, many of the US and Canadian officers involved took for granted our vast inter-operational experience gained from North Atlantic Treaty Organization (NATO) or NORAD. Here, however, there was no foundation, no standardization agreements (STANAGS), no contingency plans (CONPLANS) upon which to build. Thus, the simple became complex and required a greatly expanded focus on basic aviation profiles that would have been labeled "SOP" (Standard Operating Procedures) in any other situation.

Turning to the execution phase, the multi-day exercise scenario involved a civilian "hijacked" plane (in reality a contracted Gulfstream 4 code-named Fencing 1220) with US, Russian and Canadian military officers aboard playing the role of a Boeing 757 departing Anchorage, Alaska, en route to Russia's Far East. Following notification from the FAA that Fencing 1220 reported a hijack in progress, NORAD dispatched F-22 Raptor fighters, an E-3 Airborne Warning and Control System (AWACS) radar aircraft, and supporting refueling tankers to intercept and investigate the TOI. NORAD's airborne assets reported the TOI's progress and facilitated a positive handover to the RFAF at the mid-ocean point, where responsibility passed to RFAF command centers that employed an A-50 Mainstay radar aircraft and Su-27 and MiG-31 fighter jets. Following an uneventful recovery at a US base in the Far East, the scenario was repeated in the opposite direction two days later, with the exercise terminating upon Fencing 1220's safe landing at Anchorage on 10 August.

As the senior NORAD observer on the TOI, it was a surreal experience to watch Russian Su-27 aircraft approach to very close range, especially after years of training in CF18s to counter such a threat. The large Russian star on the tail of the intercepting aircraft was certainly not something old cold warriors ever expected to see close up. I'm confident my Russian counterpart, Colonel Alexander Vasilyev, Deputy Director of Security and Safety for the RFAF, felt similarly about the intercepting F-22s. Most importantly, however, we both shared a sense of immense satisfaction that the extensive planning produced a remarkably successful exercise that will serve as the foundation for expanded cooperation. As Colonel Vasilyev noted, "[t]his exercise is very beneficial to North America and to Russia. There has never been an exercise like this before. Terrorism is something that affects all our countries, so it is very important that we work together to develop procedures and bring the relationship between our countries closer together to unite our countries in the fight against terrorism."[1]

I couldn't agree more. ■

A CF18 pilot for most of his career, Colonel Todd Balfe is currently the Deputy Commander of the ANR at Elmendorf Air Force Base, Alaska. He was involved with the planning for Exercise Vigilant Eagle and flew aboard the TOI aircraft as the senior NORAD officer and safety monitor.

List of Abbreviations

ANR	Alaskan NORAD Region	RFAF	Russian Federation Air Force
FAA	Federal Aviation Administration	TOI	track of interest
NORAD	North American Aerospace Defence Command	USAF	United States Air Force

Notes

1. Major Mike Humphreys (NORAD), "'Vigilant Eagle' Tests NORAD, Russian Response," *U.S. Air Force*, 10 August 2010, http://www.af.mil/news/story.asp?id=123217183 (accessed November 3, 2010).

Photo courtesy of NORAD

PERFORMANCE-BASED MANAGEMENT AND AIRCRAFT PERIODIC MAINTENANCE

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SUZANNE CUERRIER, PROGRAM ASSOCIATE, ACF ASSOCIATES INC.

Photo composite by CFAWC

INTRODUCTION

Organizational strategic planning involves ongoing analysis and reflection, and the definition of clear goals and objectives. However, the resultant strategic plans are often not known to anyone in the organization other than upper management because these plans often lack clear linkages between the strategic vision, the actual required work effort, and informed decision making.[1]

Strategic vision is most often shaped from an informal and unstructured decision-making process by management in response to an organizational need. The conditions for effective decision making are usually missing as this process lacks clear, substantiated facts and accurate performance measurement information. Thus, any resultant decisions are not considered to be truly objective, credible and authoritative. Furthermore, without an effective performance measurement system in place, managers may continue to make significant decisions without having an adequate understanding of the impact of these decisions. From the outset, managers tend to be unaware of the true performance of their processes and have little objective understanding of the proposed process changes. Therefore, a new kind of Integrated Performance-Based Management System (IPBMS) is necessary to align strategy and action, and in a cyclic manner, inform the strategic decision-making process with credible data and context.

The purposes of this article are twofold. First, this article will describe the development of a new IPBMS designed for the Canadian Air Force in response to a need for improved periodic maintenance performance. Over the past 10 years, the Canadian Air Force has seen an unexplained, increasing trend in aircraft downtime associated with the execution of periodic inspections across all fleets. As a result of this increase in downtime and the associated reduction in available operational flying hours, managers have decided to contract periodic inspections to commercial companies at a significant cost to the Canadian military. A review effort, therefore, was undertaken to investigate organizational structure, planning processes, performance metrics, current initiatives, and constraint areas. Ultimately, a new sustainable programme, including an IPBMS, was developed that would allow military units to complete periodic inspections in the shortest time possible with the most efficient use of resources.

However, this new IPBMS would be of little value if there did not exist within it a mechanism by which data and context could be captured and communicated to help inform the decision-making process and organizational course redirection. Thus, the second purpose of this article is to draw attention to the value of process information and the tools and mechanisms introduced within this new integrated system that allow Air Force members to track daily maintenance performance, to manage constraints, and to meet the strategic goal of completing periodic maintenance tasks efficiently and effectively. Ultimately, process information focuses on the way in which work is done and how the results are achieved in an organization in alignment with strategy, allowing for possible course correction at all levels in the organization, including front-line supervisors, operational leadership, and strategic leadership.

This article is divided into three main sections. The first section provides a description of how industry is evolving from simply focusing on performance measuring to the development of integrated performance-based management systems, and the model used in the development of the IPBMS for the Canadian Air Force. The second section provides more in-depth description as to the specifics of the IPBMS developed to assist with improved periodic maintenance performance. Finally, the third section provides details as to the importance of process information as well as the specifics as to how this process information is captured and used to inform strategic direction and redirection.

SECTION ONE – PERFORMANCE MEASURED VERSUS PERFORMANCE MANAGED

Since the early 1990s, organizations have attempted to respond to concerns about aligning business operations with overall strategy by implementing measurement approaches and tools such as the Balanced Scorecard.[2] This particular approach attempts to create linkage between different perspectives of performance. The effectiveness and efficiency of this measurement tool is extensively discussed within literature and will not be further discussed here. Ultimately, however, the contribution of such measurement approaches depends to a large extent on three conditions: strategy must be translated into operational terms and goals that are clearly understood by management and employees, strategizing must be seen by management and employees as a continuous and fluid process, and there must be improved alignment between processes, services, and competencies within the organization.[3]

To satisfy these conditions, therefore, management must not focus on a particular performance measurement tool but rather on an integrated performance-based management system which is adaptive, accurately depicts the real activities and processes of the organization, and clearly identifies the links to strategy. Organizations must move from simply measuring performance to performance-based management, linking performance measurement to strategic planning, and using it as a lever for organizational change and sustained long-term improvements.[4]

Confusion and a lack of productivity can result when organizations introduce measures and reward systems not aligned with the overall strategic goals. Instead, in this new IPBMS, goals are established by executives based upon validated facts and a common understanding. These goals are then translated into operationalized goals that promote organizational coherence and become the "fabric of the intellectual architecture driving human performance."[5]

Performance-based management is markedly different from simple performance reporting. Performance reporting focuses on communicating results, while performance-based management uses resources and information to achieve and demonstrate measurable progress toward strategic goals.[6] Performance reporting alone is unlikely to drive organizational change and will not trigger improved results.

There are two basic stages in developing and implementing an IPBMS: the foundation stage and the ongoing management stage.[7] The purpose of the foundation stage is to undertake a critical analysis of current conditions and opportunities that confront the organization. During this stage, employees examine basic organization characteristics and document how it operates, including a cost, activity, and process analysis. This analysis represents an assessment of current performance and identifies possible performance gaps. The outcome of the analysis is a comprehensive understanding of the organization and key leverage points. Ultimately, a framework can be created within which executives can establish organization priorities and assign resources, thus causing the organization to perform differently and drive operational change.

The ongoing management stage is concerned with how the information of the previous stage is used in daily business. People work towards achieving the goals, results are monitored, and a cycle of continuous management occurs. Ongoing management involves four basic elements:

- Performance Planned: this element involves operationalizing the goals and conducting an ongoing review of strategy, goals, and budget.
- Performance Managed: this element involves daily performance measurement.
- Decision Support: this element involves the intelligent process of evaluating alternative business choices.
- Work Performed: this element represents the actual work by people and machines and the management of those processes and activities.[8]

Christina Altmayer also described the necessity for ongoing management but suggested there are three tracks associated with this stage and management structure:

Awareness: for this track, managers and employees must see the implementation of the strategic vision as part of their job and be accountable for not just administering the organizational initiative, but also evaluating whether the initiative achieves the intended results and, if not, to make improvements. In so doing, employees see the connection between their individual job performance and achievement of the organization's mission and goals.

- Development: for this track, managers and employees undertake the tasks associated with performance measurement. Performance measures should include objective measures of quality as well as objective measures of the impact or change to the organization.
- Integration: to be truly performance based, an organization's decision-making processes must be integrated with the use and review of performance measures to effect strategic direction or redirection.[9]

Srikanth Srinivas used a flight analogy to describe effective performance management. Unlike pilots, Srinivas believed that organizations often fail in the foundation stage and do not have a clear understanding of the current reality, and, thus, they are uncertain about the flight destination or strategic goals. This uncertainty results in a poorly articulated flight plan, or operationalized goals, and inevitable struggle with the ongoing management of variation and course correction. Srinivas stated that "there is a widening chasm between strategy and execution, and agile course correction."[10] Therefore, as part of ongoing management, organizations, similar to pilots, must expect variation and be prepared to make necessary improvements or course corrections. Consequently, any effective IPBMS must also provide management with the necessary tools and methods to address, or at the very least, capture the incidents of variation that influence the performance measures and their associated constraints.

As depicted in Figure 1 and using the stages previously described, following a review of current organizational conditions, a strategy is given to the people who take actions

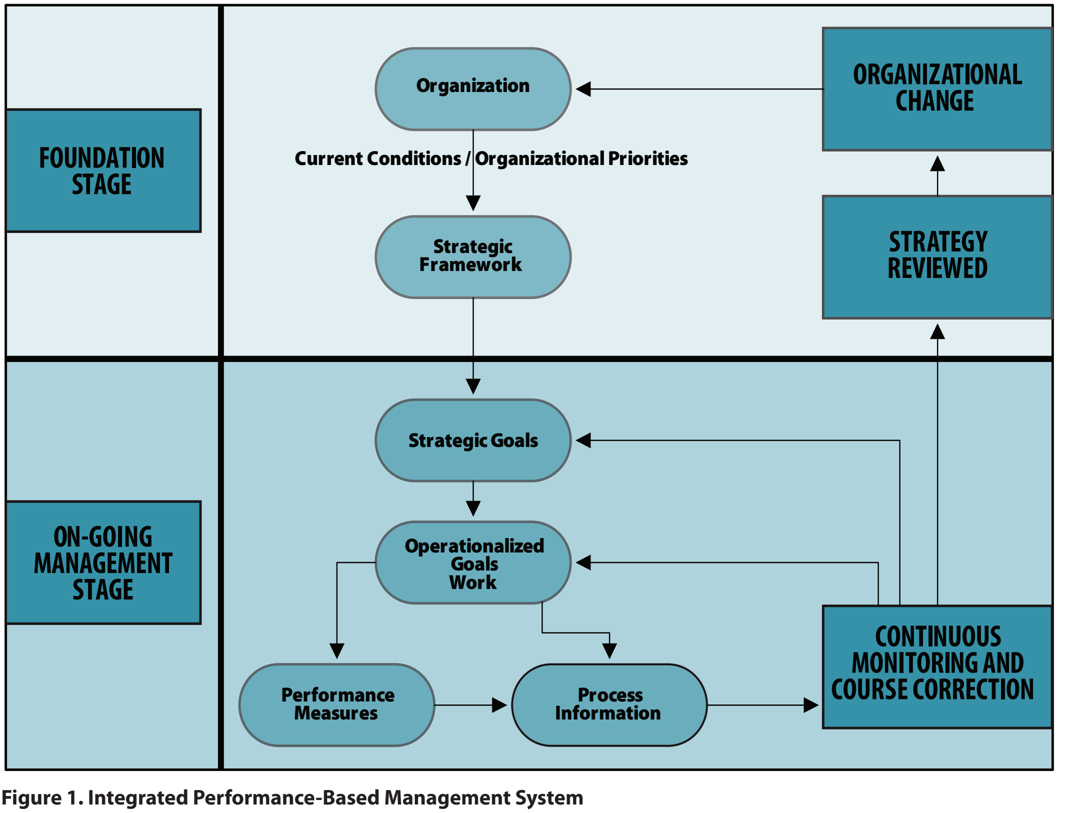

Figure 1. Integrated Performance-Based Management System

through the establishment of strategic and operationalized goals. These goals are defined by performance measures. The linking device of the established measures is activity and process information that focuses on the way in which work is done and how the results are achieved in an organization in alignment with strategy. In a cycle of continuous monitoring, performance and process data can be both a driver and lever in organizational change at all levels, and can foster employee accountability, learning, and collective ownership of organization performance.[11]

SECTION TWO – PERIODIC INSPECTION PERFORMANCE-MANAGEMENT SYSTEM

FOUNDATION STAGE

The foundation stage of the IPBMS developed for the Canadian Air Force began by examining basic organizational characteristics and documenting current operations, culminating in a thorough analysis of the problem. This analysis encompassed a complete listing and review of the challenges and constraints currently being experienced by the Air Force units in their efforts to complete periodic inspection maintenance. Information contained in the problem analysis was based upon the input from Air Force unit reports, results of a working group session, and a general analysis of Air Force documentation and processes regarding aircraft preventive maintenance plans.

