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THE ROYAL CANADIAN AIR FORCE JOURNAL is an official publication of the Commander Royal Canadian Air Force (RCAF) 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 RCAF 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 RCAF. It serves as a vehicle for the continuing education and professional development of all ranks and personnel in the RCAF as well as members from other environments, employees of government agencies, and academia concerned with air force affairs.

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THE ROYAL CANADIAN AIR FORCE JOURNAL

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THE ROYAL 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.

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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.

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ARTICLES

BOOK REVIEWS

PUSHING THE ENVELOPE

EDITOR'S MESSAGE

This issue of the *Journal* covers a wide variety of topics, but at their core, they have a common theme—adapting to changing circumstances. The reprint of a 1950 article written by United States Air Force General Hoyt S. Vandenberg provides some insight into how one air force was dealing with the advent of atomic weapons and how to meet its responsibilities. And if you are wondering what you can learn from a 63-year-old perspective on the world, try toning down the bomber-centric rhetoric and see if the overall vision applies to the global war on terrorism.

Gerry Madigan offers another historical perspective on adapting to change, as he explains how the financial aspects of World War II impact a small Canadian town, in this case Debert, Nova Scotia. He offers some insight into the "boom" days of large military contracts and spending. As the Department of National Defence and the Canadian Forces (CF) adjust to shrinking budgets, the communities and businesses that have been the cornerstone of our support during operations over the past decade experience the same.

Lieutenant-Colonel Jason Kenny and Dr. Thierry Gongora speak to the complexities of intelligence, surveillance and reconnaissance (ISR) and how this activity has impacted on the way we conduct operations. Kenny points out that the nature of counter-insurgency warfare has placed a premium on ISR and has caused an exponential growth in the demand for information. However, he argues that the type of information required must incorporate a broader approach, where understanding the human dimension of the conflict may lead to a non-kinetic solution. Echoing the need for the "human" touch in ISR, Gongora speaks to the need to access manned versus unmanned ISR assets because there are times when having a human on board permits a more dynamic approach to operations. These are issues that the Royal Canadian Air Force (RCAF), and the CF, are wrestling with right now.

Lieutenant (Navy) Tracy Coulthard explores the need for the RCAF to adapt its orders and regulations that deal with fatigue. As the flying community as a whole continues to conduct research into the

physiological and psychological demands on the human body, there needs to be a corresponding examination of how our own processes and procedures should be amended to reflect this new data.

Finally, Doctors Yannakogeorgos and Lowther provide a thought-provoking discussion on the North Atlantic Treaty Organization (NATO) and the importance of air power to its future. As both the alliance and its air forces continue to evolve during the 21st century, there is no doubt that they will have to continue to adapt to both internal changes and external demands.

So, at least from my perspective, this issue is all about adapting to changing circumstances. This makes it most apropos for me, in that I am transitioning from my Regular Force career of 35 plus years to a new opportunity as a Class A Reservist. To paraphrase some very bad gangster movies, "They made me an offer I couldn't refuse." However, as I adapt to what I have discovered to be a whole new realm of processes, procedures and bureaucracy, I will remain as editor of the *RCAF Journal* … at least for the time being.

Enjoy the read.

Major William March, CD, MA
Senior Editor

Abbreviations

CF	Canadian Forces
ISR	intelligence, surveillance and reconnaissance
RCAF	Royal Canadian Air Force

LETTERS TO THE EDITOR

Sir,

There is one gentleman, not mentioned in the article "Missed Opportunity: Currie, Turner, and the Abortive Birth of the Canadian Air Force in the Great War," (*Royal Canadian Air Force Journal*, Vol. 1, No. 3), who was pre-eminent in the formation of the Royal Canadian Air Force: Canada's first pilot, Honorary Air Commodore, The Honourable J. A. D. McCurdy.

Ever since J. A. D. McCurdy made the first flight in the British Commonwealth on February 23, 1909, in Baddeck, Nova Scotia, he had visualized the aeroplane as not only a commercial entity but also an instrument of war, particularly as he had discerned the storm clouds of the First World War looming ominously on the horizon. However, as early as August 1909, at the invitation of Ottawa, he and Casey Baldwin transported the Silver Dart to Petawawa, and after several flights—the fifth one ending in a crash—the appropriate military officers solemnly declared that flying seemed to have no future.

With the outbreak of war, McCurdy sought an interview with Sam Hughes, Minister of Militia and Defence during which he did his best to inform Hughes what he thought the aeroplane could do for the defence of the country. The meeting was brief; Hughes snapping it short by telling McCurdy, "The aeroplane is an invention of the devil and will never play any part in such a serious business as the defence of a nation, my boy!" The government was adamant that Canada would have no air corps. Subsequent meetings with Prime Minister R. L. Borden proved equally unproductive.

Realizing that he would be offered no government assistance in his efforts to initiate the foundation for Canadian aviation, McCurdy established Canada's first aeroplane factory in April 1915 which, within a short time, grew into the McCurdy Flying School, from where members of the Royal Flying Corps, the Royal Naval Air Service and some 300 Canadians received their Aero certificate from McCurdy. Among those to graduate were luminaries such as Raymond Collishaw, W. A. Curtis and Robert Leckie, all of whom later became air marshals.

McCurdy's regrets were for his failure to convince an immovable government that the air age had come to Canada, as it had to the rest of the world. However, eventually in 1920, the Canadian government finally established the Canadian Air Force, which became the Royal Canadian Air Force on April 1, 1924. McCurdy's dream that Canada have its own air force—originally proposed by him in 1909—finally became a reality. Few had worked so assiduously to bring this about.

Honorary Colonel Gerald P. J. Haddon
Canadian Forces School of Aerospace Technology and Engineering

EDITOR'S RESPONSE:

Sir,

I agree with your observation on McCurdy's unflagging support for the creation of a Canadian aviation corps (or air force) during the First World War. William Stewart's article focused primarily upon the overseas efforts to form such a body, but we should never lose sight of the individuals back home, McCurdy prominent amongst them, who were advocating the same goals. He well and truly deserves his eminent position as a Canadian aviation pioneer.

Cheers
Bill

Reprint from the Roundel, Vol. 2, No. 4, February 1950

Building a Balanced Air Force

by **General Hoyt S. Vandenberg**
Chief of Staff, United States Air Force

(Reprinted by courtesy of "The Army Information Digest," United States Army.)

Editor's note: The author's American spelling and punctuation conventions have been maintained.

(Based on addresses by General Vandenberg at Dallas and Indianapolis, February and May 1949.)

As a nation, our resources in men and material are great, but they are not limitless. We face a mighty and growing challenge. Unless we act wisely, unless we plan well, we must face the possibility of ultimate defeat. It is no longer adequate merely to say we shall have as many cannon as possible, as many skills as possible, as many ships or as many aeroplanes as possible. It is no longer adequate even to plan for as many soldiers, sailors, and airmen or as many workers as possible. So total are the demands of modern war that each of these categories of products or of people must be subtracted from the others. We must plan for the most effective distribution of all that we can spare for our defense.

Such planning has recently been called "balancing" our forces. Anything, to be "balanced", must be balanced with or against something else. A well-balanced team, for instance, is not one in which all players are of equal size or weight, or are evenly spaced on the playing field. A well-balanced team is one which is organized and trained in such a manner as to be able to counter an opposing team's strength and take full advantage of an opposing team's weaknesses. This is the kind of balance we want in the forces that defend our Nation.

The proper balance of our forces depends upon the circumstances that face us. A military force is not properly balanced against itself. It should be weighted against the enemy. It should be designed and proportioned to evade an enemy's strength and to exploit his weakness. Our Air Force must be planned or balanced to defeat a potential enemy, while protecting, as completely as possible, our Nation and its allies. Only the defeat or decisive damaging of an attacking enemy can guarantee our own safety. This is the mission for which our Air Force must be planned and equipped—the mission it must be prepared to accomplish.

No one of the services can do the job alone. Whether the Air Force strikes back at the heart and the internal strength of an attacking enemy from bases on our own continent—with long-range heavy bombers, with

USAF photo of General Hoyt S. Vandenberg

medium bombers refueled in the air, or with medium bombers operating from forward bases overseas (any or all of which methods we could employ today)—we must depend upon the coordinated effort of all our armed services to achieve the ultimate aim.

There are many balances which we must achieve within the Air Force itself. We must balance our investment against the possibilities of war today and the possibilities of war five or ten years from today. We must not fatally weaken ourselves today in order to be strong tomorrow. On the other hand, we must not mortgage our future by neglecting research and development in order to gain the temporary advantage of a great number of today's weapons. Our long-range weapons, such as the great B-36 now in production, take much longer to develop and produce than our short-range and defensive weapons. This must be taken into account in our planning.

From time to time, various phases of our operations and various types of our aircraft have been the object of unusual emphasis in the public mind, to the seeming exclusion of interest in the overall development of our strength. Within the past year or so, public focus has ranged from interest in jet fighters and bombers through our adventures in the penetration of the sonic barrier and the development of very heavy bombers. Each of these aircraft has a definite place in our broad, long-range planning. No one of them is the criterion of our aerial strength.

The Air Force has been careful to reiterate that there is no defense that is a complete defense today. This is unfortunately true even of air defense by high-performance fighters. In a heavy, determined attack, some planes will probably get through. This is a fact which must be faced. We do not, for example, refer to our radar net as a "fence". For there are no fences against airplanes. Nor are our air defenders trying to build a Maginot Line out of radar beams, airplanes, or anything else.

The best defense, in fact, is an active defense in depth and a powerful strategic offense in depth. This is true for our entire land, sea, and air team—a team in which each member performs that portion of the task for which it is best fitted.

The Air Force, as part of that team, wields the weapon of strategic air power. In the hands of the United States, strategic air power is primarily a deterrent to war. It is a means of quick retaliation against any aggressor. A strategic Air Force is designed to destroy an enemy's means of making and supporting an attack against ourselves.


USAF photo of the B-36

We believe strongly in the effectiveness of long-range strategic bombing and have done so since this effectiveness was established between 1942 and 1945. If conflict were forced upon us, our strategic force would pass from the role of deterrent to that of heavy retaliation. Our insurance against defeat and our hope of future victory would depend, in large measure, upon the effectiveness of this attack. This is the reason for the recent improvements in our strategic weapons. These weapons are not only the B-36, but also the B-50, the B-29, and other types and modifications now being developed. Of the fourteen Air Force groups equipped primarily for strategic bombardment, only four are being equipped with the B-36. For while the B-36 is a capable performer, the Air Force has never held that any one type of plane, any more than one type of combat operation, is the solution of our security problems.

Strategic attack against an enemy's vulnerable interior is only one phase of the Air Force job. The Air Force also is responsible for the air defense of the United States and for air support of land and sea operations. Thirty-four of our forty-eight groups are equipped primarily for these tasks. These groups include troop carrier, transport, reconnaissance, light bombardment, and similar types of employment.

The development of aircraft for tactical and transport operations is not being relegated to some obscure limbo, discarded and forgotten. More than the two-thirds of the Regular Air Force groups are trained and equipped primarily for air defense and for the support of land and sea operations. In addition, the Air National Guard consists entirely of fighter and light bomber groups. This adds up to more than four-fifths of the Air Force designed for purposes other than strategic bombardment.

As for our transport operations—their flexibility and their effectiveness—the Berlin Airlift, the greatest effort of its kind in history, has become a [sic] commonplace. Operation Vittles has become an unobtrusive triumph of skill and organization. And, in our own country, we witnessed the stirring performance of Operation Haylift.

Air power, alone and unassisted, is scarcely capable of winning a complete victory. Any future war, I am convinced, will be fought and won by land, sea, and air. Such being the case, it is not likely that I would be a party to any Air Force programme which would neglect the area of tactical support. When the day comes that the men of our ground forces need the utmost in tactical air backing, it will be immediately and overpoweringly forthcoming.

Maintaining a balanced Air Force involves more than a carefully adjusted relationship between planes for offense and defense, between planes for tactical support and strategic counteroffensive. We also must plan for the effective utilization of our reserve strength in machines and men.

For air power today includes everything that flies. It includes everything that

an air force uses in support of its operations. It includes every factory and every man that produces anything necessary for that support. In a sense, it even includes the raw material for the bases, the transportation, the fuel, and all the gadgets that are required to keep airplanes in the air. To maintain this backing of reserve strength, we must spend some of our limited funds to maintain planes in readiness, to provide stockpiles of materials, and to keep plants in stand-by status.

Also, we must maintain a carefully calculated proportion between our regular and reserve strength in manpower and skills. Despite the increasingly sudden nature of modern war, we cannot attempt to keep on active duty all the trained airmen who would be needed immediately if war should begin. The reserve forces available to us, therefore, must be brought to peak efficiency, in readiness for mobilization assignments.

The basic plan for a strong and adequate Air Force with proper recognition of reserve elements, was endorsed by the President's Air Policy Commission and the Congressional Aviation Policy Board, in their reports published in 1948. Under Lieutenant General Elwood R. Quesada, my Special Assistant for Reserve Forces, intensive studies have been made, and plans have been developed for the efficient use of Regular facilities in training our Air Reserve.

As part of its mission, the Regular Air Force must be ready at all times to deliver an immediate and powerful strategic counter-offensive against the sources of any enemy's potential war-making capacity. The reserve forces, for their part, must be prepared to play an important role in the defense of our own territory. They likewise must be prepared to furnish personnel to augment the Regular establishment in an emergency.

The Nation's security is a common responsibility. The Army, the Navy, the Air Force are equally involved. All veterans of past service and all citizens of the United States have an equal stake in our safety. This safety probably cannot be completely guaranteed for a long time to come. It will not be easily achieved. Some sacrifice by all of us may be necessary, even through years of peace.

Any realistic plan for our own security which can be drawn up today requires the complete participation of all members of our national security team.