More specifically, the problem analysis contained detailed descriptions of the constraints faced by the units at each phase of the periodic inspection work flow process. Constraints were identified and assigned cause-effect relationships with the aim of clearly identifying the root causes associated with increased downtime for periodic inspections. Often, within organizations, management is able to identify the constraints or the undesirable effects (UDEs) that prevent an organization from meeting its stated goal, but the constraint in and of itself is not necessarily the root cause of the larger problem. Few organizations have developed a systematic and logical method of uncovering the root cause(s) and are often unable to gain consensus from all involved as to the true nature of the problem. For this reason, Eliyahu Goldratt suggested that organizations use logic tools to assist in identifying the areas for change. One such tool is Goldratt's Current Reality Tree (CRT), and the use of this tool was employed in the development of the IPBMS.[12]

The intent of the CRT is not to simplify the complexity of the problem, but rather to exercise objective logic to provide links between the UDEs. This approach is preferred over an ad hoc method of determining root causes and serves to convey a system-level understanding of the problem. In the CRT analysis process, a root cause can be classified into either of two categories: a core driver that is considered to be beyond the control of the problem solver but must be managed, and a core problem that is the concern of the problem solver. Upon examination of the CRT, eight root causes were identified and were categorized as below:

CORE DRIVERS:

- lower technician experience;
- unexpected developments resulting in reassignment of resources; and
- no control over varying periodic inspection workload (associated with emergent work from inspection tasks).

CORE PROBLEMS:

- difficult to plan using maintenance card decks;
- lack of performance measures for identifying, tracking, and reporting;
- no control over varying periodic inspection workload;
- unavailability of parts when required; and
- engineering response time not meeting production requirements.

Through the construction of the CRT, it was determined that approximately 70 per cent of all the effects listed on the CRT were linked to the identified core problems. Therefore, it was determined through the problem analysis that if the core problems could be adequately addressed, then most of the UDEs would be resolved, resulting in more effective and efficient periodic inspection maintenance performance.

As was anticipated from the completion of the problem analysis and foundation stage of this IPBMS, a comprehensive understanding of the organization was obtained and a type of framework was constructed through a doctrine document. This document represented an organizational shift in strategic vision, and included integrated doctrine and policy statements that would allow for the implementation of a new programme for improved periodic maintenance performance. More specifically, the doctrine document contained doctrine statements with links to the identified root causes, outlined key programme components to ensure the long-term sustainability of the new periodic inspection programme, and included a cost-benefit analysis.

ONGOING MANAGEMENT STAGE

To ensure that the information garnered in the previous stage could be successfully translated into a programme for effective ongoing periodic inspection maintenance activity, an integrated performance management structure had to be defined. Without the appropriate management structure and the associated elements, effective organizational change would be unlikely. While Sharman and Altmayer identify four and three key management structure elements respectively, the management structure developed for the Canadian Air Force included the following seven elements grouped according to three management categories. Each element will be further described in the forthcoming section (see Figure 2). However, it should be noted that these categories and elements are not to be viewed as sequential, but rather as overlapping and ongoing areas for development, leading to organizational improvement.

Category 1 - Performance Planned

This category involves determining a common set of methods and frame of reference within which to communicate and address potential problems. It involves operationalizing the goals and conducting ongoing reviews of the strategy, goals, and budget:

- Element 1: Management Methods; and
- Element 2: Centre of Expertise.

Category 2 - Performance Supported

This category represents the identified areas of support necessary in realizing the strategic and operationalized goals:

- Element 3: Training;
- Element 4: Best Practice Sharing;
- Element 5: Provision of Tools; and
- Element 6: Unit Programmes.

Category 3 - Performance Managed

This category represents the daily performance and the management of those processes and activities:

- Element 7: Performance Metrics and Process Information.

CATEGORY 1 - PERFORMANCE PLANNED

Within the first management structure category, Performance Planned, it is necessary to achieve consensus as to a common set of methods to be used in addressing the strategic and operationalized goal(s), as a consistent and focused set of management methods are critical to the success of any complex programme. At this level, there must also be an established mechanism to allow for the ongoing review of strategy, goals, and budget to ensure that processes, services, and organizational competencies can be appropriately aligned. During the development of the IPBMS for the Canadian Air Force, it was determined that Management by Constraints, Critical Path methods, and advanced planning and scheduling techniques should be utilized, and that the establishment of a Centre of Expertise be considered to oversee and fulfill the role of programme champion for this improved periodic inspection initiative. Although method descriptions will not be provided here as these are readily found in literature, an explanation of why these particular methods were chosen in the development of the IPBMS as well as a more detailed description of the Centre of Expertise will follow.

The primary benefits of incorporating this method were twofold. First, a powerful performance metric structure was constructed that provided timely and accurate feedback on performance, constraint identification, and the effect of the constraint on the goal. Second, an ability to prioritize constraints by the associated level of effect was generated, thereby ensuring that constraints could be resolved in order of priority to meet the goal.

Figure 2. Element 1 - Management Methods

Management by Constraints was adopted due to the extremely dynamic nature of the Air Force environment and the ever-changing nature of the constraints, both within and across Air Force units. In essence, the Management by Constraints method allowed for the continuous and repeated identification and documentation of constraints that influenced each unit's ability to achieve the operationalized goal of completing periodic inspections in the shortest time possible with the most efficient use of resources.

Critical Path Management was deemed to be an essential principle, ability, and skill set for this production-oriented activity. The capability to define and manage the critical path for periodic inspections is necessary for efficient production. The structure and nature of the periodic inspection work package lent itself well to Critical Path Management, and its application within the new periodic inspection programme resulted in increased inspection velocity and reduced aircraft downtime.

The volume of periodic inspection maintenance tasks and their specific attributes for any given aircraft is beyond the capability of manual scheduling systems. For this reason, commercial advanced planning and scheduling software and techniques had to be adopted into the new periodic inspection programme, and they have had an influence on Air Force periodic inspection productivity.

ELEMENT 2 - CENTRE OF EXPERTISE

An Air Force Centre of Expertise for periodic inspections was considered to be essential for a couple of reasons. Firstly, periodic inspection completion is a production process distinct and separate from daily aircraft maintenance and aircraft generation. Consequently, the skills and knowledge necessary to be an expert practitioner are not widely held across the Air Force, and with high personnel turnover rates, this expertise is difficult to maintain. Secondly, the adoption of a new pan-Air Force maintenance programme would require a programme champion with the responsibility to monitor programme participation, to ensure the continued health of the programme, and to suggest improvements or course redirection when required.

Therefore, more specifically, a Centre of Expertise was established to:

- assist supervisors and managers in ensuring that the strategic and operational goals were being met;
- monitor the advancement of science and technology as well as best practices in other militaries and commercial maintenance providers;
- provide training based on personnel turnover at units;
- maintain core skills and knowledge that cannot be maintained at the unit level;
- ensure continued emphasis on importance of periodic inspection production at the participating units;
- update doctrine and policy as required; and
- monitor key unit performance measures for currency, trends, and effects of improvement initiatives.

CATEGORY 2 - PERFORMANCE SUPPORTED

As previously stated, this category represents the identified areas of support necessary in realizing the strategic and operationalized goals and thus organizational change.

ELEMENT 3 - TRAINING

As a part of the new periodic inspection programme, the Air Force adopted a Just in Time (JIT) training model for personnel responsible for the management and supervision of periodic inspections. The specialty skills and knowledge required, combined with the high rate of personnel turnover, and the relatively small percentage of personnel employed in managing and supervising a periodic maintenance environment, supported the adoption of a JIT specialty training model. This model is triggered whenever an individual is selected for employment in a periodic maintenance environment rather than a general training model that provides training to all personnel and is often triggered by career advancement. The benefits of this JIT training model over a general training model included decreased cost of training and increased effectiveness, as the training was provided to only those individuals with a specific job requirement.

ELEMENT 4 - BEST PRACTICE SHARING

As part of the new periodic inspection programme, it was recommended that the Air Force create and maintain a Community of Practice for periodic inspection practitioners for several reasons. First, given that periodic inspection maintenance across the Air Force takes place in a variety of geographic locations and at varying times depending on the aircraft requirements, little or no opportunity exists for internal benchmarking or idea and information sharing amongst practitioners. Therefore, practitioners must be able to access and communicate externally with other practitioners, both for benchmarking to assess performance and for idea-sharing to drive continuous improvement. Second, given the high rate of personnel turnover, combined with the distributed nature of periodic inspection work, new practitioners often do not have the opportunity for on-the-job learning from more experienced personnel. A Community of Practice can provide this opportunity. Third, the requirement for specialist skills and knowledge for scheduling and planning are not widely held by Air Force personnel. A Community of Practice can assist in enhancing skills and knowledge through dialogue with other practitioners, thereby creating a virtual learning organization to support and assist practitioners in achieving their goal. And, finally, membership in a Community of Practice serves as a source of motivation to practitioners by providing a forum in which to share their knowledge and reducing feelings of isolation that stem from decentralization.

The establishment of this Community of Practice was achieved through the commencement of the following: a Community of Practice website that provided a common locale where all the Air Force unit personnel could share and publicly discuss their best practices regardless of personal acquaintance, location, or even time zones; quarterly newsletters published by the Centre of Expertise that report unit successes with the intent of keeping members of the Community of Practice engaged and motivated; an annual symposium, organized by the Centre of Expertise, to discuss key issues, initiatives, and possible solutions to common problems that may be occurring; and, an external review, undertaken by the Centre of Expertise, to monitor and investigate external advancements in production management and procedures in other militaries and commercial practices to ensure that the Air Force keeps pace with current best practices.

ELEMENT 5 - PROVISION OF TOOLS

Effective execution of planned and emergent work within a periodic inspection requires the use of advanced planning and scheduling tools. The volume of tasks, the interrelation of resource constraints that affect the execution of the tasks, the dynamic nature of emergent work, and the overall environment are at a level of complexity that requires information technology support to provide key decision information to the practitioner. Therefore, technology was provided to support Air Force personnel, and the provision of these support tools has assisted in an improved yearly flying rate (YFR) generation capability.

ELEMENT 6 - UNIT PROGRAMMES

Ultimately, it is the job and responsibility of the units and Air Force technicians to execute effective and efficient periodic inspections as well as to drive continuous improvement and to develop best practices. Therefore, higher-level organizations such as the Centre of Expertise and the Canadian Air Division must provide the support structure, tools, and motivation necessary to facilitate system-wide solutions. Areas of support include the provision of resources, training, expert advice, and support and advocacy for unit constraints and challenges.

CATEGORY 3 - PERFORMANCE MANAGED

Management of daily performance, work processes, and activities must be ongoing to ensure a cycle of continuous monitoring and improvement. Information garnered from daily management will allow organizations to focus priorities and identify and monitor constraints that may threaten the outcome of realizing the strategic and operationalized goals. Daily management information can inform organizational decision-making processes with credible data and context and thus highlight possible areas of improvement.

ELEMENT 7 - PERFORMANCE METRICS AND PROCESS INFORMATION

Effective performance-based management requires effective performance metrics, as decision making and resource allocation are based on achieving specific performance results, and metrics are explicitly used to measure that progress. In the case of the IPBMS developed for the Canadian Air Force, effective metrics provided the capability to obtain accurate measures of performance; identify and manage constraints; identify areas of improvement; provide insight to all levels of management and Air Force command; improve baseline planning, including the allocation of resources and time; and, provide commonality between the units, thus facilitating performance comparisons between units and yearly flying trends.

The proposed key performance metric for the Air Force periodic inspection improvement programme included the single output measure of inspection velocity. Inspection velocity represents a measure of the rate at which the inspection is completed, or the progress made each day and any associated constraint. This measure allows for comparison between units, between inspections, and over time, if inspection velocity has been normalized by the number of technicians available to complete the inspection.

Unlike performance metrics of the past that attempted to capture all available information, this performance metric captured the essence of the strategic and operationalized goals and serves as an objective measure of the efficiency of periodic inspection completion. This metric focuses on the rate of work and is independent of the volume of work, and, thus, is not affected by variable workload between inspections and between units. The adoption of this metric shifted the focus at the production level from days to completion to rate of completion, and was considered to be the most relevant and meaningful to strategic and operational decision making.

This performance metric, however, is only useful if effectively supported by additional diagnostic measures, or process information, that provide insight into the reason for either low or high velocity, and consequently, provide the necessary information for possible course redirection and correction. For the IPBMS developed for the Canadian Air Force, process information focused on the impact of constraints associated with inspection velocity, and this impact was communicated either as an impact to the operational YFR or as a velocity issue, requiring unit improvement initiatives. Due to the necessity for accurate and timely process information, a collection system was developed such that this process data could be automatically generated from upgrades to the current user systems and inputs, thereby eliminating any additional overhead associated with performance metric and process information data collection. The specifics of how process information was used to inform decision making at all levels of management will be further described in the upcoming section of the article.

SECTION THREE – PERIODIC INSPECTION PROCESS INFORMATION

As was previously stated, process information focuses on the way in which work is done and how the results are achieved in an organization. The collection of process information requires a mechanism by which the data and context can be captured and communicated to inform decision making at all management levels, including front-line supervisors, operational leadership, and strategic leadership. As is depicted in Figure 3, this new IPBMS developed for the Canadian Air Force allows for the first opportunity for course correction and possible adjustment of the operationalized goals at the front-line supervisor level as daily velocity statistics are collected, hours lost due to constraints are identified, and the average velocity and lost hours are tracked.

The purpose of this information is to capture and communicate the impact of constraints associated with inspection velocity at that particular unit. Once captured, this impact can be addressed through unit initiatives, the development of unit improvement programmes, and the daily management of resources. Performance velocity can also be readily expressed to operational and strategic leadership.

As was required, average inspection velocity was reported to operational management, and the associated constraints were reported as was applicable. However, a requirement for the generation of quarterly unit reports was instituted. Comparing the periodic performance of each unit as well as the associated constraints allows for the possibility of best practice sharing as well as possible course correction and redirection at the operational-management level through a readjustment of strategic goals. A report capability is planned such that the front-line supervisor can identify the inspection progress in a compatible format with their current tools and technology, and so that a report could be created from the collected information that can summarize the average periodic inspection downtime per quarter for each fleet by unit.

Finally, organizational strategy can be reviewed as the established Centre of Expertise monitors the success of each of the management structure elements mentioned earlier, including management methods, training, best practice sharing, tools, unit programmes, and performance metrics and process information. The extent to which these elements positively contribute to organizational change will be reported annually to Canadian Air Division for ongoing assessment.

SUMMARY

The new IPBMS and associated periodic maintenance programme was introduced to a limited number of Canadian Air Force units. During its introduction, the Canadian Air Force saw a 15 per cent to 40 per cent reduction in downtime associated with periodic inspections for these fleets, and a resultant operational increase of between 4 per cent and 11 per cent. The Air Force now has plans to incorporate the IPBMS into its management policies and for widespread implementation. At the foundation of this IPBMS are strategic and operationalized goals that are realistic and achievable, with a mechanism to allow for these goals to be converted into daily work effort that can be tracked through reportable measures. Additionally, the collection of process information informs strategic decision making and course redirection at all levels of management. ■

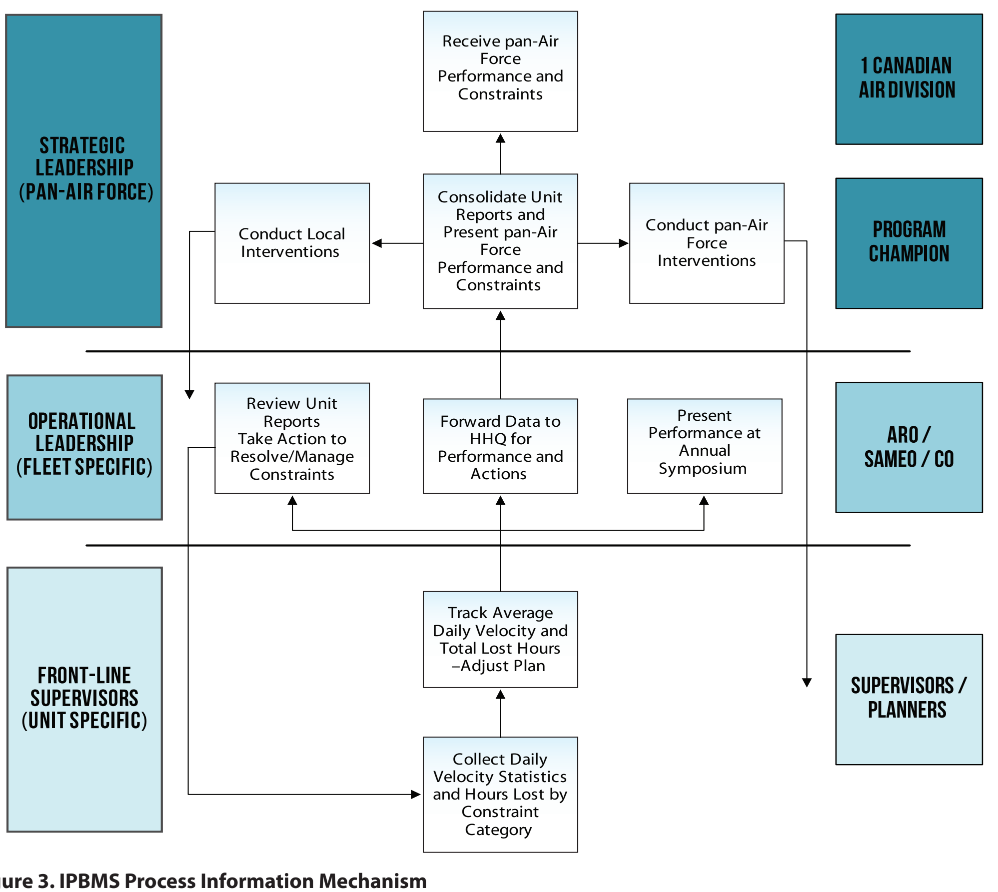

Figure 3. IPBMS Process Information Mechanism

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LIST OF ABBREVIATIONS

ARO	aircraft repair officer	SAMEO	squadron aircraft maintenance and engineering officer
CRT	Current Reality Tree	UDE	undesirable effects
IPBMS	Integrated Performance-Based Management System	US	United States
JIT	Just in Time	YFR	yearly flying rate

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MAINTENANCE ANALYSIS OFFICER (MAO) COMMENTS ON ACF ARTICLE PERFORMANCE-BASED MANAGEMENT AND AIRCRAFT PERIODIC MAINTENANCE

A key element in successful business practice is strategic business planning: setting goals and planning for their achievement. Employing effective performance management techniques provides a means of monitoring progress towards the goals and enabling necessary course corrections.

The IPBMS discussed in the article *Performance-Based Management and Aircraft Periodic Maintenance* presents a business system aimed at integrating strategic business practice and effective performance measurement, thereby conducting business more efficiently and effectively. The IPBMS was applied to the Air Force second-line maintenance environment with very positive results.

Canadian Forces aircraft were spending too much time undergoing periodic maintenance. Recognized by 1 Canadian Air Division as being problematic, Operation (Op) PRODUCTION was initiated with the aim to control and reduce the duration of periodic maintenance. The resultant IPBMS elements which were developed are described in the article.

Through the application of the IPBMS, the aircraft periodic maintenance environment was better understood, constraints were identified, applicable data was collected, and performance metrics were developed and employed. Subsequently, managers and decision makers were able to monitor progress and implement changes resulting in improved efficiency and execution of the inspections.

Key personnel were provided training, and practitioners were provided forums to collaborate and share their best practices. Additionally, a new preventive maintenance doctrine was developed, and changes were made to preventive maintenance policy, institutionalizing and providing support from upper management for the new and improved approach to second-line maintenance.

Ultimately, the IPBMS approach for periodic maintenance proved to be thorough and provided practical results. Through the findings observed to date, the application of an IPBMS has been successful in reducing the duration of periodic maintenance.

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Photo composite by CFAWC

FUTURE AIR PLATFORMS

* Preliminary Analysis

By Irene A. Collin

During the past year, the Canadian Forces Aerospace Warfare Centre (CFAWC) Operational Research Team began an investigation into innovative air platform types that are currently unused by the Canadian Forces (CF). The goal was to identify the air platform types that may become commercially available in the near future, and to perform an evaluation as to their associated strengths, weaknesses, potential uses, costs, and technological risks. This article describes the preliminary assessment process, as well as the decision as to which of these air platforms may benefit the Air Force, and, thus, should be the focus of further research.

BACKGROUND

The Air Force needs to consider all possible aircraft, including those not widely used today, in order to fulfill its operational requirements. We must question whether or not all operational roles are being performed to the extent desired. Some defence priorities may not receive sufficient attention due to a lack of resources. Are current aircraft suitable for every mission that might be required of them, today, and in the near future? All of the CF current aircraft will eventually need modernization or replacement. In taking all of these thoughts into consideration, CFAWC personnel decided that future or as-yet-unused air platforms should be researched and evaluated as to their potential contribution to the various roles of the Air Force.

APPROACH

The approach to this problem involved a broad survey of air platforms and their design characteristics. Most of these platforms were either in operation or being tested by other countries, or they were in the phase of prototype design and testing. The research was organized and presented to a subject matter expert (SME) working group. The working group discussions and comments were compiled and analysed, and the results were used in an overall evaluation. This evaluation involved four factors, described later in this report: mission effectiveness, mission flexibility, cost, and technological risk.

RESEARCH

Research into the many varied types of air platform was performed and those worthy of consideration were grouped into the following categories:

a. Aerostat;
b. Conventional Airship (low altitude [i.e., below 25,000 feet] and high altitude [i.e., above 45,000 feet]);
c. Hybrid Airship (intelligence, surveillance and reconnaissance [ISR] type, and cargo type);
d. Micro-satellite;
e. Medium-altitude long-endurance (MALE) unmanned aerial vehicle (UAV), fixed-wing and rotary-wing (RW); and
f. High-altitude long-endurance (HALE) UAV (small and large).

There were numerous other types of air platforms, but these were immediately discounted (i.e., prior to the working group) if they appeared to be in the conception phase rather than an advanced prototype design phase, or if their function seemed unsuitable for the CF (e.g., a platform designed to provide far greater capacity than the CF has ever needed or might need in the foreseeable future).[1] The considered categories are described in the following paragraphs.

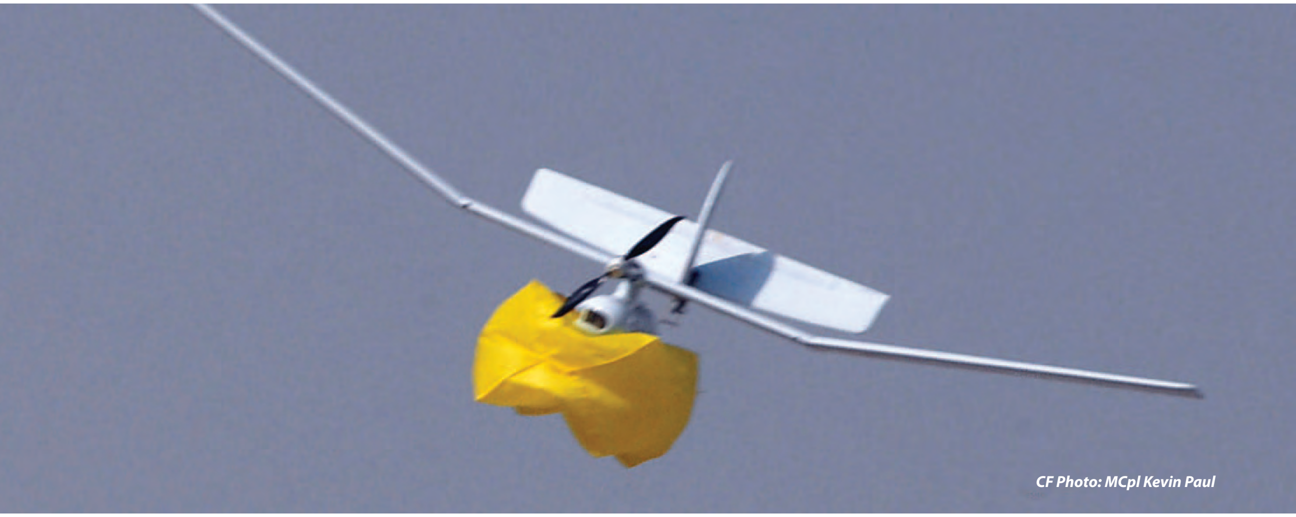
AEROSTAT. The "aerostat" category[2,3,4,5] is meant to include tethered balloons that are buoyed by lighter-than-air gases. Their frames are generally non-rigid, and many types can be packed, along with a small ground station, onto a ground vehicle, and transported to another location. Aerostats often resemble airships, with the exception that aerostats are static and have no means of propulsion, although direction may be controlled from the ground in order to deal with high winds. They can maintain persistent surveillance, often staying aloft for weeks at a time. Aerostats are currently in use in surveillance operations, such as those defending ground forces, those performing sovereignty patrols, and those involving drug interdiction.

AIRSHIP. Airships[6,7,8,9,10] are similar to aerostats in that lighter-than-air gases are used for buoyancy. However, the airship is able to move under its own power, and it can be steered in any direction. Airship frames can be non-rigid or semi-rigid. Low-altitude airships typically have endurances in the range of several hours to several days. High-altitude airships that use solar power are being developed with endurances in the order of one month. Military airships are used for surveillance missions in which the ability to hover outweighs the requirement for speed and manoeuvrability, or for the transportation of cargo, again, where speed is not important.

HYBRID AIRSHIP. Hybrid airships[11,12,13] differ from conventional airships in their use of aerodynamic lift and vertical thrusters as well as gases for buoyancy, and they generally have greater manoeuvrability. Today, more of the hybrids are designed specifically for heavy loads (e.g., 50 tons) or outsized cargo. Although none are as yet commercially available, several manufacturers are constructing and testing prototypes.

MICRO-SATELLITE. Micro-satellites[14,15] are small (i.e., less than 150 kilograms), low-earth orbit, single-purpose satellites, designed to carry small sensors, such as automatic identification system (AIS) sensors. Since micro-satellites are so small, a constellation would normally be required for full coverage in most surveillance missions. Some have been successfully launched, and further development continues.