USAF photo of B-29 and XB-36

THE CRUCIBLE FOR CHANGE

DEFENCE SPENDING IN DEBERT, NOVA SCOTIA, DURING WORLD WAR II

BY MAJOR GERRY D. MADIGAN, CD, MA (RETIRED)

IT WAS THE BEST OF TIMES,
IT WAS THE WORST OF TIMES,
IT WAS THE AGE OF WISDOM,
IT WAS THE AGE OF FOOLISHNESS,
IT WAS THE EPOCH OF BELIEF,
IT WAS THE EPOCH OF INCREDULITY,
IT WAS THE SEASON OF LIGHT,
IT WAS THE SEASON OF DARKNESS,
IT WAS THE SPRING OF HOPE,
IT WAS THE WINTER OF DESPAIR,
WE HAD EVERYTHING BEFORE US,
WE HAD NOTHING BEFORE US,
WE WERE ALL GOING DIRECT TO HEAVEN,
WE WERE ALL GOING DIRECT THE OTHER WAY ... .[1]

Charles Dickens

INTRODUCTION: THE WORST OF TIMES

People easily quote Charles Dickens "It was the best of times, it was the worst of times … ."[2] But Dickens' opening paragraph to the epic *A Tale of Two Cities* illuminates much more; it also illustrates the breadth and depth of human emotion, pain, suffering, trials and triumph inherent in history. History is neither black nor white. It is changeable and dynamic, and it is dramatic.[3] The course of human conflict is much the way that Dickens describes.

History, though, is often seen as peeks through the rear-view mirror. Its points are viewed along a line in a continuum. But in so doing, we often miss the bigger picture. World War II is such an example. It shaped the Canadian experience. But we often tend to concentrate on the "specific" period of the war without looking back upon it. There is a context of what came before and what followed that is often overlooked. The before and after provide some insight on who and what we are today.

World War II changed the way Canada looked at itself as well as its values. The war shaped Canada's future. The story of "opening the floodgates" on public spending during World War II is the story of policy and social change within Canada. The Great Depression was but a very recent memory. Canada's war investments were used to pave not only the road to victory but also the way ahead for its post-war future. Fiscal policy would become an instrument of economic and social policy and, more importantly, change.

Some consider the "Dirty 30s" or the Great Depression as the most traumatic and darkest period in Canadian history. It was a low point that deeply shaped the Canadian psyche to the core. There was a loss of hope. The mood was one of desperation

and despair. Its effects were felt very deeply by many Canadian families. Many were impoverished, and without a job, they lacked the basic necessities of life, food and shelter. The statistics of the day paint a horrible picture. At the height of the Depression, more than half the wage earners in Canada were on some form of relief. One in five Canadians was on the dole.

Interestingly, the poverty line was marked at $1,000 per year for a family of four. What points to the desperation and plight of many Canadian families, though, was the fact that for many the average annual income was less than $500.

What did the government do? It had decided that balancing the budget was more important than feeding its needy and hungry. It took a laissez-faire approach to the management of the economy and suffering. Little succour was provided in the way of government relief. People and families were left to their own devices. These were truly desperate days, the blackest period in Canadian history, with a "government" unmotivated to act to spare the suffering.[4] That desperation was the crucible for change.

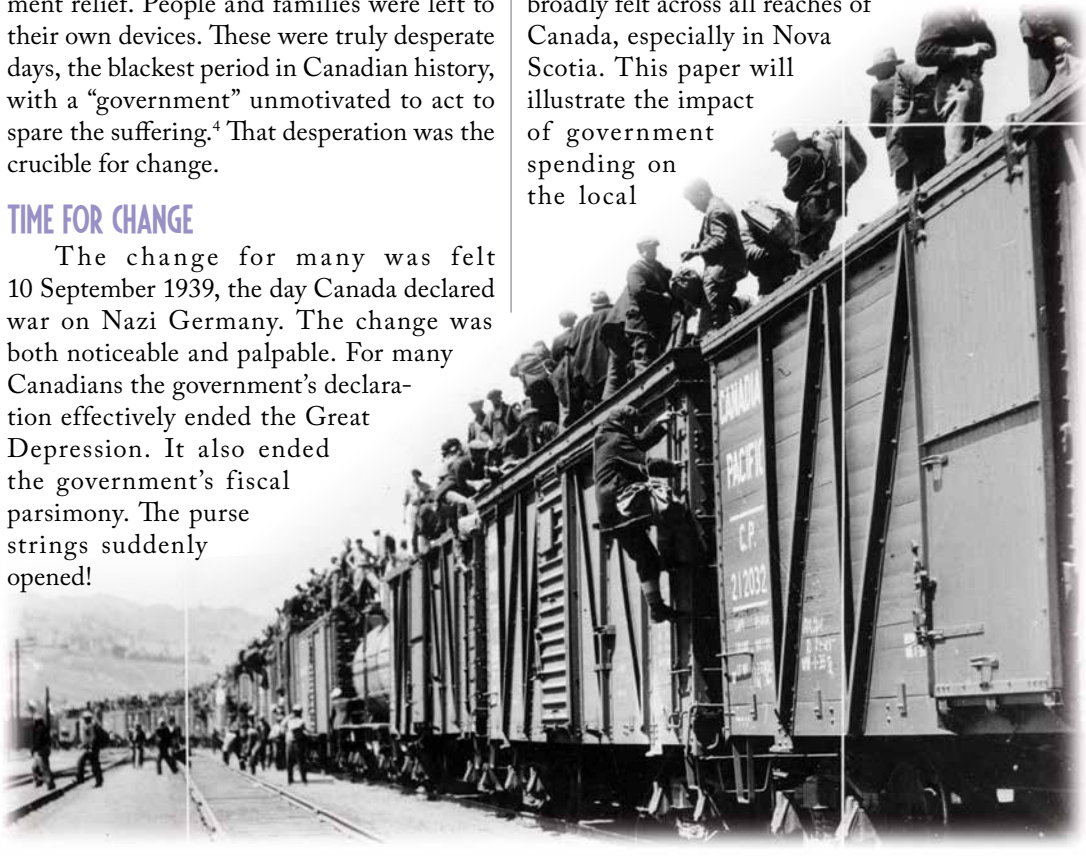
TIME FOR CHANGE

The change for many was felt 10 September 1939, the day Canada declared war on Nazi Germany. The change was both noticeable and palpable. For many Canadians the government's declaration effectively ended the Great Depression. It also ended the government's fiscal parsimony. The purse strings suddenly opened!

Although war would bring great privations, trials and tragedy, it would also bring prosperity and jobs. There would be a vast industrial expansion. The addition of defence spending boosted the demand for labour for war production and full employment. In some ways, the war restored hope and prosperity to a nation by stimulating the moribund Canadian economy. It not only jumped-started the Canadian economy but also was the catalyst for a new view on fiscal management and social development for the post-war period.

A country that had been unable to find work or succour for a fifth of its people in the Dirty 30s and Great Depression would suddenly, and miraculously, be able to find work for all, including women, young boys and old men.[5] It was an economic miracle that did not go unnoticed.[6]

Government spending became widely and broadly felt across all reaches of Canada, especially in Nova Scotia. This paper will illustrate the impact of government spending on the local




Prime Minister Mackenzie King

economy, expectations and lives, with particular emphasis on Debert, Nova Scotia. World War II was not just fought overseas; it was also fought on the home front.

THE BRITISH COMMONWEALTH AIR TRAINING PLAN

At the onset of the war, Prime Minister Mackenzie King had some expectations for managing Canada's war effort. He wished to limit the employment of Canadian armed forces.[7] King and many Canadians did not relish the thought of war or "active" service. The open sores of World War I were still all too recent. Thus, King and the public desired a very limited Canadian role at the beginning. So the British Commonwealth Air Training Plan (BCATP) was designed as the sop to that end. Canada's major contribution was designed to be the "aerodrome of democracy" for the training of Allied aircrews on Canadian soil.[8] To King's dismay, matters did not unfold as intended.

King signed the BCATP on 17 December 1939, which was coincidentally his birthday, three and a half months after the declaration of Canadian hostilities.[9] But King's desire for limited participation would be for naught. All of Canada's armed forces, industry and public opinion would be eventually engaged and employed toward winning the war.

ON THE FAST TRACK TO BUILDING AN AIRFIELD AND AN ARMY CAMP

The BCATP was just the tip of the iceberg. It was an ambitious undertaking. Yet, defence spending was increased, thus creating a complex web of military and defence establishments, manufacturing, construction and labour, all in support of Canada's military. Thus the Royal Canadian Air Force (RCAF), Army and Royal Canadian Navy would come to have a huge bearing on defence and local spending. The government would try to find economies of scale. Debert is an example. It was chosen as a site that was strategically located near Halifax, where both the Air Force and Army would be collocated.

As ambitious as King's BCATP was, the facilities simply did not exist in 1939. They had to be created and built largely from the ground up. Mackenzie King's declaration of 17 December, in effect, not only increased the defence establishment and contribution to the war effort but also set Canada's economy firmly on a war footing. The government of the day not only mobilized defence establishments; it also mobilized the country's economic and labour flows to achieve those ends under extremely tight deadlines.

Defence construction at Debert commenced August 1940. There was virtually nothing there but woods and farmlands. The Army and Air Force facilities were literally carved out of the woods. Engineers hired local woodsmen to clear the forests, and then, these were followed by the builders who turned 28 million board feet (66,073 cubic metres) of lumber, poured concrete and paved roads and runways that transformed the forests into the training facilities, accommodations and other infrastructure, which were crucial to the war effort.[10]

The construction effort required the rapid mobilization of Canadian industrial capacity and labour to meet a looming start date of 29 April 1940 for the BCATP alone.[11] Nine hundred and eighty nine million dollars was set aside to achieve the aim of the plan that was designed to train 29,000 aircrew annually. The BCATP "sausage machine" was geared to produce 850 pilots, 510 air observers / navigators and 870 wireless operators / air gunners monthly.[12] Debert was to play an important role in execution of that plan.

The BCATP aerodrome building program, alone, was most ambitious. It required detailed organization, thought and planning. But its ends were ultimately achieved through basic standardization. All the training establishments would be built on the same pattern, thus achieving efficiencies that helped save time and effort.[13]

Contractors were able to rapidly build the facilities because of the forethought of standardization. The aerodromes were often built with all buildings (including hangars, barracks and workshops) and hard-surfaced runways completed within the incredibly short period of eight weeks from the shovel in the ground to planes on the tarmac.[14] The economic impacts were felt very quickly and locally. Many rural communities were transformed from sleepy hollows to bustling centres.

DEBERT AND THE IMPACTS OF THE AIR FORCE: ARMY PRESENCE

Donald Davidson, a long-time resident, recalls Debert in the 1930s as a small rural town located in central Nova Scotia. This small town's population numbered no more than 500–600 people at any one time. The local residents survived on mixed farming and lumbering, with a permanent lumber mill and factory located near the local train station. The town, by the standards of the day, was large. It supported three stores, a post office, a barber shop, a two-room school, a community hall and a blacksmith shop at the outset of the war.[15] All that changed with the local defence construction.

Some 5,400 men were soon employed in the construction of an Army camp and airfield nearby. They had to be provisioned, housed and fed along with elements of the Army which also occupied the same site while under construction. It was to the credit of this workforce that the necessary accommodations, sewage, hospital facilities, special storage areas for gasoline and 30 miles (48 kilometres) of paved roadway were constructed in quick time.[16]

In the meantime, the village of Debert changed too. It grew immensely. The town now supported 10 restaurants, two drug stores with lunch counters, two meat markets, an additional grocery store, a hotel with telephones and running water, two barber shops, a telephone office, a bank, three taxi services, a laundry service, a bus line service to Truro (20 kilometres southeast) and a charter service to meet a growing demand.[17]

This gives one a sense of the pace of construction and prosperity, but in no way does it adequately describe the magnitude or scope of the Air Force and Army projects. The Army project was massive and was the first to be "completed." Approximately 13,150 personnel were accommodated by Christmas 1940. In a nutshell, some 512 buildings (including a fully equipped 500-bed hospital; two fire halls; four dental clinics; a supply depot; a 100-cell detention barracks; quarters for other ranks, non-commissioned officers, medical staff, nurses and officers; and various messes) were all completed in that time, along with adequate water, sewage, septic and electrical systems. By the end of 1940, only 24 buildings remained under construction for the Army.[18]

The work on the airfield and facilities was deferred; it was completed in 1941. It continued in a small way over the course of the winter of 1940–41 with the further clearing

of woodlands and fields in preparation for the next construction season. The Debert aerodrome required its own buildings, hangars, barracks, workshops and associated hard-surfaced runways. Those projects commenced with better weather. The work progressed well, and the aerodrome was ready to receive its first unit over the summer of 1941.[19]

DIFFICULTIES

There were bound to be difficulties and introspection, given the hurried state of the construction. Many were concerned with the lack of oversight as well as checks and balances. It did not help matters that, despite the apparent completion of many projects, much was left undone. The progress of the construction became subject to intense parliamentary scrutiny. None other than John George Diefenbaker, future Prime Minister of Canada, came to Debert to investigate.

The aerodrome was designated to and occupied by the Royal Air Force's (RAF's) Operational Training Unit 31 (O.T.U. 31), one of four units transferred from Great Britain. The unit and its equipment were moved across the North Atlantic in three echelons starting in May 1941.[20] Training at Debert, though, was necessarily delayed until August 1941, once again because of the unfinished state of the airfield.[21] It became a lightning rod for public scrutiny and attention.

Diefenbaker said of Debert, "if ever there was a camp chosen anywhere in Canada which is little short of disgraceful from the point of view of the men required to live in that Camp, it is Debert." In the spring of 1942, Diefenbaker stated that the camp was "inundated." He found difficulty with its selection, given all the available sites in Nova Scotia. Diefenbaker found it incredulous that this site was chosen, given that $239,000 had to be spent immediately on drainage.[22]

Diefenbaker's concern was not unwarranted. His observations were supported by the opinions of many trainees at the time. The facilities were indeed still under construction and the living conditions were Spartan.[23] Still Colonel Ralston, then Minister of National Defence, tried to dust off Diefenbaker's remarks as simply exaggerated.[24] Ralston could defend the costs, but he was hard pressed to defend the state of affairs at Debert.

In all fairness to Ralston, the facilities were started from scratch. Ralston defended Debert as a choice because of its accessibility to railroads, its central location and its proximity to the RAF airfield.[25]

Yet Diefenbaker's criticisms put the government of the day on the defensive. This scrutiny ultimately led to a public accounting of the results to 1943. Costs were at the forefront, and the public's need to know had to be satisfied.

ECONOMIC SPIN OFFS

It is worthwhile to investigate the known costs, given the level of public scrutiny. For good or ill, money was being spent and many prospered. O.T.U. 31 and Camp Debert came into being. An additional 1,082 permanent and training staff were accommodated on this aerodrome; this was incremental to the Army's staff of 13,500 men already situated at nearby Camp Debert.[26]

The addition of approximately 15,000 military personnel in a small town of 600 produced many economic opportunities and financial windfalls. Soldiers and airmen get paid and do like to spend money. But there was more to it than that; there was local government spending on capital as well as operations and maintenance costs that also had collateral impacts.

There is a paucity of data on the individual costs for the BCATP and Army construction. However, F. J. Hatch provides insight for the Air Force costs in *Aerodrome of Democracy*, outlining details of the BCATP's

total costs. From there, we can extrapolate some local impacts.

METHODOLOGY

The problem of estimating the individual airfield costs becomes a simple one. The essence of the plan was standardization, and as one airfield was designed to be more or less the same as another, it is logical, then, that they shared similar costs.

Still, we must recognize that each airfield did have unique circumstances. We can only arrive at a rough estimate of the individual costs, but surely, this is an indicator of the magnitude of the local economic boom.

To arrive at those rough costs, the first step is to segregate Hatch's data between flying schools and ground support establishments. There were 67 airfields built during the BCATP programme. But the BCATP was more than airfields; training was required for both flying and ground establishments. The BCATP consisted of 56 flying[27] and 13 ground support[28] establishments that directly supported flying training. From this first step, we can easily identify the standard airfield from the non-standard elements and estimate their costs. Then we apply the percentage of the standard airfield pool against the gross total to determine its portion of the total costs.

RESULTS FOR DEBERT AIRFIELD

Debert was one of 56 air training establishments. Thus, we can identify the percentage of Debert as part of the standard air training total (1.79 per cent) and apply that result against the share of the total costs to derive its component costs of the BCATP (see Table 1). It is a rough estimate, but it does provide an indication of what was spent locally. Thus, it is an indirect measure of the impact to the local economy.

Debert's representative share of the BCATP costs was approximately $39.8 million. It was a huge investment for its time. It may sound like a bargain today, but in terms of 2012 dollars, the expenditure amounts to $547 million (Table 1).

We can estimate the component and period costs associated with Debert. It must be noted that not all costs are associated with local spending. Capital costs and contributions are such examples. Furthermore, spending was not homogeneous. There were two critical periods of investment in Debert for the Air Force.

First, Canada invested $31.3 million from 1940 to 1943 for O.T.U. 31 alone (see Table 2). Notably, this is the period that had the highest intensity of investment in capital. Secondly, the remaining $8.5 million was spent between 1944 and 1945, when the airfield reverted back to RCAF control that had a lesser capital component but a greater operations and maintenance component.

The potential local spending figure can be estimated by deducting the pertinent capital contribution and lend-lease cost categories from the grand total. Great Britain contributed all of the flying equipment that

Category	# of Establishments	% of	Cost (1941$)
All BCATP units	69	100.0	2,231,129,039.26[29]
Flying establishments	56	81.2 (BCATP units)	1,810,771,394.18
Ground support establishments	13	18.8 (BCATP units)	420,357,645.08
Debert	1 of 56	1.79 (flying establishments)	39,841,589.99
Debert in 2012 $ (per cent change 1,273.03)[30]			**547,038,460.31**

Table 1. Derivative costs of Debert airfield, 1939–45

Major Elements	Special Elements	1941 $
All flying costs		6,757,400[31]
O.T.U. 31 capital costs – aircraft		5,925,960[32]
Replacement value aircraft		2,021,560[33]
BCATP Debert share of costs (estimate)	Equipment contribution	2,897,514[34]
	Materiel contribution	500,009[34]
	Lend lease	5,062,506[34]
	Army contributed capital investment	1,400,000[35]
Maintenance services and associated personnel costs	Maintenance	438,000[36]
	Personnel	704,155[36]
	Estimated O&M costs	3,714,494[37]
Other personnel costs (military salaries)		1,959,962[38]
Canadian $ investment total		**31,381,560**

Table 2. Invested and capital costs estimates to 1943 for O.T.U. 31

was used. Capital costs of aircraft likely had a minimal local impact, if any. Still, the aircraft had to be fuelled, that fuel transported, the airfield provisioned, heated, and so on.

But what likely matters to local spending were the direct costs associated with military/civilian salaries as well as operations and maintenance (O&M). Approximately $8.4 million in these costs was spent between 1940 and 1945 (Table 3).

Recognizing that there were likely peaks and valleys to the spending pattern, the data suggests that the government's annual local spending on the Debert airfield was approximately $1.7 million.

O.T.U. 31 spent $6.8 million locally over its three-year lifespan in the Debert area. This spending pattern continued with RCAF No.7 Squadron that subsequently replaced O.T.U. 31. Both entities spent an average of $1.7 million per year in personnel, operations and maintenance locally. The Army's presence also presented a sizeable opportunity that bears investigating.[39]

RESULTS FOR THE ARMY

The gross Army spending was easier to identify. The Army was made to account for all its wartime investments to 1943 because of Diefenbaker's scrutiny and censure. Diefenbaker's introspection prompted the government to report the spending in order

Period	Category	Amount ($)
O.T.U. 31 1940–43 (from Table 2)	Maintenance	438,000.00
	Civilian salaries	704,154.93
	Estimated O&M costs	3,714,494.07
	Military salaries	1,959,962.00
	Total O.T.U 31	**6,816,611.00**
RCAF No. 7 Squadron 1944–45	Estimated O&M costs	1,643,418.99[40]
	Total (1940–45)	**8,460,029.99**[40]
	Average spent annually	**1,692,006.00**

Table 3. Estimate of annual O&M spending, Debert airfield, 1940–45

Category	$	% Total
Total War Related Expenditures (All Canada 1939–43)	**1,861,578,353.37**	
Army spending by military district	1,468,149,469.37	78.87
Navy ship building by province	138,377,000	7.43
Navy building construction	36,668,000	1.97
Transport Canada departmental expenses	10,052,197	0.54
Transport Canada in support of air operations	81,446,825	4.38
Transport Canada in support of navy operations	653,636	0.04
Canadian National Railroad capital expenditures 1939–42	116,212,431	6.24
Works Department to 31 March 1942	10,018,795	0.54

Table 4. Summation of Army and other government spending, 1939–43[41]

to deflect some of these criticisms. Colonel Ralston, Minister of National Defence, reported that $1.8 billion was spent in defence of Canada's war effort to 1943. The specific details are found in Table 4.

Ralston was responsible for overseeing $1.8 billion spending on capital investments. This oversight crossed many departmental boundaries including the Air Force. The Army represented the lion's share of spending amounting to $1.4 billion (79 per cent) of the total of $1.8 billion then allocated to 1943.

This gross spending was broken down further by province and military district. The government of the day allocated $70.9 million to No. 6 Military District, Nova Scotia. This represented 3.8 per cent of the government's total spending to 1943 (Table 5).

Regrettably, these figures could not be broken down into their component costs as was done with the Air Force at Debert. The government only reported the various departmental capital investment costs for the public's consumption. However, given the importance of Halifax (representing all HQ and armouries in Nova Scotia) and the fact that there were two major training units in Nova Scotia (at Debert and Aldershot),

Category	Total	Ottawa
Total war-related expenditures (all Canada 1939–43)	1,861,578,353.37	
Army spending by military district	1,468,149,469.37	1,051,506,087.00
Navy shipbuilding by province	138,377,000.00	0.00
Navy building construction	36,668,000.00	0.00
Transport Canada departmental expenses	10,052,197.00	0.00
Transport Canada in support of air operations	81,446,825.00	1,193,267.00
Transport Canada in support of Navy operations	653,636.00	0.00
Canadian National Railroad capital expenditures 1939–42	116,212,431.00	0.00
Works Department to 31 March 1942	10,018,795.00	6,831,988.00
Provincial subtotals (1939–43)		**1,059,531,342.00**
Provincial % share spending (all)		**56.9**
Provincial subtotals (1939–43, less Ottawa and overseas)	802,047,011.37	
Provincial % share spent in Canada (less Ottawa and overseas)	43.1	

Table 5. Summation of defence-related expenditure by province, 1939–43[42]

we can roughly estimate what the Army invested. At least one-third of the government's reported investment on Military District No. 6 ($70.9 million) must have been directed to the Army Camp Debert from 1939–43. That low estimate is approximately $23.6 million, but it was likely more.[43]

The amount that the Army spent from 1944 to 1945 in Nova Scotia was unknown. But based on the Air Force's spending pattern, the Army spent at least an additional $15.1 million on O&M given that the major capital investments had already been made. Thus, an estimated $38.7 million was spent on Camp Debert from 1940 to 1945.

This truly must have had a regional impact. Ralston's report provides some positive proof to that effect.[44] Army spending was spread out across the country, but the highest provincial spending gives an indication of where that spending was considered most important by the Canadian government.

Based on the percentage of directed government spending, Table 5 gives a clear indication of the provinces that were key to Canada's defence. Canada invested its money where the critical industries, strategic areas and major access/departure points were; therefore, these were likely essential and primary to its war effort.

Nova Scotia saw an investment of $150 million in Army spending, representing 8.1 per cent of total Army spending to 1943 or 18.7 per cent of funds actually spent in Canada (Table 5). Ontario enjoyed the lion's share, but significantly, Nova Scotia rated second. This is not surprising, given its importance as an open-water seaport and the importance of the convoy system as Britain's lifeline at the time. Added to that was the fact that both air and naval forces were employed in defending the strategic approaches that were essential to that lifeline for Britain.

TURN OVER OF FACILITIES TO RCAF

By 1943 though, matters were coming to a head. The tide was starting to change, imperceptibly at first. But the Air Force was among the first to feel the change. There was a virtual glut of surplus personnel in the BCATP training system.

One of the first units to be affected was O.T.U. 31 at Debert. Canada agreed

Ontario	Quebec	Nova Scotia	British Columbia	All others
156,447,745.00	41,129,214.37	70,939,213.00	53,473,248.00	94,653,962.00
42,325,000.00	38,085,000.00	29,997,000.00	25,875,000.00	2,095,000.00
1,480,000.00	1,154,000.00	29,997,000.00	3,693,000.00	344,000.00
4,356,817.00	1,921,351.00	58,046.00	863,945.00	2,852,038.00
14,280,924.00	5,828,552.00	4,431,876.00	17,923,033.00	37,789,173.00
180,326.00	107,273.00	184,328.00	181,309.00	400.00
27,496,823.00	45,610,790.00	13,750,802.00	5,086,432.00	24,267,584.00
706,345.00	468,408.00	642,642.00	1,254,905.00	114,507.00
247,273,980.00	**134,304,588.37**	**150,000,907.00**	**108,350,872.00**	**162,116,664.00**
13.3	**7.2**	**8.1**	**5.8**	**8.7**
247,273,980.00	**134,304,588.37**	**150,000,907.00**	**108,350,872.00**	**162,116,664.00**
30.8	16.7	18.7	13.5	20.2

that RAF schools would be the first to be closed as part of a rationalization plan. But British units considered essential were to be Canadianized and given RCAF designations. In the meantime, they would continue to function as part of the BCATP. Thus, Debert was given a temporary reprieve.

No. 31 Operational Training Unit at Debert and No. 36 at Greenwood, NS were redesignated as No. 7 and No. 8 respectively and staffed with RCAF personnel.[45] A significant air presence would continue to exist at Debert along with the socio-economic benefits of that operation.

Still, a firm decision was made in 1943 to commence winding down the BCATP with the final termination in March 1945.[46] The financial taps for many communities were starting to be turned off and closed. But concurrent with this activity, Canada also commenced studying its post-war future. Dark days still lay ahead. It was not that victory was either assured or certain by 1943. There were still many trials to be surmounted. But, there was a stirring within the inner circles of government to start looking forward.

By late 1944, victory was seen as just a matter of time. May 1945 would bring the joy of Victory in Europe. Then the atomic bombing of Hiroshima and Nagasaki, that produced Japan's unconditional surrender on 2 September 1945, finally ended the war. That surrender rendered Debert's purpose—and that of many other bases, stations and establishments in Canada—moot.[47]

WINDING DOWN DECONSTRUCTION

There was no longer a reason for defence facilities once peace had arrived. Demobilization proceeded as quickly as possible. But "peace" was also a double-edged sword. Without the reason for being, the wartime boom soon dried up. Where there once was a frenzied pace, there was now silence and slow decay.

This was a reality facing Debert and many small Canadian communities in the fall of 1945. They prospered during the boom but were now being left to languish during the bust. And the bust was quick. For example, what was once a jewel in the crown of the Army's training system in Debert was now coming under the hammer. It was no longer wanted.

The *Calgary Herald* reported that 400 men were involved in the deconstruction and salvage of the Camp Debert buildings. The camp was abandoned. Windows were left open on many of the buildings and gaping holes were noticed in others. It was a ghost town whose only sign of recent activity was the initials left carved on the walls by many of the soldiers of the 168 units who trained at Debert. For many, this would be their final reminiscence of the time spent here in Canada.[48]

At the time of the *Calgary Herald*'s report, 68 buildings had come under the hammer with 55 totally demolished. In the process, 1.25 million feet [381,000 metres] of lumber, 12 tons [10,886 kilograms] of nails, 1,000 windows, 39 bath tubs, 200 basins, 139 radiators and 24,000 feet [7,315 metres] of piping and plumbing fixtures as well as assorted electrical supplies and other items had been salvaged.

These materials would get a new life under the *Veteran's Land Act* or emergency shelter programs in the erecting of new homes. The project was started in the fall of 1946 and was scheduled to be completed in April the following year with 75 per cent of the materials expected to be salvaged.[49]

On the Air Force side, it was much similar. Ralph Harris' reminiscence is poignant:[50]

> Debert, with all its natural advantages of clear approaches, cheap land for expansion, proximity to the army camp,

location beside the Trans-Continental Railway and soon-to-be Trans-Canada Highway, not to mention its favourable weather record, was closed in a very few days.