MEDIUM- AND HIGH-ALTITUDE LONG-ENDURANCE UNMANNED AERIAL VEHICLES. There are many types of MALE and HALE UAV, including RW UAV. Those in operation today generally have an endurance range of 24 to 48 hours. MALE UAVs usually fly at an altitude of 10,000 to 30,000 feet, and HALE UAVs fly between 50,000 and 70,000 feet. Most MALE and HALE UAVs are fixed-wing aircraft, and are in use in diverse applications around the world. Developments that make these air platforms fall into the classification of "future air platforms" include adaptations to use



CF Photo: MCpl Kevin Paul

alternative fuel sources, such as fuel gas, liquid hydrogen, and solar-electric power, changes in size and corresponding endurance (e.g., smaller but with longer endurance), and adaptations to fulfill some purpose (e.g., hybrid propulsion systems comprised of turbo-diesel propeller for long-loiter endurance missions combined with hydrogen-cell jet for high dash speed). The RW UAV[16,17] provides the capability of a RW aircraft (hovering, manoeuvering, vertical take-off and landing), along with greater endurance and autonomous operation.

For each air platform category, certain measures of comparison were used to differentiate one type from another. These measures, chosen for their relevance to the air platforms, are shown in Table 1. Not all of the comparison measures were available, and some, such as costs, were only estimated. However, for most of the platform types, there was sufficient information to determine the expected performance, mission capability, and infrastructure considerations.

Characteristics	Size (wingspan / length / rotor diameter / volume)
	Frame (rigid/non-rigid)
	Fuel / Gas / Power for buoyancy / propulsion
Requirements	Hangar
	Runway
	Ground Station
Performance	Range
	Altitude
	Speed
	Ability to hover
	Endurance
	Payload
	Control (pilot/autonomous/waypoints)
Function	Communication Relay
	Lift
	Pursuit
	Surveillance
Costs	Initial
	Operation & Maintenance (including fuel)
	Personnel/Training
	Infrastructure
Realistic?	Technological Complexity
	Year of Expected Availability

Table 1. Air Platform Measures of Comparison

WORKING GROUP

SMEs were invited to a working group at CFAWC (Ottawa Detachment) on December 8, 2009. The SMEs were military personnel with years of operational experience, and were drawn from the Chief of Air Staff (CAS) / Director of Air Strategic Plans (D Air SP), CAS / Force Readiness, Canadian Operational Support Command (CANOSCOM), Strategic Lift, Chief of Defence Intelligence, Expeditionary ISR, Maritime ISR, Maritime Search and Rescue (SAR), and Aerospace Surveillance. The objective of this meeting was to identify the missions that the future air platforms might fulfill, the factors by which the platforms should be compared, and the relative importance of these factors.

The aim of the project was presented, and the air platform groups were described. The SMEs discussed each type of air platform at length, and provided their thoughts as to the benefits and drawbacks, possible missions in which the air platform might have a role, and missions in which the air platform would probably perform better than existing CF aircraft. The SMEs decided not to look at conventional fixed-wing UAVs since this is currently under study by the Directorate of Air Requirements. The results of the working group were achieved by consensus and were originally recorded on flip charts. (These results were often comparative in nature and were not necessarily elaborated upon.) This information was subsequently compiled in Table 2.

Mission	Component	Aerostat	Airship		Hybrid Airship		Micro-Satellite	RW UAV
			low	high	ISR	Cargo		
General	Covertness	no	no	yes	no	no	yes	no
	Risk of Interception	tether, high	high	low	high	high	low	high
	Weather Vulnerability	high	high	none	high	high	none	high
	Mobility	relocatable	high	high	high	high	single purpose	high
	Speed (knots)	--	45-90	60-100	20-80	25-104	--	140
	Altitude Changes	--	yes	no	yes	yes	--	yes
	Persistence/Endurance	days-weeks	hours-days	days-weeks	weeks	hours	years?	hours
	Technological Complexity	low	low	medium	medium	medium	medium	medium
	Infrastructure Requirements	minimal	minimal	minimal	minimal	minimal	minimal	minimal
	Manning/Pilot	none	optional	autonomous	optional	optional	none	autonomous
C2	Radio Relay	all types	all types	all types + satellite	all types	all types	burst relay	all types
ISR	Detect/Track/Target/ID	all; ID if near	all	all but ID	all	all	no	all
	Carry Large Sensors?	yes	yes	yes	yes	yes	no	yes
	Needs Bandwidth?	no	if unmanned	if unmanned	if unmanned	if unmanned	yes	yes
	Sensor Suite	all types	all types	all but EO/IR	all types	all types	EO/AIS	all but SIGINT
SAR	Communication Suite	all types	all types	all but EO/IR	all types	all types	n.a.	all types
	Search	only within area	yes	yes	yes	yes	no	yes
	Rescue	no	if manned	no	no	if manned	no	yes
	Recovery	no	yes	no	no	yes	no	yes
	CSAR	no	no	no	no	no	no	yes
Transport	Outsized Cargo	no	yes	no	no	yes	no	yes
	Tactical Lift - Arctic	no	yes	no	no	yes	no	yes
	Tactical Lift - Safe	no	yes	no	no	yes	no	yes
	Tactical Lift - Littoral	no	yes	no	no	yes	no	yes
Other	Weather Data Collection	yes	yes	yes	yes	yes	yes	no
	Power Generation	yes	yes	no	no	yes	no	no
	Jamming	yes	yes	yes	yes	yes	no	yes
	Control	yes	yes	yes	yes	yes	no	yes
	Escort/Shield for Chinook	no	no	no	no	no	no	yes

Table 2. Overall Results of Working Group

The following notes provide clarification of Table 2:

a. The first three factors, covertness, risk of interception, and weather vulnerability, are all dependent on the flying altitude of the aircraft. "Covertness" refers to the visibility of the platform from the ground; "risk of interception" refers to the probability of being intercepted from the ground; and "weather vulnerability" refers to the vulnerability of the aircraft itself as well as that of the communication links. For the aerostat, the tether poses an additional point of vulnerability.

b. "Mobility" refers to getting the air platform to the desired area.

c. "Altitude Changes" refers to the aircraft's ability to change altitude in response to a situation (e.g., descending to identify a ship).

d. "Persistence/Endurance" refers to the length of time the platform can remain in the sky before it needs to be brought down for any reason.

e. The "Manning/Pilot" factor is noted since unmanned assets, unless stationary (e.g., aerostat) or very high altitude (e.g., high airship, micro-satellite), may be subject to controlled airspace restrictions;

f. Under command and Control (C2), "radio relay" includes voice, cell phone, code division multiple access (CDMA), time division multiple access (TDMA), etc.), global command and control system (GCCS), or other common operating picture, sensor relay from another ISR asset, and UAV control/sensor relay. For the high-altitude airship, "satellite" refers to free space optical communication links.

g. Under ISR, the "Sensor Suite" includes radar (synthetic aperture radar, ground moving target indicator [GMTI] modes), AIS, electro-optical/infrared (EO/IR), halogen infrared reflection (HIR) multi-spectral, and signals intelligence (SIGINT).

h. Under SAR, the "Communication Suite" includes AIS, emergency locator transmitters, radar, emergency position-indicating radio beacon and SAR radio frequencies. "Rescue" refers to retrieving a subject whose life is at risk; whereas, "recovery" refers to retrieving a subject without risk to life, including a deceased person, an uninjured person on site following a rescue, or an inanimate object. CSAR refers to combat search and rescue.

During the working group, each air platform type was evaluated for its ability to contribute to the operation of various missions. Table 3 shows the mission components that are in any way possible for each air asset. Green cells show full capability, yellow cells show some capability, and red cells show no capability. (However, this table does not denote feasibility; an air platform may be capable of contributing to the mission, but may only perform a partial role, or several platforms may be required to complete a mission.) This table is used in estimating one

Mission	Component	Aerostat	Airship		Hybrid Airship		Micro-Satellite	RW UAV
			low	high	ISR	Cargo		
C2	Communication Relay	yes	yes	yes	yes	yes	burst relay	yes
	UAV Control	yes	yes	yes	yes	yes	no	yes
Surveillance	Aerospace Contacts	yes	yes	yes	yes	yes	intermittent	yes
	Arctic	point	yes	yes	yes	yes	intermittent	yes
	Maritime - Wide Area	on ship	yes	yes	yes	yes	intermittent	yes
	Expeditionary	point	yes	yes	yes	yes	intermittent	yes
	Disaster	point	yes	yes	yes	yes	intermittent	yes
	Vital Point/Maritime - Littoral	yes	yes	yes	yes	yes	no	yes
Reconnaissance	Strategic	no	no	no	no	no	intermittent	no
	Tactical	no	no	no	yes	no	no	yes
SAR	Recover	no	yes	no	no	yes	no	yes
	Monitor	point	yes	yes	yes	yes	no	yes
	Search	point	yes	yes	yes	yes	no	yes
	CSAR	no	no	no	no	no	no	yes
Transport	Strategic Lift	no	no*	no	no	no*	no	no
	Tactical Lift - Expeditionary	no	no	no	no	yes	no	yes
	Tactical Lift - Safe	no	yes	no	no	yes	no	yes
	Tactical Lift - Littoral (small load)	no	yes	no	no	yes	no	yes
	Tactical Lift - Littoral (large load)	no	yes	no	no	yes	no	yes
	Tactical Lift - Domestic Disaster	no	yes	no	no	yes	no	yes
Other	Weather Data Collection	yes	yes	yes	yes	yes	yes	no
	Power Generation	yes	yes	no	no	yes	no	no
	Jamming	yes	yes	yes	yes	yes	no	yes
	Control	yes	yes	yes	yes	yes	no	yes
	Escort/Shield for Chinook	no	no	no	no	no	no	yes

* too slow and insufficient payload

Table 3. Mission Capability

of the principal evaluation factors for this study, the flexibility of the aircraft (i.e., the ability of the aircraft to perform many roles).

It can be seen that the low-altitude airship, the cargo hybrid airship and the RW UAV are the most flexible (with a high proportion of green cells), the micro-satellite is the least (with mostly red and yellow cells), and the other air platforms fall somewhere in between. However, although flexibility is important, it does not necessarily imply effectiveness.

The next principal evaluation factor, the mission effectiveness of the air platform, is assessed in a broad mission sense. Although a true estimation of mission effectiveness would require exact and specific airframe data, at this preliminary stage of analysis, specifics are undetermined. Hence, the approach is of a general nature.

The working group stated which of the air platforms they thought would perform better than any of the aircraft currently used for the particular CF mission or than any of the other platform types. The results are shown in Table 4. In this case, green cells imply that the air platform is foreseen to perform better than any current CF alternative; yellow cells imply that the air platform should be of benefit, but with possible drawbacks; red cells imply that the air platform is not foreseen to rival the CF alternative. As expected, most of the table is red since no single platform type would be best for all missions. Cells are marked yellow for the following reasons:

a. Reconnaissance, Tactical: Platforms may not have sufficient speed, range or endurance.

b. SAR, Recover and CSAR: Manned aircraft are always preferable to unmanned.

Mission	Component	Aerostat	Airship		Hybrid Airship		Micro-Satellite	RW UAV
			low	high	ISR	Cargo		
C2*	Tactical - Access Guaranteed	Green	Red	Red	Red	Red	Red	Red
	Strategic/Operational	Red	Red	Green	Red	Red	Red	Red
Surveillance	Aerospace Contacts	Green	Red	Green	Red	Red	Red	Red
	Arctic	Red	Red	Green	Red	Red	Red	Red
	Maritime - Wide Area	Red	Red	Green	Red	Red	Red	Red
	Expeditionary	Green	Red	Green	Green	Red	Red	Red
	Disaster	Red	Red	Green	Red	Red	Red	Red
	Vital Point/Maritime - Littoral	Green	Red	Green	Red	Red	Red	Red
Reconnaissance	Strategic	Red	Red	Red	Red	Red	Green	Red
	Tactical	Red	Red	Red	Yellow	Red	Red	Yellow
SAR	Recover	Red	Yellow	Red	Red	Red	Red	Yellow
	Monitor	Red	Red	Green	Red	Red	Red	Red
	Search	Red	Red	Red	Red	Red	Red	Red
	CSAR	Red	Red	Red	Red	Red	Red	Yellow
Transport	Strategic Lift	Red	Red	Red	Red	Red	Red	Red
	Tactical Lift - Expeditionary	Red	Red	Red	Red	Red	Red	Yellow
	Tactical Lift - Safe	Red	Red	Red	Red	Green	Red	Red
	Tactical Lift - Littoral (small load)	Red	Red	Red	Red	Red	Red	Green
	Tactical Lift - Littoral (large load)	Red	Red	Red	Red	Green	Red	Red
	Tactical Lift - Domestic Disaster	Red	Red	Red	Red	Yellow	Red	Red

* The C2 components listed in this table are considered more pertinent than those of Table 3. However, Table 3 has been left as it is, including the "Other" missions, to faithfully reflect the results of the working group.

Table 4. Mission Effectiveness

c. Tactical Lift, Expeditionary: The need is dependent on the level of risk considered acceptable by providers of current alternatives—if this risk becomes too great, current sources may refuse the mission, and unmanned alternatives may be required.

d. Tactical Lift, Domestic Disaster: There may be difficulty in finding suitable places for a large airship to land.

This table is used in estimating the mission effectiveness of the air platform.

From this table, the high-altitude airship shows the greatest mission effectiveness, and the low-altitude airship and micro-satellite show the least. The other air platforms show effectiveness in certain areas. The aerostat is particularly effective for several components of surveillance and C2. The RW UAV should provide some value in reconnaissance, SAR (especially CSAR), and transport. As for the hybrid airship, discussions among CFAWC personnel prompted the thought that the two categories might have been combined from the start since these categories were artificially determined. This would result in combining the effectiveness of the two hybrid categories.