On October 6, 1945, I went to the release centre at Moncton, N.B., returning to Truro October 7. On October 8, 1945, I went out to Debert to see what was going on and found that most of the windows had been boarded up, about 50 personnel of all ranks dining in the Airmen's Mess, and the Control Tower gutted—radios and speakers had been ripped out of the console, furniture gone (contents of drawers simply dumped on the floor), even the motor gone out of the furnace.[51]

Debert no longer served a purpose, and there were too few people to safeguard the assets. But the government learned well from the BCATP experience. It realized spending brought prosperity. Government had a role to play in conjunction with the private sector. Of great concern from the experience of the Great Depression was the public's censure of the laissez-faire approach that was taken.[52]

CONCLUDING REMARKS

There was a certain hope on the government's part that the ultimate goal of the sacrifice and of its invested treasure would make Canadians the happiest people on earth. As early as 1943, the government looked to civil aviation as key to Canadian prosperity. Investments made in the BCATP and Debert were to be the basis of that expansion, and prosperity happened for some but not for others.[53]

Still, confidence remained high in the post-war period. There was a prosperous economic outlook even with the large industrial draw-downs in war production and the rapid demobilization of Canada's armed forces. Exports were far above the level required for full employment and were forecasted to remain so in 1946. But the government thought a buffer was needed to ease the future transition to a peace-time economy. Many measures were to be taken to ease any transition or social dislocation, such as the institution of unemployment insurance plans and social welfare.[54]

But Canadians, too, were concerned with the transition to peace. The war left many asking some deep social questions on the use of taxpayers' money. Many could not understand how the Government of Canada was able to find a billion dollar gift for Britain during the course of the war. Where did that capital come from? Why was the government unable or unwilling to ease the public's suffering during the Dirty Thirties / Great Depression with a similar investment?[55]

Canada's gross national expenditure (GNE) in 1943 was approximately $11 billion. This loan, therefore, represented 9 per cent of GNE or, from another perspective, represented 24 per cent of $4.1 billion of government spending that year.[56] That put pressure on the government. The seeds for change in public policy had been sown during the war, as the public had no desire to return to darker days.

Looking ahead in 1946, the domestic market was strong and demand for goods and services would continue to increase as they became available.[57] There was a pent-up demand after all the years of scarcity, saving and privation during the war years. Looking on the horizon, the world had to be rebuilt. Canada would continue to be looked upon as a bread basket and a source of raw materials for the post-war reconstruction. Prosperity appeared to be assured, and the future looked bright indeed.

But the reality was that for all the prosperity forecasted, it was boom for some, bust for others. The Canadian economy did grow, but for many regions, the pace was slower.

Many communities languished, as their wartime tactical and strategic importance declined. Many reverted to what they were before.

The legacy of World War II was as Dickens foretold, "It was the best of times, it was the worst of times … ."[58] The investments were not only just for prosecution and victory, but they were also the forge for change to Canada's future. It was a lasting legacy whose blood and treasure are still paramount and relevant to our generation. The active participation and work by many—in cities, small towns and villages—was accomplished by average Canadians. Their collective efforts were important and vital to winning the war. The home front was also a war front. It is an effort worth remembering!

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Abbreviations

BCATP	British Commonwealth Air Training Plan
GNE	gross national expenditure
O&M	operations and maintenance
O.T.U. 31	Operational Training Unit 31
RAF	Royal Air Force
RCAF	Royal Canadian Air Force

Notes

1. Charles Dickens, *A Tale of Two Cities*: *A Story of the French Revolution*, Project Gutenberg, http://www.gutenberg.org/files/98/98-h/98-h.htm#2H_4_0002 (accessed December 5, 2012).

2. Ibid.

3. Herb Peppard, "The Agony and the Ecstasy," *Truro Daily News*, http://www.trurodaily.com/Opinion/Columns/2012-07-04/article-3023331/The-agony-and-the-ecstasy/1 (accessed December 5, 2012). Peppard captures his experiences of the horrors of the past, the face of the present and his hidden hope in his wish for the future. His story is one of many of his generation who share this common background. It is a common story that shapes who and what we are today.

4. Pierre Berton, *The Great Depression: 1929–1939* (Toronto: Anchor Canada, 2001), 9.

5. Ibid., 503–4.

6. Alexander Brady and F. R. Scott, *Canada After the War: Studies in Political, Social, and Economic Policies for Post-War Canada* (Toronto: Macmillan, 1945), 3. "[I]f we are not now to take thought for the future we can expect nothing but backsliding to the bad old ways of the inter-war period. As to the claim that thinking of the post-war future slackens the war effort, nothing could be more paltry. People are bound to think of the future. Only the promise of better things to come sustains us in war. If this promise is not to be frustrated and our high hopes disappointed, we must be prepared to discuss now in a realistic manner the modifications of our institutions necessary to fulfil man's aspirations for a 'better world.'"

7. Berton, 499.

8. F. J. Hatch, *Aerodrome of Democracy: Canada and the British Commonwealth Air Training Plan 1939–1945*, Monograph Series No. 1 (Ottawa: Department of National Defence, Directorate of History, 1983), 1–2.

9. Ibid., 1.

10. G. H. Sallans, "Wilderness One Week, and a Home for Troops the Next—The Birth of Debert," *The Vancouver*, September 15, 1941, http://news.google.com/newspapers?id=JDNlAAAAIBAJ&sjid=OokNAAAAIBAJ&pg=1267,3797474&dq=debert+nova+scotia+1941&hl=en (accessed December 5, 2012).

11. Hatch, 33.

12. Ibid., 16.

13. Ibid., 64.

14. Ibid.

15. Testimony given by Donald Davidson to William Langille, Chairman, Standing Committee on Veterans Affairs, Halifax, March 1, 2001, http://www.gov.ns.ca/legislature/hansard/comm/va/va010301.htm (accessed December 5, 2012), 6. This is the personal recollections of Don Davidson, who lived in Debert all his life; when the war started he was a teenager—15 or 16 years. During the war he was a businessman, operating Davidson's Store.

16. Sallans.

17. Davidson, 6–7.

18. Canada, National Defence, Directorate of History and Heritage, DHH File 360.003(D5) Debert Military Camp file.

19. Hatch, 64.

20. Ibid., 74.

21. Ibid., 74–75.

22. "Debert Described as an Efficient Camp, Ralston Says NS Development Best in Dominion Is Said Effectual, Answers Diefenbaker Who Says Choice of Site Is Little Short of a Disgrace," *The Montreal Gazette*, 1 June 1943.

23. Sergeant R. W. Harris, "Memories of Debert, N.S.," undated. Written account in Debert Military Museum archives, http://www.debertmilitarymuseum.org/harris.htm (accessed October 5, 2010, site discontinued).

24. "Debert Described as an Efficient Camp."

25. Ibid.

26. Bert Meerveld and Yvonne Holmes Mott, "Art Presswell: A Soldier's Journey," (November 2003), 4, www.Ocl.Net/Pdf/Art_Publication.Pdf (accessed December 5, 2012).

27. Hatch, 16. To avoid duplication of costs, the 15 air observer schools have been excluded as most were collocated with flying facilities for co-training and efficiency.

28. Canada, National Defence, Directorate of History and Heritage, DHH File 74/13 No. 31 O.T.U, 2–7 and 11.

29. Ibid., 200.

30. Canada, Bank of Canada, "Inflation Calculator," Bank of Canada, http://www.bankofcanada.ca/rates/related/inflation-calculator/ (accessed December 5, 2012).

31. Ibid., 212. The 13 ground support establishments are restricted to those that were directly associated with air training and include: the seven initial training schools, two radio direction finding (radar) schools, Air Armament School, AID Inspector School, 1 Composite Training School and 2 Composite Training School.

32. For Debert aircraft establishment see DHH File 74/13, 3–4 and 7. For aircraft costs see "Lockheed Hudson in RAF Service," Military History Encyclopedia on the Web, http://www.historyofwar.org/articles/weapons_lockheed_hudson_RAF.html (accessed December 5, 2012); and Kenneth C. Cragg, "Charge Laxity in Production of Aircraft – Diefenbaker, Hanson Critical of Mosquito Program," *The Globe and Mail*, June 22, 1943.

33. For the number of aircraft lost at Debert, see "No.31 Operational Training Unit and No.7 Operational Training Unit, Debert, Nova Scotia, Roll of Honour, Training Casualties," Ancestry.com, http://www.rootsweb.ancestry.com/~nbpennfi/penn8b1RollOfHonour_No31OTU_TrainingCasualties.htm (accessed December 5, 2012).

34. Hatch, 200. These values are 1/56th of BCATP's total costs for equipment ($162,260,787.89), materiel ($28,000,498.85) and lend lease ($283,500,362.66).

35. "Spendings Broken Down by Provinces: Army, Navy and Transport Department Tell How Money Is Spent," *The Montreal Gazette*, June 1, 1943, http://news.google.com/newspapers?id=c4AtAAAAIBAJ&sjid=NpkFAAAAIBAJ&pg=6720,51314&dq=rcaf+debert&hl=en (accessed December 5, 2012). Debert's share is estimated as one-third of Transport Canada's investment in support of air operations.

36. Canada, National Defence, Directorate of History and Heritage, DHH File 360.003(D5), Debert Military Camp file, 5.

37. This estimate of O&M costs was derived by deducting the Army Contributed Capital Air Investment from the known and unexplained difference of $5 million.

38. For Debert's personnel establishment, see Canada, National Defence, Directorate of History and Heritage, DHH File 74/13 No. 31 O.T.U, 2. Pay was calculated using "CBI Chapter 204 – Pay of Officers and Non-Commissioned Members" CBI 204.21, CBI 204.211 Tables A, B and C as well as CBI 204.30 Table B (TB, effective 1 April 2010), Canada, Department of National Defence, http://www.cmp-cpm.forces.gc.ca/dgcb-dgras/pub/cbi-dra/204-eng.asp (accessed January 17, 2012, content updated); and "GDP Deflator," Josh Staiger, http://www.gdpdeflator.com/ (accessed December 5, 2012). The data was deflated and then benchmarked and adjusted to the salaries in J. L. Granatstein, *The Generals: The Canadian Army's Senior Commanders in the Second World War* (Toronto: Stoddart Publishing, 1993), 17–18; and Canadian Army, Soldier's Pay Book, Militia Book MI Part II 40/p & S/279 (6620), D144848, Okeefe, Leslie Jeffrey, Pte.

39. Davidson.

40. The total (1940–1945) is the difference of Debert's total cost in Table 1 ($39,841,589.99) and the total Canadian investment in O.T.U. 31 in Table 2 ($31,381,560.00). RCAF No.7 Squadron's estimated O&M costs are the difference of the 1940–1945 total ($8,460,029.99) and the total for O.T.U. 31 ($6,816,611.00).

41. "Spendings Broken Down by Provinces."

42. Ibid.

43. "Debert Described as an Efficient Camp."

44. Ibid.

45. Hatch, 184.

46. Ibid., 178–83.

47. "Lancaster's of Tiger Force: Canada's Contribution to Tiger Force," http://www.lancaster-archive.com/lanc_tigerforce.htm (accessed December 5, 2012).

48. "War Assets Salvaging Debert Camp Buildings," *The Calgary Herald*, 21 November 1946, http://news.google.com/newspapers?id=JilkAAAAIBAJ&sjid=onsNAAAAIBAJ&pg=7393,2288245&dq=debert&hl=en (accessed December 5, 2012).

49. Ibid.

50. Harris.

51. Ibid.

52. Brady and Scott, 3.

53. "Goal Is to Make Canadians Happiest People on Earth!" *Hamilton Spectator*, December 13, 1943, Canadian War

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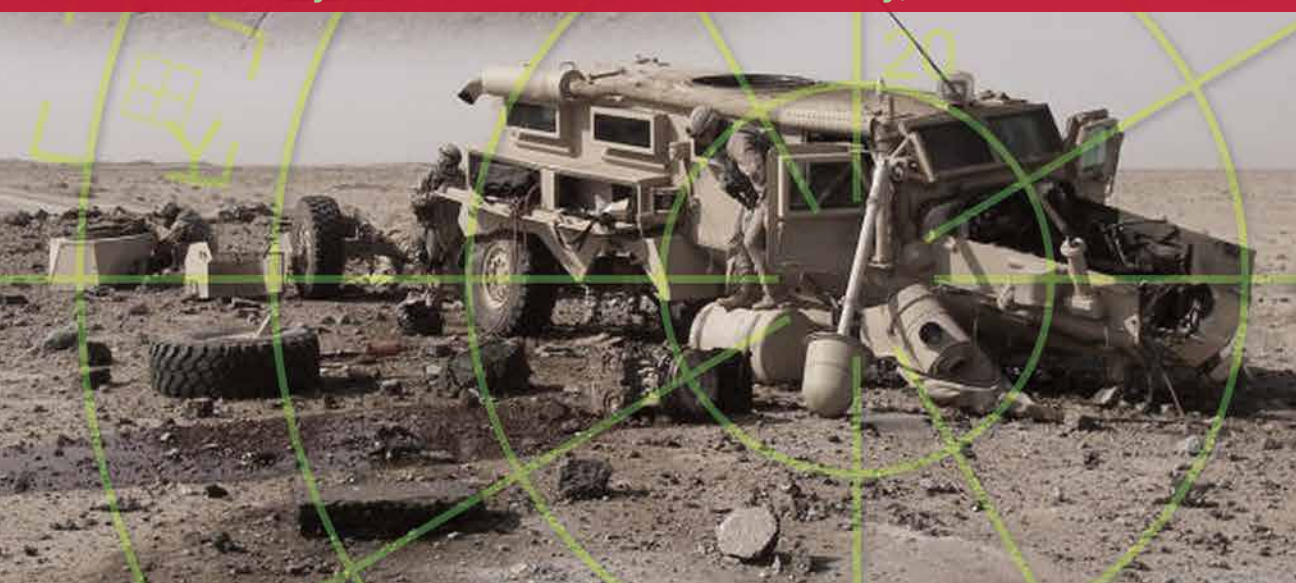
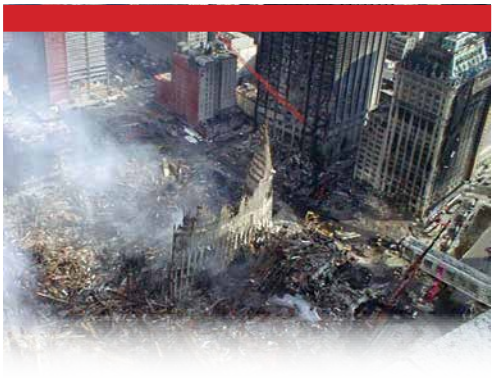
TARGETING IN IRREGULAR WARFARE: HOW IS IT DIFFERENT?

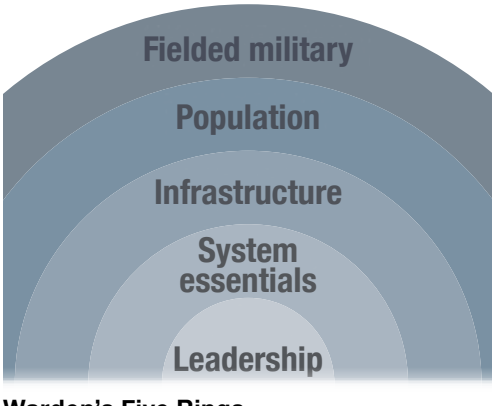
By Lieutenant-Colonel Jason Kenny, CD





Introduction

From early theorists such as Giulio Douhet to more contemporary examples such as John Warden, debate has existed regarding the most effective method of targeting during war. While Douhet advocated the destruction of the enemies' ability to fight, focusing targeting on the will of the people,[1] Warden's approach seeks to identify which of the five rings represents the enemy's strategic centre of gravity and to focus targeting strategy towards it.[2] Arguably, much of the debate regarding targeting in warfare has been a by-product of the type of warfare and technology available at the time. As such, targeting theory has evolved and often sought to explain or improve targeting strategies from the previous conflicts. Recent discussions have also added new dimensions and considerations aimed at addressing the unique circumstances of irregular warfare and counter-insurgency (COIN). This particular kind of warfare has introduced four new facets to the targeting dialogue: target distinction, the human dimension, engagement decisions, and whole-of-government (WoG) engagement. This paper will discuss each of these facets, highlighting their application to targeting in a COIN scenario and demonstrating the unique challenges they seek to resolve. More to the point, it will demonstrate that targeting in a COIN environment is different from classical targeting, particularly due to the human dimension that must be considered throughout.



Warden's Five Rings

Target distinction

One of the most challenging characteristics for warfare in a COIN environment is distinguishing combatant from non-combatant. While this requirement is not new to targeting debates, the stealthy and cohabitant nature of the enemy makes this task extremely difficult in irregular warfare. Traditional battle lines, where the enemy is on one side while friendlies are on the other, are almost non-existent with COIN. Furthermore, identifying the enemy by their uniforms or equipment is almost impossible. Insurgents are often embedded within the friendly populations and may have little or no equipment that would differentiate them. Therefore, the level of effort required to identify a potential target in a COIN environment is exponentially more difficult than it is

in a traditional conflict. The ability of identifying a hostile by their equipment, infrastructure, electromagnetic signature, acoustic characteristics, or their appearance is no longer possible without additional context. Therefore, effective targeting in a COIN environment relies very heavily on fully developed intelligence to provide such context, thus enabling distinction of insurgents from the regular populace.

An additional characteristic that significantly affects targeting in a COIN environment is the fleeting nature of potential targets. Often as immersed elements of an indigenous population, insurgents can blend in seamlessly with their surroundings. From this perspective they hold the initiative, choosing when, where and for how long they will expose themselves to commit their actions. This poses a two-fold challenge or targeting. First, one must be capable of detecting the presence of insurgents when a brief opportunity presents itself. Doing so implies establishing persistent surveillance with enough precision and fidelity to detect and distinguish the enemy. Examples meant to address this targeting requirement in COIN warfare are persistent presence balloons and unmanned aircraft (UAs). The second challenge is to have a rapid enough targeting cycle capable of capitalizing on detections when they occur. For instance, an improvised explosive device (IED) cell, known to friendly forces, might stay hidden by remaining undistinguishable until they place the device, which may only last several minutes. The challenge in such a circumstance is to find, fix, track, target and engage the target during the few minutes available; a feat requiring the ability to rapidly process surveillance data and fuse it to known intelligence in order to establish a valid target and rapidly deploy the appropriate resource to engage.

Armoured vehicle falls prey to IED

Photo: Pete Souza

Human dimension

Unlike conventional warfare where opponents and desired end states are normally identified, intentions or agendas in irregular warfare are seldom as clear. Insurgents usually seek to discredit and undermine current leadership publicly by making them overreact or underreact, leading to a loss of public support. Thus, it may be argued that irregular warfare has more emphasis on the human dimension vice the force on force perspective prevalent in conventional warfare. As was observed by Secretary of State Dean Rusk during the Vietnam War, "the way to win a guerilla war was to win the support of the people."[3] Therefore, targeting in a COIN context seeks to preserve public support for one's self while eroding the public power base of the other. The implications for targeting in such a reality are numerous, but two items stand out above others: a requirement to

Vietnam war propaganda leaflet

minimize collateral damage and the necessity for precision.

In a war to win the "hearts and minds of the people," minimizing collateral damage is essential. To be successful, the people of the nation must feel that they are relatively safe and protected from the activities of the insurgents. Thus, there is an underlying expectation that the "good guys" will not cause inappropriate harm or damage. From a targeting perspective, great care must be taken in assessing potential collateral damage for all engagements in order to preserve support and prevent any ill will from those meant to be protected. Significant collateral damage results in an outcome opposite to that desired. This vulnerability in COIN warfare is frequently exploited by insurgents any time collateral damage occurs in order to discredit current leadership. Therefore, collateral damage in COIN warfare must be minimized as much as possible; this can be achieved through distinction, regulated use of force, and precision.

Where regulating force and the notion of proportionality are prevalent in conventional warfare, the emphasis on precision as a means to reduce collateral damage represents a significant difference for targeting in COIN warfare. Prior to the advent of precision guided munitions (PGMs), achieving precision from the air was very difficult and sometimes risky. Where collateral damage assessment for a target zone was required prior to PGMs—when second and third order effects of an attack were almost impossible to predict—modern surgical engagements could limit damage, making predictions more realistic and achievable.

Engagement decisions

Traditional targeting cycles, as were practiced from the Second World War to Vietnam, stereotypically end with a kinetic explosion. For the reasons discussed above,

USAF Photo: MQ-9 in Afghanistan 2007

the possible outcomes for a targeting cycle in COIN must consider many more options, many of which are non-kinetic. While this facet is not original in nature, the importance and emphasis placed on it for targeting in a COIN environment is unique. There are several examples of targeting cycles in existence between services and nations, all of which share the general phases of detecting, locating, tracking, attacking and assessing. Though applicable in a COIN context, there has been recognition that the complexities posed by the human dimension in COIN require consideration of non-kinetic outcomes. For example, a person is "caught" via surveillance placing an IED along a route. Traditional targeting approaches to this problem would likely end in a kinetic engagement, thus ending the targeting and intelligence cycles. In contrast, modern COIN targeting should seek to maximize the effect of the engagement, possibly using non-kinetic means to learn more about the insurgent network in hopes of identifying its leaders and centre of gravity. Therefore, this approach might dictate further surveillance or capture vice destruction. As such, the traditional targeting cycle has been enhanced in a COIN context to include a command decision regarding not only the viability of a target but also the best means of engagement.

Camp x-ray detainees

CF Photo: Sgt Matthew McGregor

Whole-of-government engagement

The last facet that makes targeting in a COIN environment different from conventional targeting should be viewed as a culmination of all the previously discussed points. While the issues of distinction, collateral damage, precision, and course of action selection (deciding) all have military solutions, the human dimensions of COIN


CF Photo: Sgt Matthew McGregor

makes it such that a solely military solution is likely inadequate. As argued by General Curtis Lemay when he was Chief of Staff of the United States Air Force, counter-insurgency requires the integration of "all parts of a nation's social, economic, and government structure, not one segment alone."[4] This idea is now known as a WoG approach. It implies that conventional targeting methodology no longer suffices. Targeting must take on a new level of complexity not fully addressed in existing doctrine. The fact that competing and conflicting interests can be represented on the same targeting board makes it very difficult to achieve commonality and requires a high degree of cohesion and understanding to achieve. To succeed with targeting in a WoG context, clear strategic intent and end state must be communicated by the political leadership in all applicable levels. One of the main challenges of taking a coherent WoG approach to targeting stems from the fact that the very leadership that should be providing strategic guidance and intent is often also the victim of the insurgency, requiring the interventions of a third party, which further complicates the situation and weakens the credibility of a WoG approach to targeting. Credibility is important for the success of this approach as it is crucial in earning the trust and respect of the population, thus denying support for insurgents. Therefore, from a military standpoint, military leaders involved in targeting within a COIN context should seek to take an all-encompassing approach, involving as many of the national stakeholders as possible.


CF Photo: MCpl Angela Abbey

Conclusion

The complexities presented by COIN warfare have necessitated re-thinking regarding targeting. The difficulties in distinguishing friend from foe have affected the type and amount of resources that must be dedicated to identifying potential targets as well as highlighted the requirement to rapidly respond. Understanding the human dimension in targeting is key in targeting decisions and has led to minimizing collateral damage and increased precision in the use of force. Acknowledging the command responsibility in deciding an appropriate course of action, which may not include kinetic application of force as a solution to a targeting problem, further supports the human dimension to targeting in COIN warfare and serves to facilitate an essential WoG resolution. While the aforementioned facets do not represent an all-encompassing perspective on the challenges in targeting in a COIN environment, they should serve to highlight the unique nature of doing so and encourage further discussion and debate on the subject of targeting.

Lieutenant-Colonel (LCol) Jason Kenny graduated from the Royal Military College of Canada in 1998 with a Bachelor of Arts in Business Administration. Upon completion

of pilot training in 1999, he flew CP140 Auroras with 415 Long-Range Patrol (LRP) Squadron—where he had the opportunity to deploy to the Middle East for Operation APOLLO in 2002—and 404 LRP and Training Squadron. In 2007, LCol Kenny was selected to serve on exchange with No. 10 Squadron of the Royal Australian Air Force as an AP-3C crew commander. During his time there, he participated on a number of operational deployments, the most notable of which was Operation SLIPPER, the Australian Defence Force's contribution to the international campaign against terrorism in the Middle East. Upon his return to Canada, he served as the Operations Officer and Deputy Commanding Officer of 405 Maritime Patrol Squadron in Greenwood. A recent graduate of the Joint Command and Staff Program in Toronto, he has over 4000 hours of flying time with more than 3000 hours on the CP140 Aurora. LCol Kenny is currently the Commanding Officer of 407 LRP Squadron in Comox.

Abbreviations

COIN	counter-insurgency
IED	improvised explosive device
LRP	long-range patrol
PGM	precision guided munition
WoG	whole-of-government

Notes

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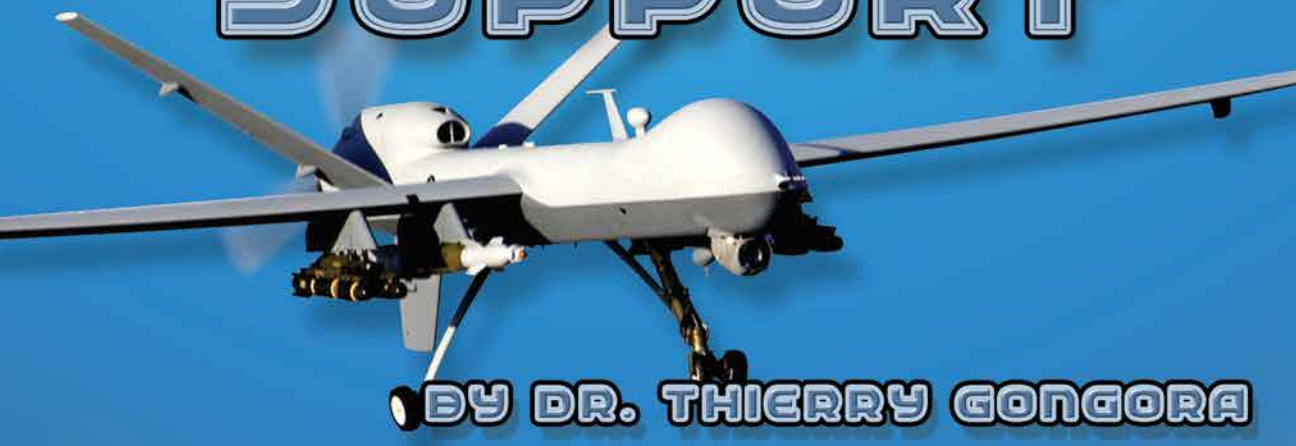
2. John Warden III, "Air Theory for the Twenty-first Century," in *Battlefield of the Future: 21st Century Warfare Issues*, http://www.airpower.maxwell.af.mil/airchronicles/battle/chp4.html (accessed September 10, 2012).

3. James S. Corum and Wray R. Johnson, "Airpower in South Vietnam, 1954–1965," in *Airpower in Small Wars: Fighting Insurgents and Terrorists* (Lawrence: University Press of Kansas, 2003), 256.

4. Ibid.

CF Photo: Sgt Matthew McGregor

The Relevance of Manned, Fixed-Wing Aircraft in the Provision of ISR and C2 Support



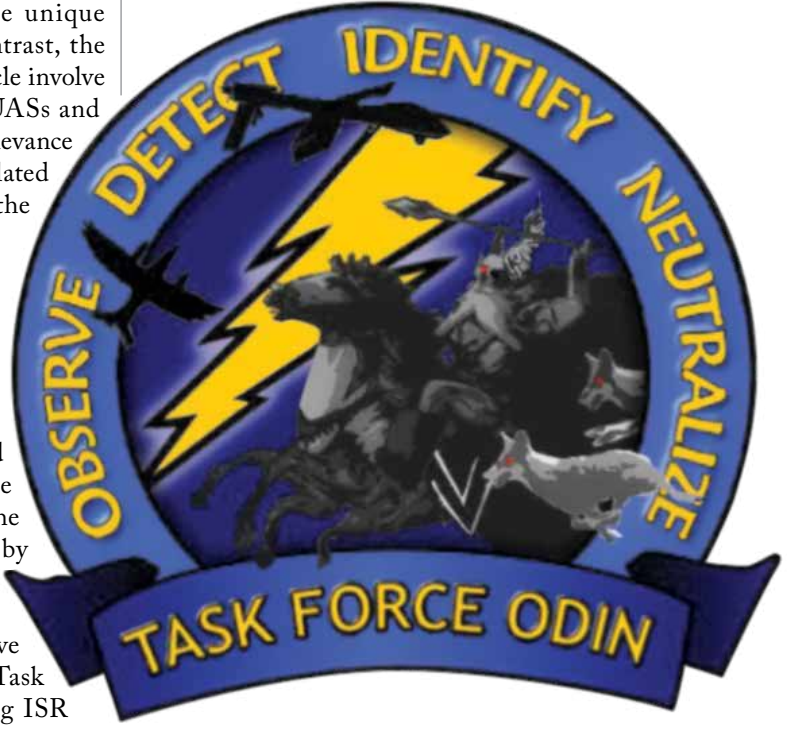
By Dr. Thierry Gongora

INTRODUCTION

During the last decade, the significant growth in the employment of unmanned aircraft systems (UASs) to support ground operations in Afghanistan and Iraq[1] may have led a number of decision makers and analysts to wonder if there is still a place for manned aircraft in that realm of air operations. This article will illustrate that and explain why manned, fixed-wing aircraft remain relevant in providing intelligence, surveillance and reconnaissance (ISR) and supporting command and control (C2), amidst the increasing employment of UASs. Most of the examples will be drawn from the United States (US) and from organizations that operate both manned and unmanned aircraft, in particular medium-altitude long-endurance (MALE) UASs. Many other examples could have been given—notably of maritime patrol aircraft used in overland ISR and C2 support roles;[2] these other examples, however, would have been weak because they would have included organizations that had no other option than to rely on manned aircraft or for which there was no clear explanation for the unique value of a manned aircraft. In contrast, the selected cases reviewed in this article involve organizations that had access to UASs and for which an explanation for the relevance of manned aircraft can be extrapolated from the available references and the context of the operation.