The third evaluation factor is cost. As previously stated, since this preliminary analysis is at a high level, costs were only estimated in a comparative, order-of-magnitude standard. A precise cost comparison would require quotes for specific platforms, which is beyond the scope of this study. The cost estimates are presented in Table 5.

Of all of the options, the aerostat is by far the least costly, being the least complex, with no moving parts, requiring no fuel (other than lighter-than-air gases, such as helium, which may be recoverable), and very little training, very few personnel for operation, and very little infrastructure (e.g., some aerostats can be packed away for storage and transport). In terms of cost, the aerostat is followed by the conventional airships and the micro-satellite. Conventional airships are less complex than hybrid airships, but all require large hangars, fuel or gas, and personnel for control. The most critical of the cost components is the operation and maintenance (O&M) cost, which is greatest for the hybrid airships and the RW UAV. The more complex air platforms are also the more costly.

The fourth and final evaluation factor is technological risk. Technological risk is the risk of platform development being stalled by difficulties in overcoming the technological complexity of the platform design. This risk is estimated from the current state of development of each platform type: aerostats and low-altitude airships are considered low risk since these platforms are in operational use; the other platform types are considered moderate risk since these are in the prototype construction and testing stage (shown in the next section).

	Aerostat	Airship		Hybrid Airship		Micro-Satellite	RW UAV
Costs:		low	high	ISR	Cargo		
Initial	$	$$	$$	$$	$$	$$$	$$
O&M	$	$$	$$	$$$	$$$	$	$$$
Infrastructure	$	$$	$$	$$	$$	$$	$
Personnel/Training	$	$$	$$	$$$	$$$	$$	$$$

Table 5. Costs

SYNTHESIS OF RESULTS

The overall evaluation of the preceding factors of mission effectiveness, flexibility, cost, and technological risk is summarized in Table 6. These factors are listed in order of importance. In this table, the best case is represented by green cells (i.e., greatest mission effectiveness, greatest flexibility, least cost, and lowest technological risk), the worst case by red cells, and yellow cells fall between the two. Mission effectiveness is ranked from best (1) to worst (7).

Factor	Aerostat	Airship		Hybrid Airship		Micro-Satellite	RW UAV
		low	high	ISR	Cargo		
Mission Effectiveness	2	7	1	5	4	6	3
Flexibility							
Costs							
Technological Risk							

Table 6. Overall Evaluation

In determining the most promising air platforms, mission effectiveness is the first factor examined. Platforms with the poorest scores in this measure should probably be eliminated from further consideration since this is the most important measure, and the other platform types are expected to be much more effective by comparison. Indeed, the low-altitude airship and micro-satellite achieve low scores on mission effectiveness since neither provides much of an additional benefit over and above current CF options. In particular, the micro-satellite seems a poor candidate for further research since it scores weakly in the two most important measures, mission effectiveness and flexibility. But, regardless of the low-altitude airship's high scores in flexibility and technological risk, it simply does not provide enough of an advantage to seriously consider it.

The aerostat, high-altitude airship, and RW UAV score well in mission effectiveness. Table 6 shows that the aerostat scores well in every factor except flexibility. Although the aerostat is suitable for a limited number of missions, it seems to be a highly effective, low-cost, low-risk choice for those missions.

Table 4 shows that the high-altitude airship is an excellent surveillance platform, which contributes to this airship's high mission effectiveness. However, its flexibility, cost, and technological risk scores are moderate. Since the aerostat can perform some of the same missions as the high-altitude airship, and at lower cost, the high-altitude airship loses some of its advantage. If the aerostat is chosen, an assessment should be performed to estimate utility and surveillance gaps. It should then be decided whether or not current air assets can fill the requirement or if additional assets of a different type, such as the high-altitude airship, may be needed.

The RW UAV scores well in both mission effectiveness and flexibility, and moderately in cost and technological risk. It may be an option worthy of further study. The only caution may be the drawbacks indicated in Table 4 (i.e., insufficient speed, range, or endurance to perform tactical reconnaissance; manned aircraft are preferable for CSAR and SAR recovery; and the risk is too great for alternatives so as to create a need for the RW UAV for expeditionary tactical lift).

The hybrid airships score moderately on mission effectiveness and technological risk, and poorly on cost. As previously mentioned, the air platform categories were artificially created from examination of the many varieties of air platform in the literature. After the SME working group met, it was thought that the hybrid categories should have been combined into one category, just as the RW UAV (either for ISR or cargo) is one category. If both hybrid categories were to be combined, then the mission effectiveness and flexibility scores would be higher. Cost and technological risk would still score the same. This might warrant further study into hybrid airships.

CONCLUSIONS

From the information presented, several conclusions can be made. The one air platform type that stands out from the others is the aerostat. If only one air platform type could be chosen for further study, it should be the aerostat. It is a low-cost platform, using technology that is well understood, and it is highly effective for certain operations.

The drawbacks related to the implementation of the RW UAV should be considered, and if these present real problems, the possibility of circumventing them should be assessed. If this is possible or if the concerns are not important, the RW UAV should merit further study.

Similar to the RW UAV, the hybrid airships should be considered along with their associated drawbacks. It should be noted, however, that cost is expected to be high for the hybrid airships.

FURTHER WORK AND CONSIDERATIONS

A complete and in-depth analysis will be required before it is possible to decide which air platform type merits the investment of research, time and money. The following areas should be considered:

a. Mission Priority: Assuming one of these air platforms performs a mission significantly better than any current CF aircraft, is this mission a priority for the Air Force or is it expected to become a priority in the near future? Any further work should align with Chief of Force Development concepts and priorities.

b. Mission Gaps: Do current CF aircraft nonetheless satisfy enough of the mission requirements that a replacement in the form of some future air platform is not yet needed (i.e., is there a gap to be filled)?

c. Cost Effectiveness: Would the future air platform provide a cost-effective alternative to current CF aircraft?

d. Number of Platforms Required: How many of this air platform type would be required to perform a mission, and is this number of platforms still feasible?

e. Infrastructure: Are there major infrastructure considerations, such as runways, hangars, or ground stations, that may delay the introduction of the new platform type?

f. Training: Concerning training, will this platform be easy to integrate into current operations?

g. Technological Risk: Are aspects of this air platform so technologically complex as to risk failure of achievement? (This should not be the case since very futuristic platforms were screened out of this study.)

h. Platform Adaptation: Will this air platform require substantial adaptation to improve any of its features, such as payload, control, speed, or endurance?

Although these issues are beyond the scope of this preliminary work, they should be addressed in detail in future work, before final decisions are made.

Other exercises, again beyond the extent of this report, may establish rules or guidelines on choosing air platform types to match mission requirements. For example, it may be possible to verify the working group findings through numerically scoring and weighting various attributes and factors (i.e., those factors relevant to each mission as shown in Table 2). If this method can be perfected, a sensitivity analysis will determine the conditions under which one air platform type performs better than another. This may allow for some refinement in the ratings of each platform type for such measures as mission effectiveness, specifically under changing conditions.

ACKNOWLEDGEMENTS

Thanks and appreciation are due to the members of the subject-matter-expert working group and to Canadian Forces Aerospace Warfare Centre personnel, including Major Bernie Thorne, Captain Luisfelipe Baez, Captain Nathan Carreiro, Captain Glenn Dean, Captain Laura Kissmann and Captain John MacKinnon, for their advice and input into this study. ■

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LIST OF ABBREVIATIONS

AIS	automatic identification system	GMTI	ground moving target indicator
C2	command and control	HALE	high-altitude long-endurance
CANOSCOM	Canadian Operational Support Command	HIR	halogen infrared reflection
CAS	Chief of the Air Staff	ISR	intelligence, surveillance and reconnaissance
CDMA	code division multiple access	MALE	medium-altitude long-endurance
CF	Canadian Forces	O&M	operating and maintenance
CFAWC	Canadian Forces Aerospace Warfare Centre	RW	rotary wing
CSAR	combat search and rescue	SAR	search and rescue
D Air SP	Director of Air Strategic Plans	SME	subject matter expert
EO/IR	electro-optical/infrared	TDMA	time division multiple access
GCCS	global command and control system	UAV	unmanned aerial vehicle

NOTES

1. For example, there are search and rescue aircraft in development that can carry 150 people, but Canadian search and rescue efforts rarely require carrying more than 10 people.

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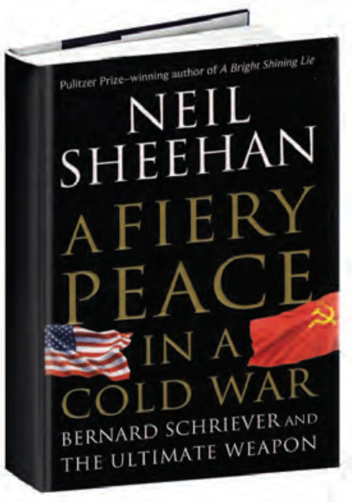


A FIERY PEACE IN A COLD WAR:

BERNARD SCHRIEVER AND THE ULTIMATE WEAPON

BY **NEIL SHEEHAN**

NEW YORK:
RANDOM HOUSE, 2009
534 PAGES ISBN 978-0-679-42284-6

Review by
Colonel Peter J. Williams, CD

Twenty paces from (indeed, deliberately so) the Arlington National Cemetery grave of General of the Air Force Henry ("Hap") Arnold, who commanded the United States (US) Army Air Forces (USAAF) in the Second World War, is that of another, somewhat lesser-known US Air Force (USAF) general whose epitaph reads simply, "Father of the Air Force's Ballistic Missile and Space Program." That man was General Bernard Schriever, the subject of this book by Pulitzer Prize-winning author Neil Sheehan (his work, *A Bright Shining Lie: John Paul Vann and America in Vietnam*, won this award in 1989). With such a strong pedigree (and frankly a very positive review on the front page of the Sunday *New York Times* Book Review insert), I knew that this was something I had to read. I wasn't disappointed.

To be truthful, the book is no ordinary biography, as it not only follows the fortunes of the German-born Schriever, but also traces in some detail the origin and progress of the cold war, and the fight within the US defence establishment to attain strategic superiority over the former Soviet Union. Lest one think that this is mere history, I found that it offers many useful lessons for modern-day defence debates on issues ranging from capability development, project management in the face of bureaucracy, the use of unmanned systems, the challenges inherent in trying to determine the extent of a potential adversary's capabilities, and even the usefulness of being able to play golf… particularly with the right partners! From an early age, "Bennie," as he was known, was an accomplished golfer, and in later years often played with generals who took on a role in mentoring the young Schriever.

The author admits that part of his inspiration for writing the book was coming across a photo of a hitherto unknown USAF general surrounded by models of ballistic missiles. Originally, he had intended to write about the US-Soviet arms race, but after finding the photo of Schriever, decided that the man was so central to the story that he could not be ignored. In compiling the book, Sheehan relied heavily on interviews, including with General Schriever himself. He also relied on several sources of archival material. If there is one fault I could find, it is the lack of footnotes, an omission the author freely admits in the Source Notes portion of the book. For a less experienced writer, one could almost pass such a fault, but I would have expected better from a Pulitzer Prize winner.

The author traces Schriever's birth in 1910 and early childhood in Germany, followed by emigration with his family to the US. Though a talented golfer, he was equally attracted to engineering and flying, and so joined the US Army Air Corps as a pilot in the 1930s. His technical skills were quickly realized and he was given further training in this regard, and was studying toward a master's degree in aeronautical engineering when the Second World War intervened. His wartime service was in the Pacific, where despite possessing wings, Schriever spent much time in maintenance posts, while at the same time rising rapidly through the ranks, a testimony to the status he had gained as a latter day "go to guy" who was able to maintain his unit's aircraft at exceedingly high readiness rates. By age 33, he was a full colonel.

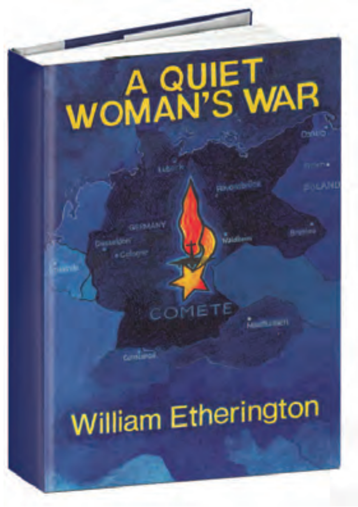
Schriever's expertise was also recognized by "Hap" Arnold, who personally chose Schriever to head up the Air Force's Scientific Advisory Group (SAG), a forward-thinking body composed of some of the most brilliant technical minds in America. This was a task Schriever relished (it was "cutting the bacon," in his Texan language), as he foresaw the impact of the atomic age, and the need to protect America from its enemies, mainly the Soviet Union. Here the book comes into its own with a description of the cold war and the increasing importance of atomic weapons, which Schriever more and more realized would have to be delivered by missiles. In this fight, he ran up against several other military leaders, not the least of whom was General Curtis Lemay, head of Strategic Air Command (SAC), and an advocate of the manned bomber. From this point on the pattern of Schriever's career was set as he devoted himself totally to the development of what would later become the Intercontinental Ballistic Missile (ICBM) we know today. The author challenges conventional wisdom, making the case that while there was indeed a so-called "missile gap," it was in the Americans' favour. Schriever's fight to advance the cause for ICBMs needed political support, and the author's description of how Schriever got his project on President Eisenhower's National Security Council (NSC) agenda, and ultimately achieved Ike's support for the project, was one of the most enjoyable parts of the book, and provides many lessons for the modern-day staff officer attempting to advance a particular issue through the staff chain. On the day he met with Eisenhower, though allocated only 30 minutes, Schriever was able to get the President's attention for an hour and 35 minutes! Schriever was equally adept at gaining additional funding, and in maintaining a high degree of independence from the Air Force bureaucracy, in giving the US a major element of its nuclear deterrent. When Schriever died in 2005, he was 94, and in attendance at his funeral were nine of the 10 serving USAF four-star generals.