THE RESURGENCE IN THE CONTEXT OF US AVIATION ESTABLISHMENTS

The resurgence of manned aircraft in the realm of ISR can be first observed in the context of the deployment of Task Force ODIN by the US Army in Iraq in 2006–07.[3] The mission of Task Force ODIN was to combat improvised explosive devices (IEDs). This was done by Task Force ODIN's air assets providing ISR to cue the intervention of attack helicopters or troops on the ground to neutralize or capture individuals involved in the networks that planned and executed IED attacks. Task Force ODIN's success in making Iraqi roads safer for US troops and in targeting the IED networks has often been credited to the employment of a company of UASs (Alpha Company), but this overlooks the fact that the task force also had a company of manned aircraft (Bravo Company) that contributed to its success. While the UASs performed persistent surveillance with their electro-optic/infrared (EO/IR) or synthetic aperture radar (SAR) sensors, the manned aircraft provided unique capabilities that could not be fielded by the then available UASs, namely a fusion of full-motion video (FMV) and signals intelligence (SIGINT) as well as new experimental ISR capabilities, such as change detection and a wide-area forensic FMV capability. These capabilities were fielded on military derivatives of Hawker-Beechcraft twin turboprop aircraft and on tactical transport aircraft. Together, the manned and



unmanned systems of Task Force ODIN were credited by US military authorities for contributing to the killing and capture of respectively 2400 and 141 insurgents in one year of operation.[4] The success of the initial Task Force ODIN led to its subsequent sustainment through additional rotations in Iraq and to the deployment of a similar task force to Afghanistan in 2009.

In April 2008, impressed with the success of Task Force ODIN and upset by the continued shortage of airborne ISR in Afghanistan and Iraq, then US Secretary of Defense Robert Gates publicly singled out the United States Air Force (USAF) for its inability to rapidly field UASs in theatre and created an ISR task force within the US Department of Defense to recommend solutions. As a result of Secretary Gates' urgings, USAF launched Project Liberty, which was designed to rapidly generate more airborne ISR for employment in the two war theatres. The solution consisted of fielding more manned, tactical aircraft based on an improved version of the militarized Hawker-Beechcraft 350 fielded by Task Force ODIN. Known as MC-12, the aircraft carried a crew of four, EO/IR and SIGINT sensors, a suite of secure means of communications and a laser designator.[5] With the project approved in June 2008, the first aircraft reached Iraq and Afghanistan respectively in June and December 2009. Although these aircraft may have been seen initially as a stopgap measure for an insufficient number of Predator UASs, they rapidly gained a reputation of their own. USAF generals were quoted as referring to them as "Predators on steroids" and "god-send."[6] As in the case of Task Force ODIN and the US Army, USAF started appreciating the synergies of a mixed fleet of manned and unmanned, tactical ISR assets. The MC-12 fleet was judged so successful that USAF decided to retain it within its establishment—with a transfer to the Air National Guard—despite reductions affecting many other manned and unmanned aircraft fleets, as a result of fiscal austerity and the new US defence strategy.[7]

The resurgence of the need for manned tactical ISR aircraft is not limited to the US Army and USAF. The United States Marine Corps has also sought a similar capability, and open sources indicate that a similar capability

USAF Photo: SrA Felicia Juenke **Hawker-Beechcraft 350 MC-12W**

is available to US special operations forces (SOF). The capabilities available to US SOF appear to have included an aircraft like the MC-12, an ISR version of the U-28 (i.e., the military version of the Pilatus PC-12 in US service), and civilian-patterned aircraft operated by contractors; this in spite of the US SOF community having access to its own MALE-UAS capability.[8] Outside the United States, the only confirmed North Atlantic Treaty Organization (NATO) nation with a similar dedicated manned, tactical ISR capability is the United Kingdom, with the acquisition of five Hawker-Beechcraft 350 aircraft in a configuration pointing at a tactical ISR role. Little detail is available on these aircraft except that they are known as Shadow R1, are operated by the Royal Air Force (RAF) No. 14 Squadron and were the result of an urgent operational requirement to support operations in Afghanistan.[9]

Another interesting US case of a mixed fleet of manned and unmanned aircraft is offered by the Office of Air and Marine (OAM) of the US Customs and Border Protection (CBP). The OAM operates the world's largest law-enforcement aviation fleet with more than 290 aircraft, including 8 MQ-9 Predator B UASs with intent to field as many as 24 Predator UASs by 2016.[10] As in the case of military operations, the advantages of a MALE UAS are evident for homeland security: improved coverage of US borders through increased endurance—in comparison to manned aircraft—and the transmission of real-time imagery to remote command and intelligence centres.[11] However, manned aircraft remain part of the OAM fleet for many good reasons. One interesting finding made by the Department of Homeland Security's Inspector General was that UASs were less effective at

Photo: Gerald L. Nino — CBP's MQ-9 Reaper (Predator B)

supporting the apprehension of suspects than manned aircraft.[12] The CBP also noted the fact that many of their manned aircraft are civilian patterned and that this provides a measure of stealth, as they can blend with local air traffic and "mask the presence of continuous air surveillance."[13] Finally, until greater access to civilian airspace can be granted to UASs, manned aircraft remain more flexible in their operation and deployment than unmanned aircraft. This flexibility is augmented by the fact that a number of manned aircraft operated by OAM have short-field take-off and landing capability (e.g., Cessna C-172/182, Pilatus PC-12 and the Piper PA-18-150 fleet).

WHY MANNED, FIXED-WING AIRCRAFT REMAIN RELEVANT

The previous section provided evidence that a number of US organizations at the forefront of UAS development in their respective domain have maintained a mixed fleet of manned and unmanned systems. In the context of the OAM, it also hinted at some of the reasons that make manned aircraft relevant despite the strengths of UASs. This section will review more systematically the reasons for the continued relevance of manned aircraft, which can be categorized as follows: quality of tactical support, suitability for deployment and force generation.

Photo: Arpingstone — Cessna C-182


USAF Photo — Pilatus PC-12


Photo: Sputniktilt — Piper PA-18-150

The value of the MC-12 in Afghanistan was evident in the ability of its crew to handle dynamic situations better than a UAS crew operating from great distances and looking at the local situation through the limited field of view of their sensors and with generally less familiarity with the units supported on the ground.

QUALITY OF TACTICAL SUPPORT

The quality of tactical support provided by a manned aircraft in comparison to a MALE UAS is well summarized in the following extract based on MC-12 employment in Afghanistan:

> Ground troops in Afghanistan have come to rely heavily on a rather unglamorous-looking airplane … . [It] listens for enemy signals and watches the blind curves ahead of the troops, looking for signs of planted bombs or contacts with people who may—or may not—be the enemy. …
>
> MC-12 crews also watch over takedown operations, looking for the motion in the window, the escape out the back door, or the arrival of enemy reinforcements. The MC-12 crews consistently win the thanks and praise of the land forces: Ground troops routinely report that they prefer working with an actual crew overhead.
>
> The common alternative is communicating with an analyst who may be thousands of miles removed from the fight and is watching the proceedings through the lens of a Predator or Reaper unmanned aircraft, via satellite link.
>
> The MC-12 will offer unique capability until medium-altitude remotely piloted aircraft can operate in all weather, achieve more in-depth situational awareness, and offer ground forces a much more user-friendly interface—preferably with real people somewhere in the information processing, exploitation, and dissemination chain.[14]

The value of the MC-12 in Afghanistan was evident in the ability of its crew to handle dynamic situations better than a UAS crew operating from great distances and looking at the local situation through the limited field of view of their sensors and with generally less familiarity with the units supported on the ground.[15] Interestingly, in the totally different context of US homeland security, the value of manned aircraft in supporting the apprehension of suspects along US borders seems to be based on a similar ability to provide support to personnel on the ground during dynamic and dangerous operations, as explained by a civilian contractor who worked as an ISR mission commander on a manned aircraft supporting border patrols:

> Air to ground talk-on tactics, ("Sensor to Shooter") radio communications, and target identification played a significant role in the success … . …
>
> Once the target has been located and identified, the mission commander provides talk-on assist to ground agents [and] monitors for potential threats and situational awareness to ensure ground agents do not walk into ambush scenarios … . …
>
> If helicopters are available … the mission commander will provide command and control of target airspace and will coordinate close air support with … Office of Air and Marine helicopters, talking them in on the target area to assist with apprehensions … .[16]

The quality of tactical support provided by a manned aircraft over a UAS seems to reside in five specific factors. First, the manned-aircraft crew have access to higher resolution imagery, without the degradation involved in data passed over data links. Second, the crew have a capability for on-board intelligence fusion and analysis as well as relaying the resulting information to local operators. They can rapidly transform various sources of intelligence into actionable information. Third, the crew on board the aircraft act as an additional sensor and sense-making system that, in comparison with remote operators, has direct local situational awareness. Fourth, the aircraft can provide command and control functions to ground and air elements involved in an operation by performing an airborne forward air control function, coordinating other elements supporting the operation, acting as a communications relay or carrying the mission commander or their deputy. Finally, the fact that manned aircraft, compared to current MALE UASs, are generally a more reliable source of support because, in theory, they have greater systems' reliability, can operate in non-optimal weather and are not dependent on long-distance communications.

Interestingly, one limitation of many manned aircraft, their limited range/endurance in comparison to most MALE UASs, is a contributing factor to the quality of tactical support provided because it requires forward deploying the aircraft crew with the supported ground unit, and this facilitates the development of a close collaboration between them. This collaboration is much more difficult to establish in the context of reachback operations with MALE UASs, whereby forward-deployed air vehicles are remotely operated from outside the theatre of operations. In this concept of employment, the UAS operators and the intelligence analysts are not collocated with the units they are called to support; instead, they rely on long-distance communications and rotating shift work to ensure multiple support requests during long-endurance UAS patrols.[17] In contrast, the crew operating manned aircraft in support of deployed troops are often forward

USAF Photo: SSgt. Manuel J. Martinez

MC-12 Cockpit

deployed with the units they support, and the same crew works in close collaboration with them, sometimes through repeated targeting cycles of "find, fix, finish, exploit and analyze" (F3EA). SOF—in particular, as a result of experiences in Afghanistan and Iraq—have developed a preference for the forward processing, exploitation and dissemination (PED) of ISR and the forward integration of intelligence with operations as part of the F3EA cycle. As three US officers reported:

> the speed and intuition required to cross-cue, target, plan, and react amidst multiple streams of intelligence and operations in a highly fluid battlespace require a forward PED presence able to interact in that environment. The reachback nodes simply do not have the situational awareness one gains by physically being forward with supported operations and other intelligence personnel.[18]

While MALE UAS operations can be done from forward locations (this is how the US Army operates its systems), manned, tactical aircraft and their crew appear more likely to do so due to their greater deployability and the shorter endurance/range of their aircraft and, perhaps also, due to the organizational culture of the military organization they are attached to. The debate between armies and air forces on whether air assets should be parcelled out or centrally pooled and managed is probably as old as air power, and this article is not designed to take sides in this debate. However, it is clear that the trend discussed here is illustrative of the argument in favour of committing air assets to ground units in order to have an effective collaboration developing between them.

SUITABILITY FOR DEPLOYMENT

While the quality of tactical support during dynamic operations stands out as a reason why manned aircraft remain relevant in an age of increasing reliance on UASs, other factors can also play in favour of manned aircraft in the context of the planning and execution of a specific operation. Among them, the following factors reflect some of the strengths of manned aircraft compared to current MALE UASs:

Access to airspace. Military, manned aircraft currently have a greater capability to integrate and access both civilian and military airspaces than MALE UASs. The limited airspace situational awareness of current UASs restricts their operations to segregated airspace. The impact of this limitation on operations has been lessened in recent years because UAS operations have taken place mostly in airspaces under a significant measure of military control (e.g., Iraq and Afghanistan). This condition would not necessarily apply in the context of peacetime operations elsewhere in the world, where a Western military would need access to the airspace of a country that has no regulations authorizing UAS flights and would not be ready to assume the associated risks of mid-air collisions and of encroachment on the sovereignty of that country. Even in countries where UASs are allowed to fly on the basis of special authorizations, it is unclear if the civilian authorities would grant such an authorization in the context of a crisis in a densely populated area or in the context of a situation where other aircraft would require access to the same airspace.

Deployability and transition to operations. Manned aircraft can generally deploy to an operating area on their own power by air-to-air refuelling or by hopping between refuelling points. MALE UASs are transferred over long distances by strategic airlift. In some circumstances, a manned aircraft capable of self-deployment may also transition from deployment to actual operations faster than a MALE

UAS, for which strategic airlift would have to be arranged. Once in theatre, the MALE UAS operators would need additional time to set up the infrastructure for operating the system in addition to the time required to transition the air vehicle(s) from a transport configuration to the configuration needed for flying. These additional steps, specific to the strategic deployment of current MALE UASs, add time to the transition from deployment to operations that may matter to some operations.

Basing/operating options. Many manned aircraft dedicated to the provision of ISR as well as command, control and communication (C3) functions have the ability to operate from rough airfields and landing strips. This is a reflection of concepts of employment that often attach these aircraft to deployed ground units. In contrast, MALE UASs operate from fewer and larger installations with paved runways of sufficient length, relying on their endurance to cover the same area that manned aircraft, with less endurance, would cover from a greater number of operating bases. In the context of conventional operations, both options have their strengths and weaknesses; however, under some specific circumstances, the ability to operate from a greater set of access points could prove operationally advantageous to the discretion and surprise elements of an operation.