In summary, I found this to be an excellent book about a key—yet somewhat unknown—figure in US military history. One wonders how General Schriever would have fared in the modern-day Canadian Forces where we are undergoing the challenges of Defence Force Structure Review (DFSR) and the Strategic Review (SR). This book is highly recommended, particularly for those involved in capability development, project management, or quite frankly, for those wanting an example of how to better get their point across.

Colonel Peter J. Williams, an artillery officer, is Director Current Operations on the Strategic Joint Staff.

List of Abbreviations

ICBM	**Intercontinental Ballistic Missile**
US	**United States**
USAF	**United States Air Force**



A QUIET WOMAN'S WAR:

THE STORY OF ELSIE BELL

BY **WILLIAM ETHERINGTON**
NORWICH, UNITED KINGDOM:
MOUSEHOLD PRESS, 2006
132 PAGES
ISBN 1874739242 ISBN-13: 978-1874739241

Review by **Lieutenant-Colonel Doug Moulton, CD, MBA**

"The helpers were ordinary men and women who organized the escape line routes and provided safe-houses, couriers and mountain guides. Many paid for their selfless actions with their lives. Many more suffered or died in the concentration camps of the Third Reich. Others were thankfully spared to continue the common fight for freedom."

– Inscription at the Helpers' Memorial, Eden Camp, Malton, North Yorkshire

Like most people, I am aware of the major events of the Second World War (WW II). However, it was not until my wife and I attended the Escape Lines Memorial Society[1] annual reunion last April that I became aware of the escapers, evaders, and helpers of WWII. During the war, Allied servicemen either escaped custody or prisoner of war camps (escapers) or evaded capture when behind enemy lines (evaders). They made their way back to England to resume their part in the war effort. This return home would not have been possible without the assistance of the local population (helpers). The only way to return home was to travel (mostly by foot, including crossing the Pyrenees) from Holland, Belgium, and France south to Gibraltar where they were picked up and transported to England. Once escape lines were established, M.I.9 (British Military Intelligence Section 9) asked that the helpers focus on aircrew. This decision was made because of the cost and time required to train these individuals.

During the reunion weekend, we had the opportunity to meet WWII veterans who had escaped/evaded as well as helpers. We also met William Etherington; he attended not because he was an escaper, evader, or helper, but because of his interest in these events. More specifically, he had written *A Quiet Woman's War: The Story of Elsie Bell*. After talking with Etherington, he offered us a copy of his book, which we eagerly accepted.

A Quiet Woman's War is Elsie's story as well as that of her husband Georges Maréchal and their children, Little Elsie and Robert. From 1913 to 1915, Elsie trained at Norwich Teacher Training College. She met Georges, a Belgian soldier, in 1917 during an air raid warning in London. They were married in 1920 and then moved to Belgium. During the Second World War, Georges' work required him to travel frequently. "From the beginning of 1941, as his work took him into the most crucial areas of the German forces, he used his military knowledge to collect valuable information as a member of *Luc*… an intelligence network, already sending couriers to London."[2] At home, Elsie offered up their house as a place to hide Allied servicemen. Little Elsie became very involved in the resistance effort; she recruited other safe houses and moved Allied servicemen along the line. Robert was too young to become involved in theses activities but occasionally couriered documents for his sister. The Maréchals were aware of the danger associated with their activities. "German notices everywhere in Belgium threaten anyone helping Allied servicemen with the severest penalties…. [C]ivilians… if detected… could expect no mercy and received little. They would be tried by a military court; acquittals were unknown. The sentence was invariably deportation to Germany or death at once; a great many of those deported did not come back."[3]

The two Elsies were working for the Comet escape line. It was betrayed, and on 18 November 1942,[4] Elsie had two American evaders in her home. Realizing that they would not make it any further up the line, the *Geheime Feld Polizei* (Nazi Germany Secret Field Police) arrested, one by one, the Maréchal family. Robert appeared younger than his age and played up his stammer; he was interrogated and beaten for two months and was eventually released from prison. Georges and the two Elisies were tried, found guilty, and condemned to death. Georges was shot in late October 1943. In January 1944, the two Elsies were transported from the prison and spent the next 16 months in a series of concentration camps.

Elsie wrote an account of her experiences during the war for her parents to "fill up the gap in the period of our lives when you had no news from us, from 1940 to 1945."[5] A copy of this account ended up in Keswick Hall College of Education, formerly the Norwich Teacher Training College. Etherington, Keswick Hall Principal from 1973 to 1981, came across this "most unusual" document. He wanted to know how she came "to be in this fix… and "[w]hat happened to her after the war?"[6] Elsie died in 1969, but he was able to connect with Little Elsie and Robert. They allowed him to "see (and explain[ed]) their mother's personal papers"[7] and recalled their experiences. Etherington started with Elsie's words, carefully added Little Elsie's and Robert's memories, and injected some clarifying details and explanations. The result is a very balanced and compassionate telling of one woman's story.

Given the 65 years since the end of the war, there are fewer and fewer escapers, evaders, and helpers alive to tell their stories, which makes books such as *A Quiet Woman's War* so much more important. In fact, when signing our copy, Etherington wrote: "A story which had to be passed on." I could not agree more. ■

Lieutenant-Colonel Doug Moulton, a *Sea King* pilot, is currently the Canadian Forces Liaison Officer to the United Kingdom Air Warfare Centre, Royal Air Force, Waddington.

List of Abbreviations

SS	**Schutzstaffel**
WWII	**Second World War**

Notes

1. For more information on the WWII Escape Lines Memorial Society see http://www.ww2escapelines.co.uk/. For information on WWII escape and evasion see http://www.conscript-heroes.com/escapelines/index.htm (both sites accessed August 11, 2010).

2. William Etherington, *A Quiet Woman's War: The Story of Elsie Bell* (Norfolk, UK: Mousehold Press, 2006), 32.

3. Ibid., 33.

4. At the time of their arrests, Little Elsie was 18 years old and Robert was 16.

5. Etherington, viii.

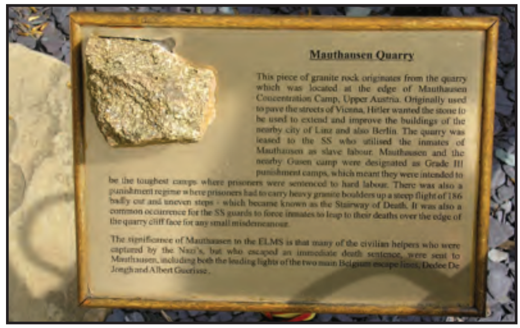
6. Ibid., see vii for the three quotes.

7. Ibid., viii.

Escapers, Evaders and Helpers – Photo used by permission from Paul Mellor Photography (United Kingdom).
Escapers, evaders, and helpers at the Escape Line Memorial Society 2010 reunion.

The Helper Memorial – Photo credit LCol Moulton

The rocks of the Helper Memorial were hewn from a French quarry in the Pyrenees Mountains, situated on the high level escape route from France into Spain, used by escapers, evaders, and other wartime fugitives.



Mauthausen Rock – Photo credit LCol Moulton

The two Elsies were liberated from the Mauthausen Concentration Camp in April 1945. The inscription reads: "This piece of granite rock originates from the quarry which was located at the end of Mauthausen Concentration Camp, Upper Austria. Originally used to pave the streets of Vienna, Hitler wanted the stone to be used to extend and improve the building of the nearby city of Linz and also Berlin. The quarry was leased to the SS [Schutzstaffel] who utilized the inmates of Mauthausen as slave labour. Mauthausen and the nearby Gusen camp were designated as Grade III punishment camps, which meant they were intended to be the toughest camps where prisoners were sentenced to hard labour. There was also a punishment regime where prisoners had to carry heavy granite boulders up a steep flight of 186 badly cut and uneven steps—which became known as the Stairway of Death. It was also a common occurrence for the SS guards to force inmates to leap to their deaths over the edge of the quarry cliff face for any small misdemeanour.

"The significance of Mauthausen to the ELMS [Escape Lines Memorial Society] is that many of the civilian helpers who were captured by the Nazi's [sic], but who escaped an immediate death sentence, were sent to Mauthausen, including both the leading lights of the two main Belgium escape lines, Dedee De Jongh and Albert Guerisse [both mentioned in *A Quiet Woman's War*]."

SPITFIRE:
ICON OF A NATION

BY **IVAN RENDALL**

UNITED KINGDOM:
WEIDENFELD AND NICHOLSON, 2008
288 PAGES
ISBN: 978-0-297-85511-8

Review by **Commander Mark R. Condeno**

From its first flight in 1936 to the grand air shows of today, the Supermarine Spitfire is a symbol of pride of the British nation. The famous World War Two fighter that defied the German invasion of Britain in 1940 is also well known as the only allied fighter in continuous production throughout the conflict.

In this highly fascinating narrative, Ivan Rendall (*Reaching for the Skies, the Power and the Glory, Flyers and Splash One*) presents the Spitfire as a nation's icon. The book is written with the goal of documenting the admiration and affection of a country and its allies for the plane and for those who flew in and served with this magnificent aircraft. The book is divided into eight chapters, commencing with an introduction that looks into why the fighter became a nation's symbol, and the degree of gratitude extended to its designer, Reginald Joseph Mitchell. The opening segments chronicle the early aviation period from the Wright Brothers, the air races, specifically the Schneider Cup, and the development and evolution of the aircraft with a focus on its primary characteristic—speed. The historical data on the air races is especially appreciated.

The next chapter covers the age when air power was represented by the bomber type of aircraft. This portion narrates the development of the Luftwaffe (German Air Force), and the transition from biplanes to monoplanes, and it discusses the Royal Air Force's specified requirements and research that would culminate in the Spitfire. The birth and entry of the Spitfire in service coincided with the art deco era; hence, the fighter's sleek lines and distinctive design, with the Spitfire embodying the aesthetic and the technological accomplishments of those years. The war years and the Spitfire's role in it would form the core of the three succeeding chapters, from the outbreak of the Second World War to the skies over France and the Battle of Britain. Its performance and its evolving iconic imagery are thoroughly described, together with remarks from pilots who flew it.

The two penultimate chapters follow the Spitfire in its post-war career; Spitfires and Seafires were again in the thick of fighting during the period of emergency in the Far East and the Korean War. The chapters also trace the advancements in the technology of the allied air forces that retained these machines in their aircraft inventory. A few details caught the attention of this reviewer. For example, the Spitfires bought by the Peoples Republic of China from the Soviet Union, which was new information. Also, a correction of the misapprehension that the aircraft flew with Philippine markings (the P-51 Mustang was actually the first post-war fighter of the Philippine Air Force). Finally, the last segment notes the iconic status achieved by the Spitfire in air shows, literature, and the film industry.

The author is to be applauded for this stirring account and for his fine, distinctive style of writing. Each chapter is fully illustrated with remarkable photographs and artwork. As well, the cutaway posters and the detailed specifications of the Spitfire models would appeal to aviation enthusiasts and to scale modelers. A bibliography and index supplement the book. *Spitfire: Icon of a Nation* is a valuable addition to the history of military aviation, the Royal Air Force, the Second World War, and to the Spitfire story itself. ■