Secrecy and concealment. The success of many ISR missions conducted by unmanned and manned aircraft in recent conflicts has rested on an ability to see and listen without being detected—that is, by operating at a stand-off distance where sensors can effectively gather information on targets while the aircraft remains beyond the range of unaided visual or audible detection by these targets. Secrecy and concealment, however, can also extend to the ability of certain aircraft and their operating or support personnel to maintain a low profile in other respects than in their flight profile relative to a target. For example, the presence of a MALE UAS at an airfield, in a country or region, is a clear sign of military presence that may compromise the operational security of a mission. This also applies to manned combat aircraft, the deployment of which is generally considered a clear diplomatic signal. However, some manned, tactical ISR aircraft are available in configurations that are difficult to tell from a civilian aircraft except by knowledgeable observers, and they can be operated by non-military personnel, including civilian contractors. From open-source accounts of recent US airborne ISR operations in Africa, it seems that this rationale played a role in the selection of civilian-patterned aircraft operated by contractors.[19]

FORCE GENERATION

The resurgence of manned, fixed-wing aircraft in recent years has also been facilitated by factors relating to the ease of generating the capability. The aircraft considered are often mature designs used for civilian

The continued relevance of manned aircraft can be explained notably by their superior capability to support personnel on the ground, whether military or law-enforcement, in the context of dynamic operations such as raids and patrols when contacts with armed opponents are highly likely.

activities or military liaison and transport, and a number of firms offer to convert them to ISR platforms or offer such an ISR capability on a contractual basis.[20] US evidence also indicates that these aircraft can be crewed from a variety of sources. Pilots have been recruited from diverse aircraft types in both the regular and reserve components of the armed forces, and contractors are also available to fill various crew positions. This situation can be explained by the fact that many of these aircraft are in common usage in civilian aviation and are often similar to those used for pilot training. Finally, because these fleets of manned aircraft are small in size and the aircraft generate less ISR data due to their shorter flights, they pose a lesser challenge in terms of the number of imagery and intelligence analysts required compared to a fleet of MALE UASs.[21]

CONCLUSION

This article identified a resurgence in the use of manned, fixed-wing aircraft in the context ISR/C2 within a broader context of increased employment of UASs. The continued relevance of manned aircraft can be explained notably by their superior capability to support personnel on the ground, whether military or law-enforcement, in the context of dynamic operations such as raids and patrols when contacts with armed opponents are highly likely. This trend was identified in the context of military operations conducted at the lower end of the conflict spectrum against opponents with limited means of air defences and in the context of current technologies. No claim is made that this trend is necessarily applicable in operations where the opponent would have robust air defences or in the context of aerospace technologies in 10 or 15 years from now. If there is a single lesson that should be drawn from this article, it is that arguments or solutions that depict the future of aerospace systems as being unmanned are simplistic. The foreseeable future, rather, lies in mixed fleets of manned and unmanned systems, and this mix can only be determined through a careful analysis of the missions to be conducted and the relative strengths and weaknesses of manned and unmanned systems in the context of these missions.

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Abbreviations

C2	command and control
CBP	Customs and Border Protection
EO/IR	electro-optic/infrared
F3EA	find, fix, finish, exploit and analyze
FMV	full-motion video
IED	improvised explosive device
ISR	intelligence, surveillance and reconnaissance
MALE	medium-altitude long-endurance
OAM	Office of Air and Marine
ODIN	observe, detect, identify and neutralize
PED	processing, exploitation and dissemination
SIGINT	signals intelligence
SOF	special operations forces
UAS	unmanned aircraft system
US	United States
USAF	United States Air Force

Notes

1. See, for instance, the growth in the numbers and flight hours of UAS operated by the US armed forces in Tamar A. Mehuron, "That Giant Droning Sound," *Air Force Magazine* 90,

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3. The acronym ODIN stands for "observe, detect, identify and neutralize," in addition to being a reference to the god from Scandinavian mythology. Many aspects of Task Force ODIN and of other air units with similar capabilities remain classified. Useful references on Task Force ODIN include Jean-Claude Allard, "L'US Army à la recherche de la rupture tactique : la Task Force Odin," *Défense nationale et sécurité collective* 65, no. 4 (April 2009): 143–49; Ann Roosevelt, "Army Aviation Manned/Unmanned Teaming Shortens Sensor to Shooter Time, General says," *Defense Daily* 234, issue 29 (11 May 2007): 1-1; Colonel A. T. Ball and Lieutenant Colonel B. T. McCutchen Jr., "Task Force ODIN Using Innovative Technology to Support Ground Forces," *25th Combat Aviation Brigade Public Affairs* (September 20, 2007), http://www.dvidshub.net/news/printable/12463 (accessed November 29, 2012); Kris Osborn, "U.S. Aviators, UAVs Learn up Against IEDs" *Defense News* 23, no. 3 (January 21, 2008): 1 and 9; and Paul McLeary, "Under the Radar: U.S. Army's Task Force ODIN Spreads Surveillance Blanket in Afghanistan," *Aviation Week & Space Technology* 171, no. 14 (12 October 2009): 50–51.

4. P. W. Singer, *Wired for War: The Robotics Revolution and Conflict in the 21st Century* (New York: The Penguin Press, 2009), 222.

5. For information on the MC-12 Liberty aircraft, see Daniel Wasserbly and Caitlin Harrington, "Eyes in the Sky: MARSS and Liberty to Build on Anti-IED Role," *Jane's International Defence Review* 43 (September 2010), http://www.wescam.com/pdf/media/IDR_Sept2010%20Reprint-2PP.pdf (accessed November 29, 2012); and John A. Tirpak, "Lifesaving Liberty," *Air Force Magazine*, (April 2011): 52–54, http://www.airforce-magazine.com/MagazineArchive/Documents/2011/April%202011/0411liberty.pdf (accessed November 29, 2012). The name "Liberty" was adopted in reference to the Liberty ships programme of World War II to convey that the new capability would be cheap and rapidly fielded by leveraging mature, commercially-available technologies. The analogy, however, stops here, as the two programmes were conducted on totally different scales; that is, over 2000 cargo ships built versus only 37 aircraft.

6. "Basically a Predator on Steroids," *Airforce-Magazine.com*, February 25, 2010, http://www.airforce-magazine.com/DRArchive/Pages/2010/February%202010/February%2025%202010/BasicallyaPredatoronSteroids.aspx (accessed November 29, 2012); and "Liberty Aircraft Is 'a Godsend,'" Airforce-Magazine.com, April 22, 2010, http://www.airforce-magazine.com/DRArchive/Pages/2010/April%202010/April%2022%202010/LibertyAircraftIsaGodsend.aspx (accessed November 29, 2012).

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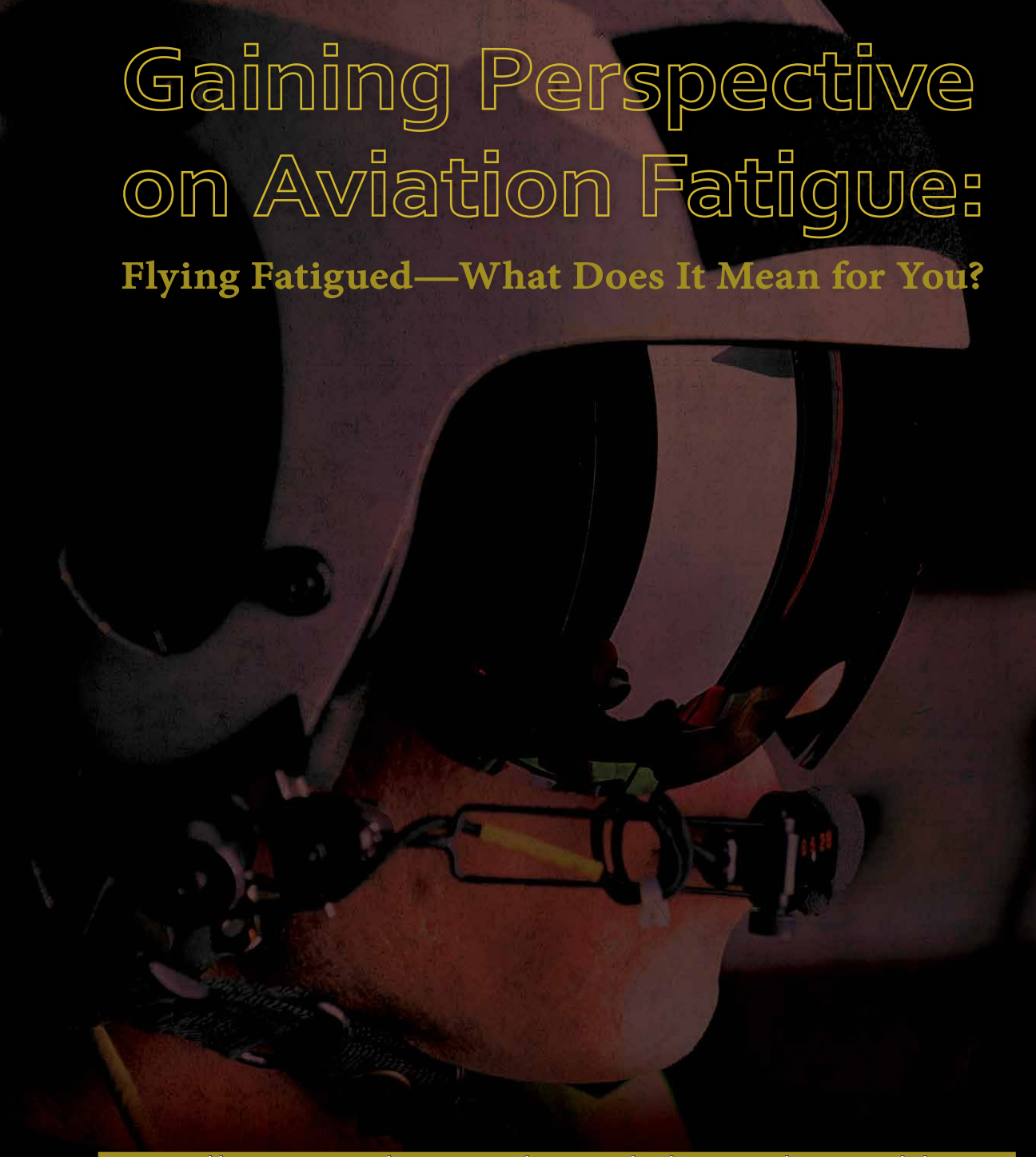
Gaining Perspective on Aviation Fatigue:

Flying Fatigued—What Does It Mean for You?



We all get tired at work. And that's the problem. Sometime within every 24-hour period, our bodies tell us that—more than everything else, more than wanting to fix or fly an aircraft—what we really need to do is sleep. What does this mean for the safety of aviation?

By Lieutenant (N) Tracy Coulthard

Aviation fatigue in context

There is now an extensive and growing body of available recent research into fatigue, which has gained serious consideration among military and civil aviation authorities in the interest of improving fatigue-related aircrew regulations. However, many of the recommendations resulting from fatigue research are generally stated, without direct and specific advice on their applicability to the regulatory environment. Correlating fatigue analysis to accident risk is more specific in some studies than others, and validation of more of these fatigue research results in field trials could more directly support specific advice for recommendations. Other than recommendations that are specific to the use of pharmaceutical intervention, most of the research recommendations are non-specific in nature, concentrating heavily on issues such as sleep hygiene (habits) and alternative mitigation strategies. Furthermore, the research acknowledges that some of the fatigue mitigation options addressed are not readily operationally practicable and do not easily translate directly to prescriptive regulations. Education on proper sleep hygiene is a common theme, and the research suggests that fatigue prevention through proper sleep hygiene is of utmost importance. The research results validate, to some extent, some of the core provisions currently found in the Royal Canadian Air Force's (RCAF's) flying orders, which lend credence to their basic regulatory structure. However, many of the fatigue research findings suggest that there is much room for improvement and that potential amendments would be appropriate for flying orders, specifically, and, to a larger extent, for the overall approach to fatigue risk management in the RCAF.

The pursuit of flight safety measures not only prevents the unnecessary loss of life but, more holistically, seeks to attain the strategic aim of preserving operational capability. This is reflected in the RCAF's flight safety mission statement:

> The Flight Safety (FS) Program is a force multiplier for the Canadian Forces (CF). FS contributes to mission accomplishment in the DND [Department of National Defence] / CF through the elimination of the accidental loss of aviation resources.[1]

Within the overall force structure of the CF, fleets of aircraft and trained operational aircrew comprise some of the most expensive capability assets available. Given that human factors have consistently been the most predominant cause factors in Directorate Flight Safety investigations, the inclusion of scientifically-based aircrew fatigue risk management practices will more fundamentally enable the RCAF to achieve its operational aims.

The RCAF's current crew-day regulations are largely derived from decades of anecdotal experience with aircrew performance limitations that have been attributed to fatigue. Recent aircrew fatigue research has demonstrated that there exists a scientific basis to improve the aircrew regulatory environment. This should allow fatigue risk management practices to be more closely aligned with the underlying known causes and mitigation limitations of human fatigue. Such efforts to modernize aircrew employment models, however, must also be viewed in light of the operational mission of the Air Force and the overall nature of risk management and risk acceptance in the CF as a military institution. The challenge will be to effectively increase the safety standards for aircrew performance while sufficiently preserving operational flexibility. Fatigue research studies acknowledge the operational imperative of military aviation, caution that there is no catch-all solution that works in all cases, and focus, to a large extent, on improving aviation culture with respect to sleep hygiene.

There are two technical reports, in particular, that were published by Defence Research Development Canada (DRDC),

Toronto within the last two years, which effectively summarize the fatigue research results and include recommendations on fatigue management for the CF. The first paper, "Management of Circadian Desynchrony (Jetlag and Shiftlag) in CF Air Operations" by Paul and others, December 2010, focuses primarily on the effects of circadian disruption on aircrew performance.[2] It highlights the results of a four-year project whose aim was to advance and retard circadian rhythms prior to planned circadian disruptions in aircrew. Its recommendations regarding the use of hypnotics (sleep aids) in aircrew have already been adopted by the RCAF. However, it contains two specific further recommendations that do not appear to have yet been addressed: 1) "That this knowledge-base [sic] be translated into an operational implementation plan through an interface with Air Force operational personnel" and 2) "That the Air Force aerospace medical community develop medical doctrine in the utilization of circadian interventions to improve and sustain operational readiness."[3]

The second DRDC paper, "General Recommendations on Fatigue Risk Management for the Canadian Forces" by Cheung and others, April 2010, is a comprehensive examination of fatigue and sleep analysis for the CF;[4] however, it was primarily written for the Air Force. It is focused primarily on the management of sleep hygiene and circadian entrainment and notes that currently there is no existing doctrine and training programme for fatigue risk management in the CF. It also cites an advisory publication (ADV PUB Number Air and Space Medical Group 6000, 7 Jan 2010, *Fatigue Countermeasures in Sustained and Continuous Operations*) that recommended that all Air and Space Interoperability Council (ASIC) nations (Australia, Canada, New Zealand, United Kingdom and United States) should have national policies regarding fatigue management.