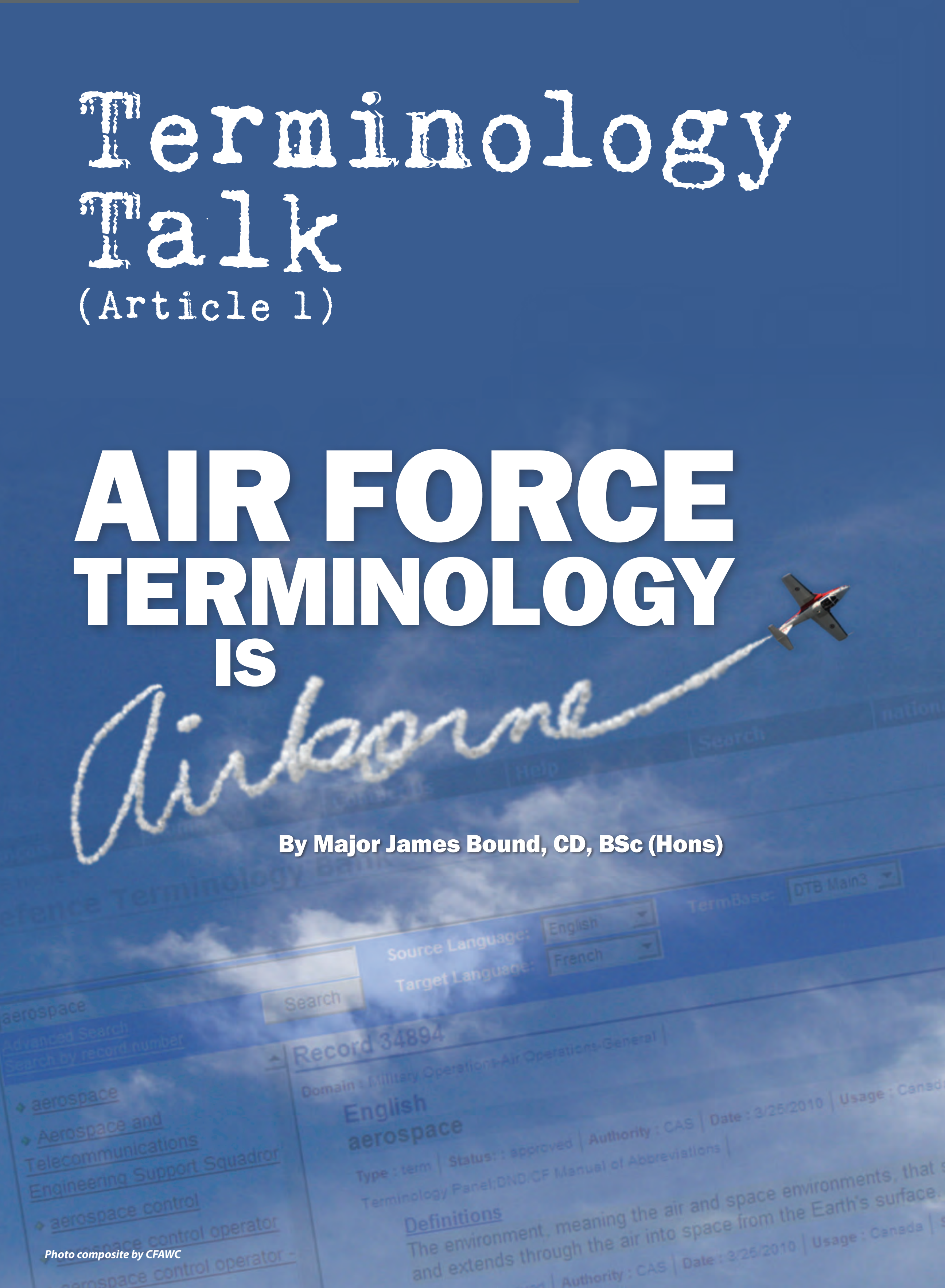
Commander Mark R. Condeno is currently Liaison Officer, Foreign Armed Forces Attaché Corps, International Affairs Directorate, Philippine Coast Guard Auxiliary (PCGA). He holds a BS degree in Architecture from Palawan State University. He was with the Class of 1997 of the Basic Naval Reserve Officer Training Course, Philippine Navy, and with the Class of 1999 of the Philippine Coast Guard Auxiliary Officer Indoctrination Course.

Terminology Talk

(Article 1)

AIR FORCE TERMINOLOGY IS Airborne

By Major James Bound, CD, BSc (Hons)



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Terminology is one of the foundation stones of doctrine. Standardized terminology is essential for the consistent interpretation of doctrine and procedures, and the coherence of policies, regulations, and training materials. Commonality of terminology adds to the quality and value of information, ease of information exchange, system interoperability, and information integrity. And all of this leads to enhanced force interoperability.

The Air Force Terminology Panel (AFTP) was established in 2006 in support of the Defence Terminology Programme. The mandate of the AFTP is to evaluate and approve Air Force terminology submissions for incorporation into the Defence Terminology Bank (DTB) and to provide aerospace subject matter expertise for evaluation of Canadian Forces (CF) and North Atlantic Treaty Organization (NATO) terminology proposals. The AFTP is chaired by Canadian Forces Aerospace Warfare Centre (CFAWC) Doctrine Development and includes members from each branch of CFAWC and the Capability Advisory Groups, as well as advisors from Air Command Linguistics Services, Defence Terminology Section, terminologists and translators from the Public Works and Government Services Canada (PWGSC) Translation Bureau, and other subject matter experts as required.

Normally, the impetus to standardize terminology comes from the development of doctrine and other key defence publications. The establishment of conceptually clear terms can have a significant ripple effect, not only in associated publications, but sometimes throughout the entire organization. For example, many of the terms and categorizations in the *Air Force Strategy,*[1] *Air Force Capability Structure*[2] (which links with Air Force business planning), and *1 Canadian Air Division Mission Management Codes,*[3] all stem from the original B-GA-400, *Out of the Sun: Aerospace Doctrine for the Canadian Forces*. Once a term has a solid grounding in doctrine, it's pretty hard to change or replace a term unless the doctrine itself changes fundamentally.

Over the last year, Air Force terminology has seen a steady evolution in both process and output. The development of some key Department of National Defence (DND) / CF documentation related to defence terminology has facilitated the Air Force to create its own equivalents, most of which are pending final approval. An additional initiative was the launch of a new terminology management website at CFAWC. The last AFTP meeting took place in March 2010, with 34 terms eventually being approved for inclusion in the DTB (as of 13 August 2010). A listing of the approved terms follows:

Act	**Action**
The operational function that integrates manoeuvre, firepower and information operations to achieve the desired effects.	Fonction opérationnelle qui intègre la manoeuvre, la puissance de feu et les opérations d'information pour créer les effets souhaités.
aerospace	**aérospatial**
The environment, meaning the air and space environments, which surrounds the Earth and extends through the air into space from the Earth's surface.	Environnement, c'est-à-dire l'environnement aérien et spatial, qui entoure la terre et qui s'étend vers l'espace depuis la surface de la terre.

aerospace operation	**opération aérospatiale**
An activity, or series of activities, related to the planning and application of aerospace power to achieve assigned objectives.	Activité ou série d'activités liées à la planification et à l'emploi de la puissance aérospatiale en vue d'atteindre des objectifs fixés.
aerospace power	**puissance aérospatiale**
That element of military power that is applied within or from the air and space environments to achieve effects above, on and below the surface of the Earth.	Élément de la puissance militaire mis en action à partir ou à l'intérieur de l'environnement aérien et spatial, pour produire certains résultats à la surface de la terre ainsi qu'au-dessus et au-dessous de cette surface.
aerospace support	**soutien aérospatial**
The provision of personnel, infrastructure, materiel, and services to enable aerospace and other military operations.	Fourniture de personnel, d'infrastructure, de matériel ou de services à l'appui d'opérations aérospatiales ou militaires.
Air Force team	**équipe de la Force aérienne**
All DND employees, CF members, and contractors employed within the Air Force.	Employés du MDN, membres des FC et entrepreneurs qui travaillent pour la Force aérienne.
Air Force terminology	**terminologie de la force aérienne**
The body of standardized doctrinal, operational, organizational, technical, procedural, administrative, and general terminology pertaining to Air Force activities.	Terminologie normalisée de nature doctrinale, opérationnelle, technique, procédurale, administrative et générale touchant les activités de la force aérienne.
air logistics operation	**opération de logistique aérienne**
An air operation, other than an airborne operation, conducted to deploy, distribute and recover personnel and materiel.	Opération aérienne autre qu'une opération aéroportée, menée pour déployer, acheminer ou récupérer du personnel ou du matériel.
air operation	**opération aérienne**
An activity, or series of activities, related to the planning and application of air power to achieve assigned objectives.	Activité ou série d'activités liées à la planification et à l'emploi de la puissance aérienne en vue d'atteindre des objectifs désignés.
airborne operation (AB op)	**opération aéroportée (op AP)**
An operation involving the movement of combat forces and their logistic support into an objective area by air. Note: The means employed may be any combination of airborne units, air transportable units, and types of transport aircraft, depending on the mission and the overall situation.	Opération comportant le transport de forces d' assaut dans la zone d'un objectif et de leurs moyens de soutien logistique par aéronef. Note : Tout dépendant de la mission et de la situation générale, une combinaison quelconque des moyens suivants peut être employée: unités aéroportées ou aérotransportables ou divers types d'aéronef de transport.

airdrop	largage
Delivery of personnel or materiel from aircraft in flight.	Sortie hors d'un aéronef en vol du personnel ou du matériel transportés.
airland	**aéroterrestre**
Delivery of personnel or materiel after the aircraft has landed or while hovering. Note: Also referred to as air landed.	Se dit de l'acheminement de personnel ou de matériel à partir d'un aéronef qui vient d'atterrir ou qui est en vol stationnaire.
airlift	**transport par voie aérienne**
The transport and delivery by air of personnel and materiel in support of strategic, operational, or tactical objectives.	Action de transporter et d'acheminer du personnel ou du matériel par la voie des airs pour favoriser la réalisation d'objectifs stratégiques, opérationnels ou tactiques.
airman	**membre d'une force aérienne; aviateur**
A military member who wears an air force uniform. Note: The term "airwoman" is commonly used for the female gender.	Militaire qui porte l'uniforme d'une force aérienne.
airworthiness activity	**activité de navigabilité**
Any duty, task or function that may affect the airworthiness of an aeronautical product.	Toute responsabilité, tâche ou fonction susceptible d'influer sur la navigabilité d'un produit aéronautique.
airworthiness instrument	**document de navigabilité**
A regulation, order, standard, guideline, code, and education and information campaign in respect of military aviation and airworthiness.	Règlement, ordre, norme, ligne directrice, code ainsi que toute campagne d'éducation et d'information relative à l'aviation militaire et à la navigabilité.
aviation life support equipment (ALSE)	**équipement de survie de l'aviation (ESA)**
All crewmember- and passenger-related life support systems and survival equipment primarily intended for the preservation of life, the prevention of injury or the environmental protection of the crewmember and passenger. Note: ALSE may be required for flight, for emergency egress, for survival until a rescue operation is effected, or to permit escape and evasion.	Tout système de survie pour les membres de l'équipage et les passagers, dont les principaux objectifs sont la protection de la vie, la prévention des blessures ou la protection environnementale des membres de l'équipage et des passagers. Note : L'ESA peut être nécessaire durant le vol, au moment d'une évacuation d'urgence ou pour survivre dans l'attente d'une opération de secours, ou encore pour s'échapper et s'évader.

combat recovery (CR)	récupération au combat (RC)
The recovery by conventional forces of isolated personnel from a situation where hostile interference may be expected. Note: In combat recovery, either the recovery force, or the isolated personnel, or both, have not been trained in combat search and rescue tactics, techniques, and procedures.	Récupération par une force classique d'un personnel isolé se trouvant dans une situation où on peut s'attendre à une opposition de la part d'une force ennemie. Note : Lors d'une récupération au combat, la force de récupération ou le personnel isolé, ou les deux, n'ont reçu aucun entraînement sur les tactiques, les techniques ou les procédures de recherche et de sauvetage de combat.
combat search and rescue (CSAR)	**recherche et sauvetage de combat (RESCO)**
The application of specific tactics, techniques, and procedures by dedicated forces to recover isolated personnel, the latter being trained and appropriately equipped to receive this support, from a situation where hostile interference may be expected.	Emploi de tactiques, de techniques ou de procédures particulières par une force spécialisée afin de récupérer du personnel isolé qui est entraîné et bien équipé pour recevoir ce soutien dans une situation où on peut s'attendre à une opposition de la part d'une force ennemie.
Generate	**Montée en puissance**
The function that develops and prepares an aerospace force to meet force employment requirements.	Fonction consistant à developper et à preparer une force aérospatiale pour qu'elle réponde aux exigences de son emploi.
isolated personnel	**personnel isolé**
Military or civilian personnel who are separated from their unit or organization in a situation that may require them to survive, evade, resist, and/or escape while awaiting recovery. Note: Applicable civilians are as designated by national authorities responsible for deploying individuals/personnel.	Personnel militaire ou civil séparé de son unité ou organisme, dans une situation où il peut être obligé de survivre, de s'évader, de résister ou de fuir en attendant d'être récupéré. Note : Les civils concernés sont désignés par des autorités nationales chargées de déployer du personnel.
measure of suitability (MoS)	**mesure de la pertinence (MDP)**
A criterion used to evaluate how well a task meets an operational requirement. Note: This criterion is typically based on logged data or rating scales.	Critère servant à évaluer dans quelle mesure une tâche répond à un besoin opérationnel. Note : Ce critère se fonde habituellement sur des données consignées ou sur des barèmes de notation.

military aviation	aviation militaire
The set of activities, services and facilities associated with the design, manufacture, materiel support, maintenance and operation of military aeronautical products; the operation and maintenance of aircraft operated by or on behalf of the military; and the operation and maintenance of aircraft operated by or on behalf of a visiting force while in domestic airspace. Note: "Visiting force" is as defined in section 2 of the Visiting Forces Act.	Ensemble des activités, des installations et des services liés à la conception, à la fabrication, au soutien matériel, à la maintenance et à l'utilisation de produits aéronautiques militaires, ou à l'utilisation et à la maintenance d'aéronefs exploités par les forces armées ou pour leur compte, ou encore par une force étrangère ou pour son compte quand elle est dans l'espace aérien du Canada. Note : La définition de l'expression « force étrangère » se trouve à l'article 2 de la Loi sur les forces étrangères présentes au Canada.
Move	**Projection**
The function that exploits global reach and speed of aerospace power to rapidly deploy and manoeuvre personnel and materiel to achieve desired effects.	Fonction exploitant toute la portée et la vitesse de la puissance aérospatiale pour déployer et déplacer rapidement du personnel et du matériel afin d'obtenir les effets souhaités.
non-conventional assisted recovery (NAR)	**récupération assistée non classique (RANC)**
The recovery by non-conventional forces of isolated personnel from a situation where hostile interference may be expected. Note 1: Non-conventional forces include special operations forces, indigenous forces, and surrogates. Note 2: In non-conventional assisted recovery, the isolated personnel have not been trained in combat search and rescue tactics, techniques, and procedures.	Récupération, par une force non classique, de personnes isolées qui se trouvent dans une situation où on peut s›attendre à une opposition de la part d›une force ennemie. Note 1 : Les forces non classiques comprennent les forces d›opérations spéciales, les forces locales et les forces auxiliaires. Note 2 : Lors d›une récupération non classique, le personnel isolé n›a reçu aucun entraînement sur les tactiques, les techniques et les procédures de recherche et de sauvetage de combat.
operational performance	**performance opérationnelle**
Those operational and support characteristics of a system that allow it to effectively and efficiently perform its assigned mission over time. Note: The support characteristics of a system include both supportability aspects of the design and the support elements necessary for system operation.	Ensemble des caractéristiques opérationnelles et relatives au soutien d'un système lui permettant de remplir avec efficacité et efficience sa mission au fil du temps. Note : Les caractéristiques relatives au soutien du système comprennent tant les aspects propres à la soutenabilité du modèle que les éléments de soutien nécessaires à l'utilisation du système.

operational suitability (OS)	pertinence opérationnelle (PO)
The degree to which a system can be satisfactorily used and sustained to meet a current or anticipated operational requirement. Note: Consideration must be given to availability, compatibility, transportability, interoperability, reliability, usage rates, maintainability, safety, human factors, manpower supportability, logistic supportability, natural environmental effects and impacts, documentation and training requirements.	Mesure dans laquelle un système peut être utilisé et maintenu en puissance de façon satisfaisante pour répondre à un besoin opérationnel actuel ou prévu. Note : Expression recouvrant les suivantes : disponibilité, compatibilité, transportabilité, interopérabilité, fiabilité, taux d'utilisation, maintenabilité, sécurité, facteurs humains, soutenabilité sur les plans des effectifs et de la logistique, effets et incidences sur l'environnement naturel, besoins sur les plans de la documentation et de l'instruction.
operationally capable	**fonctionnel au plan opérationnel**
In airworthiness, the minimum combat readiness state of a weapon system. Note: A weapon system is operationally capable when it is deemed technically airworthy, operationally effective, operationally suitable, and operationally airworthy.	En ce qui concerne la navigabilité, état minimal de préparation au combat d'un système d'arme. Note : Un système d'arme est fonctionnel au plan opérationnel lorsqu'il est en état de navigabilité au point de vue technique et lorsqu'on le juge efficace, approprié et en état de navigabilité sur le plan opérationnel.
personnel recovery (PR)	**récupération de personnel (RP)**
The sum of military, diplomatic and civil efforts to effect the recovery and reintegration of isolated personnel. Note: The elements of personnel recovery include command and control, recovery forces, preparation, reintegration teams, isolated personnel and their next of kin.	Ensemble des activités militaires, diplomatiques et civiles visant à récupérer des personnes isolées et à les réintégrer dans le groupe principal. Note : La récupération de personnel comprend : commandement et le contrôle, les forces de récupérations, les préparations, les équipes de réintégration, les personnes isolées et leurs plus proches parents.
Shape	**Acquisition de l'avantage**
The function that optimizes agile manoeuvre and integrated information operations in the delivery of kinetic and non-kinetic aerospace power to achieve desired effects.	Fonction consistant à optimiser une manoeuvre habile et une opération d'information intégrée dans l'emploi d'une puissance aérospatiale cinétique ou non, afin d'obtenir les effets souhaités.
special air operation	**opération aérienne spéciale**
An air operation, conducted across the spectrum of conflict, in support of unconventional warfare and clandestine, covert and psychological activities.	Opération aérienne menée dans toute la gamme des conflits possibles, dans le contexte d'une guerre non classique ou d'activités clandestines, secrètes ou psychologiques.

survival, evasion, resistance, and escape (SERE)	survie, évasion, résistance et fuite (SERF)
The set of tactics, techniques, and procedures that will give isolated personnel the tools to survive in any environment and to evade capture where such a threat exists. Failing that, to resist exploitation by captors and, if the situation permits, escape captivity to finally support their own or assisted recovery and return with dignity.	Ensemble de tactiques, de techniques et de procédures procurant au personnel isolé les moyens de survivre dans n'importe quel environnement et d'éviter la capture lorsqu'une telle menace existe, sinon, de résister à l'exploitation par ses ravisseurs et, si la situation le permet, de s'évader et de réaliser son propre récuperation, seul ou avec une aide extérieure, et de revenir dans la dignité.

Note: The reader is encouraged to check the CFAWC terminology management (external) website at any time to review the status of candidate Air Force terms: http://trenton.mil.ca/lodger/CFAWC/Terminology_e.asp?Type=BRIEF.

Major Bound, CD, BSc (Hons), is a navigator with 5,200 hours on the CC130 Hercules. In addition to two line tours on operational SAR squadrons, he has also had multiple tours at the Air Mobility operational training unit as a flight instructor and aerospace systems evaluator. Major Bound is currently working in the Doctrine Development Branch at the Canadian Forces Aerospace Warfare Centre. His primary duties include the development of Air Force Move doctrine and the chairmanship of the Air Force Terminology Panel.

List of Abbreviations

AFTP	Air Force Terminology Panel
CF	Canadian Forces
CFAWC	Canadian Forces Aerospace Warfare Centre
DTB	Defence Terminology Bank

Notes

1. Canada, Department of National Defence (DND), *Air Force Strategy*, 2007, http://airforce.mil.ca/dairsp/docs/afs_eng.pdf (accessed December 10, 2010).

2. Canada, DND, 3000-1 (A7), *Air Force Capability Structure*, 04 June 2002, http://winnipeg.mil.ca/a5/BP/Archive/2003/L2%20AFCapS%20SCapFA%202003%202002%2006%2004.pdf (accessed December 10, 2010).

3. DND, "Mission Management Codes," 1 Canadian Air Division Orders, Vol. 1, 1-617, 21 September 2004, http://winnipeg.mil.ca/HQSec/1cadordr/cadvol1/1-617.doc (accessed December 10, 2010).

AVIATION HALL OF FAME INDUCTEES SPAN 95 YEARS OF FLIGHT

By John Chalmers

Photo composite by CFAWC

The four inductees to Canada's Aviation Hall of Fame (CAHF) in 2010 cover a remarkable span of time and accomplishments in Canadian aviation. They flew in two world wars, in military and medical-evacuation (MEDEVAC) capacities, in private and commercial flying, in ferry transport and bush flying, in bombers and bush planes, and from early biplanes to rocket-powered space shuttles.

The four new members bring individual membership in CAHF to 200. Formal ceremonies were held at the River Rock Casino Resort in Richmond, British Columbia. Some 280 guests were present as Redford Henry "Red" Mulock, Vi Milstead Warren, Willy Laserich, and Julie Payette were admitted to the ranks of Canadians who are honoured for their accomplishments. It was the 37th annual induction since CAHF began operations in 1973. This year's ceremony had a spectacular beginning with inductees or their representatives being piped in by the Vancouver Police Pipe Band. Air cadets from 655 Richmond and 609 Stevenson Squadrons participated in the pageantry and escorted inductees to the podium.

Master of Ceremonies for the evening was Dr. Jack McGee, CD, president of the Justice Institute of British Columbia. He previously served over 30 years as a Navy and Air Force pilot with the Canadian Forces, as base commander of Canadian Forces Base (CFB) Comox, and retired from the service as a colonel. In his opening remarks, Dr. McGee pointed out that, "Canada's aviation history comprises the stories of courage, imagination, innovation, perseverance, service, and passionate, irrepressible belief in a dream." Guest speaker for the evening was Lieutenant-General André Deschamps, CD, Chief of the Air Staff, and also a pilot with over 30 years of service.

Each individual is now commemorated at Hall of Fame displays located at the Reynolds-Alberta Museum in Wetaskiwin, Alberta. Featured in each display is a portrait created by Toronto artist Irma Coucill, who has now prepared an even 200 such illustrations for CAHF. Following are brief biographies of the four individuals.

CAHF Members

Julie Payette, centre, is flanked by other members of Canada's Aviation Hall of Fame, previously inducted in years indicated. Left to right are Robert Dick Richmond (1995), Robert 'Bud' White (1974), Ronald Peel (1991), Harold Rex Terpening (1997), Julie Payette (2010), Donald Watson (1974), Wilson Leach (1974), Rosella Bjornson (1997), Barry Marsden (2009), Walter Chmela (2006). Photo: Jim Jorgenson

REDFORD HENRY "RED" MULOCK (1886–1961)

Born in Winnipeg, Red Mulock graduated in engineering from McGill University in Montreal, joined the Army in August 1914, and was shipped overseas. In January 1915, he transferred to the Royal Naval Air Service (RNAS), received his pilot's certificate, and was commissioned as a flight sub-lieutenant. By May, he was flying in combat, carrying out fighter patrols, photo reconnaissance, directing naval gunfire, and using parachute flares to spot artillery fire at night. On September 6, 1915, Mulock was the first Canadian pilot to attack a submarine. He became the first Canadian ace and the first RNAS pilot to score five victories or more.

In 1916, Mulock was awarded the Distinguished Service Order (DSO), and with the formation of No. 3 Naval Squadron, he was appointed as commanding officer. Still flying in battle, he was awarded a bar to his DSO. His responsibilities and rank continued to rise, and with the joining of the RNAS and the Royal Flying Corps (RFC) to form the Royal Air Force (RAF), he became a group captain in charge of a bomber group. Following the war he was honoured as a Companion of the British Empire. Red Mulock then joined Canadian Airways Limited and rose to the rank of air commodore in the Royal Canadian Air Force (RCAF) Reserve.

VI MILSTEAD WARREN (1919–)

Vi Milstead Warren started flying lessons as a teenager, soon earned her private and commercial pilot licenses, and by 1941 she was one of Canada's first female flying instructors. Civilian flying was suspended during the Second World War, and in 1942, Warren was hired to fly in England with the Air Transport Auxiliary (ATA) and achieved the rank of first officer. She ferried military aircraft for the RAF between factories and assembly plants and to active service squadrons. From April 1943 to July 1945, Warren flew 47 different types of aircraft as a pilot serving the ATA.

Returning home to Ontario, Warren worked as a flying instructor when she met fellow pilot Arnold Warren, destined to become her husband, and then found work as Canada's first female bush pilot. Work in that capacity included flying prospectors, miners, lumberjacks, hunters and fishermen to remote locations in the North. In 1950, she and Arnold reactivated the Windsor Flying Club. After a 12-year stretch of wartime and commercial flying, Warren continued flying for pleasure while working with the Ontario Water Commission until her retirement in 1973. Honoured as a pilot and role model for women in aviation, Warren was inducted as a Member of the Order of Canada in 2004.

WILLY LASERICH (1932–2007)

Willy Laserich immigrated to Canada from Germany in 1952, obtained his private pilot's license through the Edmonton Flying Club, and continued flying with a perfect safety record for the next 50 years. Starting in 1957, he flew in the Northwest Territories as a commercial and airline pilot for various companies. From 1983 until his death, he flew as chief pilot for his company, Adlair Aviation. Flying throughout the central Arctic, he eventually quit recording time in his logbook at 44,000 hours! Laserich flew more than 3,000 MEDEVAC flights, more than 100 search and rescue operations, and saw six babies born aboard his aircraft.

Although he would take calculated risks, he never sacrificed safety for daring, and campaigned for better air service and facilities for the well-being of northern people. In 1997, Laserich was presented with Honourary Life Membership in the Northern Air Transport Association in recognition of his outstanding leadership and contribution to the development of aviation "North of 60." In Cambridge Bay, the Willy Laserich Memorial Corporate Citizen Award is named for him since he was known as a gentleman as well as a pilot.

An inspirational pilot, he recognized contributions by others, emphasizing that the most important people behind the pilots were the engineers who deserved credit for success in flights.

JULIE PAYETTE (1963–)

A multilingual pilot, musician and singer, Montreal-born Julie Payette holds engineering degrees from McGill and the University of Toronto. She epitomizes the many talents and specialized education of Canadians selected to serve as astronauts. With research experience in computer systems, Payette was chosen in 1992 to become one of four astronauts from 5,330 applicants. In preparation for space missions, she qualified as a deep sea diving suit operator, as a commercial pilot and as a military pilot, obtaining her captain rank at Moose Jaw, flying CT114 Tutor jet aircraft. She logged more than 1,200 hours before becoming Chief Astronaut of the Canadian Space Agency from 2000 to 2007.

In 2009, Payette completed her second space flight, and has now logged more than 25 days in space. Aboard the space shuttle *Discovery* in 1999, her duties included supervision of the spacewalk, and operating the Canadarm robotic arm for the crew that performed the first manual docking of the International Space Station. In August 2009, she returned to the Space Station as the only woman in the crew, operating robotic arms, serving again as mission specialist and as flight engineer aboard the space shuttle *Endeavor*. The recipient of many honorary degrees, Julie continues work in Houston at Mission Control Center.

John Chalmers is an Edmonton writer. He is a member of the board of directors for the Alberta Aviation Museum, historian for Canada's Aviation Hall of Fame, and a member of the Canadian Aviation Historical Society. His latest book is *Navigator Brothers*, the story of his father, Jack, and an uncle, Alfred, who served as RCAF navigators in the Second World War.

List of Abbreviations

ATA	Air Transport Auxiliary	MEDEVAC	medical evacuation
CAHF	Canada's Aviation Hall of Fame	RAF	Royal Air Force
DSO	Distinguished Service Order	RCAF	Royal Canadian Air Force

Photo : Jim Jorgenson