Both of the preceding technical reports reference a position paper titled "Fatigue Countermeasures in Aviation," which was published in 2009 for the Aerospace Medical Association (internationally recognized authority in aerospace medicine), Fatigue Countermeasures Subcommittee of the Aerospace Human Factors Committee.[5] This paper alone references over 200 fatigue research papers, 99 of which were published within the last 10 years, and it is a very comprehensive overview of several decades of fatigue-related research.

The research results generally outline the known fundamentals of human sleep, describe the impacts on performance of sleep deprivation and sleep loss, and consider all available means of mitigating these effects. The research findings are not restated in their entirety here; however, the main points are summarized below.

The natural human sleep/wake cycle, or circadian cycle, is fundamentally based on natural daylight/darkness cycles, which defaults to a slightly greater than 24-hour circadian cycle in the absence of lightness/darkness cues. It is primarily regulated by the production of sleep-inducing melatonin in the absence of light and the suppression of melatonin production in the presence of light. The natural circadian cycle includes a period of maximal sleepiness, which normally occurs between 0200 and 0600 hours local.[6]

The research acknowledges that 8 hours of sleep per night is the normal human standard for correcting fatigue, which is already reflected in RCAF regulations which define minimum crew rest as 10 hours provided that 8 hours of uninterrupted sleep can be attained. The result, otherwise, is that sleep deprivation will further contribute to the normal circadian fatigue rhythm. Accumulated sleep deprivation and sleep loss result in sleep debt, and the research universally stresses that sleep debt cannot be mitigated away. Despite the utility of some partial short-term

fatigue mitigation strategies, the only way to correct sleep debt is with sleep. Further, daytime sleep is less restorative than night-time sleep. This has potential for amendments to aircrew regulations to ensure that sleep debt is accounted for both prior to duty periods and afterwards, including longer-term scheduling constraints than the typical 1–3 day period found in current regulations.

Making sense of fatigue research findings

Much attention in fatigue research literature is focused on the use of fatigue mitigation options, which include hypnotics for sleep, stimulants for wakefulness, planned circadian shift adjustments, napping, breaks and the appropriate use of light therapy mitigation (e.g., light-blocking glasses) to restore the body's natural sleep patterns. Many of these are not operationally practicable in military aviation, due to the extensive use of immediate or short-term readiness postures and the frequency of unforeseen mission assignments.

Some research has indicated that fatigue-induced accident risk in the workplace increases exponentially each hour after a person works for nine hours.[7] Research also indicates that accident risk rises at a fast rate in the 13th- and 14th-hour range and that fatigue risk increases steeply in the 15th hour and beyond.[8] Time since awakening has also been shown to be an important factor, and specifically, beyond 17 hours since time of awakening fatigue increases significantly.[9] Pilot-specific studies have shown that after 13 or more hours on duty, the proportion of pilots involved in accidents is over 5.5 times as high as that for all pilots.[10] This does not infer statistically that the 13-hour mark corresponds to 5.5 times as much risk, as the entire accident data set beyond 13 hours is included in this measurement. However, in conjunction with the other research, it would suggest that 13 hours is a significant threshold for fatigue-related performance. It is important to acknowledge that much of this research is focused on the relatively benign commercial

CF Photo: WO Serge Peters

and commuter aviation environment, which in the context of military aviation warrants due consideration for the potential increase in risk that would result from more demanding operations. An offsetting factor would be the high quality of military aviation training, although this is acknowledged to have only a minimal effect in mitigating fatigue.

Some of the research focuses on fatigue management for augmented aircrew, which refers to the carriage of extra crew on specific aircraft that are suitable for providing rest areas so that crew members can change work shifts in-flight. Due to the nature of military aircraft design and the roles performed, for the majority of Air Force missions this is not feasible, with the possible exception of some transport/patrol aircraft.

Much research has concentrated on the effects of circadian cycle disruptions due to shift lag and jet lag. Shift lag refers to any change in the daily work cycle of the acclimated sleep period and wakeful period. Jet lag refers to the same effect caused by transmeridian travel across time zones. The body's ability to adjust to such changes is generally accepted to be at the rate of one day per hour of circadian shift.[11] Other than planning circadian adjustments prior to known shifts in duty periods, there are very limited means by which this can be mitigated.

The effects of fatigue have been shown to have a measurable degradation on performance, which can be directly equated to those observed from alcohol impairment.[12] The implications of such findings are of paramount importance in aviation fatigue management due to their obvious impact on the safety of operations. Although the use of alcohol is strictly addressed in current aviation regulations (as is the prohibition on self-medication along with the strict governance of aircrew medical standards), comparatively, the issue of fatigue is not being as rigorously addressed. It is understandably more difficult to do given the insidious nature of the onset of fatigue and the lack of operationally suitable methods of objectively measuring fatigue, but the potential associated risk warrants far more comprehensive consideration.

One limited means of mitigating fatigue is through pharmaceutical intervention. The use of hypnotics for aircrew is well established in the RCAF for certain applicable cases where mission planning timelines along with foreseen circadian effects permit the effective use of prescribed hypnotics.[13] However, research strongly states that such use is only recommended for a relatively short period and that in itself it does not correct the accumulated effects of fatigue. The use of prescribed stimulants has also been shown to be effective in some cases and is approved in some US military aviation cases, but it is not currently permitted in the CF. The Canadian research advice specifically emphasizes that this class of drug is not compatible with flying duties.[14]


CF Photo: Capt Reil Erickson

One of the challenging aspects of fatigue management is that it is very difficult to objectively measure the state of fatigue in an individual. The use of an electroencephalogram (EEG) examination in clinical settings has been accepted as the medical standard for fatigue measurement, but this is operationally impracticable.[15] Efforts are under way to develop more practical means of measuring fatigue, such as the wrist actigraph that can be used to assess sleep-wake cycles across many consecutive days and nights based on body motion patterns. As these new technologies are validated for specific types of operations, they may in future be incorporated into

supplementing regulatory duty limitations. For now, however, this emphasizes the importance of the acceptance of individual fatigue self-assessment.

Individual tolerance to fatigue has been acknowledged to vary significantly, which warrants the inclusion of aircrew fatigue self-assessment and accountability in the determination of duty periods during the course of a mission. In some cases, this may necessitate the early termination of a planned duty period, and in others, it may validate the safe extension of a duty period when circumstances warrant.

Some principal factors have emerged from the research, which are known to directly contribute to fatigue in operations: time since awakening, length of the duty period, the intensity of task during the mission, the extent of circadian disruption and the effects of sleep debt.[16] It is important to note that the length of the duty period includes the full aircrew duty time, not just the flight time.

One unresolved issue in the clinical approach to fatigue research concerns sleep disorders which cannot be specifically attributed to known insomnias, substance use or physiological condition. The extent to which such unspecified sleep disorders affect sleep hygiene in the demanding military aviation environment is not known, which warrants caution against an overly prescriptive approach to fatigue risk management.


CF Photo

Implications for revisions to flying orders

To summarize, the following are some of the most important findings from fatigue research which are applicable to the aviation regulatory environment:

- Sleep debt accumulates over successive sleep-deprivation and sleep-loss cycles.
- Accumulated sleep debt cannot be mitigated—the only correction for sleep debt is sleep.
- Disruptions to the circadian cycle cannot be immediately corrected—they require phased correction based on the direction and extent of the circadian shift.
- Aircrew performance degradation from fatigue is akin to alcohol impairment, with the same effects on cognitive and physical performance.
- Pharmaceutical fatigue intervention is only recommended for relatively short durations.
- Some potential fatigue mitigation options are not operationally practicable.
- There is no available operationally-based test for fatigue.
- Fatigue is affected by time since awakening, length of duty period, task intensity, circadian disruption and sleep debt.
- Individual tolerance to sleep deprivation varies significantly.

As a result of these findings, the following considerations for amendments to flying orders / regulations may be inferred:

- Account for successive duty cycles, beyond the limited immediate crew-day

considerations found in most current regulations.

- Incorporate provisions for the correction of accumulated sleep debt during crew rest periods.
- Address more extensively circadian cycle disruptions, based on the severity and duration of the disruption, from jet lag or shift lag.
- Preclude the possibility of unacceptable performance degradation below a minimum standard, such as that for alcohol impairment.
- Focus on achievable practices and mitigation measures that enable operational effectiveness.
- Maintain self-reporting and self-grounding based on fatigue as a necessary feature of aircrew fatigue management practices.
- Ensure aircrew regulations remain aircraft-type, role and mission specific and accurately account for research findings relating to duty and rest periods.
- Maintain sufficient flexibility in fatigue risk management policies to account for disparities in individual crew fatigue tolerance.

In the larger context, accident prevention increases the operational capability of the Air Force compared to the effects of the loss of aircraft and personnel resources. In its immediate application, however, it should be noted that acceptance of any significant potential changes to current crew-day regulations—in light of fatigue research recommendations—may well impose substantive limitations on the Air Force's current level of planned operational flexibility. Such amendments (which could include reductions in crew day, increases in rest periods, aircrew scheduling constraints, medical limitations from pharmaceutical mitigation and consecutive duty cycle limitations) could adversely alter the overall operational output that is available from existing unit personnel establishments. Therefore, consideration for any significant changes to crew-day regulations should ideally also include an assessment of these factors, to provide an understanding of the resulting operational effects and/or adjustments to personnel and possibly material resources required to offset them.

Civil aviation stance on fatigue

It is noteworthy that the United States Federal Aviation Authority (FAA) has recently issued a proposed new rule which includes some significant amendments to passenger operations based on fatigue research findings.[17] In general, for un-augmented operations, civil aviation regulations regarding the length of crew day tend to be more conservative than those for military operations, which is valid given the operational imperative in military aviation vice the primary focus on commercial passenger safety. The FAA's proposed changes are based primarily on general workplace and aviation-specific fatigue research studies. Research shows that after a person works for eight or nine hours, the risk of an accident increases exponentially for each additional hour worked, to the extent that the risk of an accident in the 12th hour is more than double that in the 8th hour.[18] For pilots specifically, after 10–12 hours' duty time, their proportion of accidents is 1.7 times higher than for all pilots, and after 13 or more hours on duty, the proportion is over 5.5 times higher.[19] Additionally, research shows significant increases in pilot fatigue during periods of serious circadian disruption, to the extent that the fatigue level found after 12 hours duty for periods that start between 0600 and 1200 hours local is already exceeded after 3 hours for a duty period that starts between 0000 and 0300 hours local. Duty length and the number of flights per duty period were also found to linearly increase fatigue.[20] In the development of the proposed rule, the FAA

has, for the most part, validated these findings to its satisfaction with its own analysis of an FAA aviation accident data set.

The new FAA rule imposes a reduction in the maximum flight time limit for an individual flight to eight or nine hours, depending on the time of day at the start of the duty period, and, of particular note, further amends the total duty period limitations based on shift lag and jet lag considerations. The total duty period limitations are contained in a chart; accounting for the start time of the duty period and the number of flight segments, the limitations range between 9 and 14 hours. The minimum crew-rest stipulation has been increased by 2 hours to 10 hours and mandates that pilots must have an opportunity for 8 hours of uninterrupted sleep. Of likely interest to military aviation authorities is the fact that, based on research recommendations, the FAA has also chosen to fully adopt a fatigue risk-management system to more comprehensively address fatigue issues. This specifically includes a system approach to liability, which places equal onus on the individual's fitness for duty as well as on management's adherence to regulations. This was prompted by the FAA's concerns regarding pilots who commuted long hours on other flights prior to reporting for duty. Although commuting is not a particular problem in itself for the RCAF, the focus on aircrew fitness for duty with respect to sleep hygiene does warrant closer attention, as it has potential application for both RCAF individual aircrew and for an improved risk-managed approach to scheduling.

The FAA has taken this to the extent that individuals must state in writing prior to accepting each duty period that they are sufficiently rested to be fit for duty. This roughly equates to the current Air Force regulation that individuals must not report for flying duty if they self-assess that they are unfit due to illness, and consideration should be given to similarly incorporating fatigue self-assessment prior to duty. One of the most difficult aspects of assessing fatigue as a cause factor in flight safety investigations is that the state of fatigue prior to the mission is not known. Incorporating formalized self-assessment criteria along with aircrew fatigue-based scheduling software that can be tracked would go a long way in improving the accuracy and applicability of future aviation fatigue studies.

In response to the FAA's proposed rule, the International Civil Aviation Organization (ICAO) directed signatory countries to file official differences if they were unable to comply. In its response to ICAO, Transport Canada stated formally that "Canada has not filed a difference because current Canadian regulations are consistent with the ICAO's Standards and Recommended Practices (SARP)." [21] In fact, current Canadian civil aviation regulations do not account for many of the fatigue research recommendations and have not been amended to include any distinction in regulations pertaining to circadian shift disruptions. Transport Canada's stance has, therefore, been criticized by some aviation industry observers as not being scientifically based.

The differences between civil and military aviation imperatives have already been acknowledged, and civil aviation regulations are not, in general, directly applicable to military aviation. However, although military aviation authorities maintain their own distinct regulations, the discussion regarding the alignment of aircrew regulations with scientifically based fatigue research is important, as the weight of fatigue research knowledge makes it increasingly clear that overall the fundamentals are applicable to both civil and military aviation environments. The fact that, for the first time, the FAA has taken the lead in adopting a research basis in civil aviation regulations reflects a significant transformation in the overall approach to managing fatigue risk in aviation.

RCAF flying orders

Fatigue research results corroborate, in part, many of the stipulations found in current flying orders and are provisionally consistent with limitations such as 10 hours minimum crew rest and 15 hours maximum duty period.[22] The finding regarding the rate of increase in fatigue levels beyond nine hours suggests that any duty period longer than nine hours inherently includes an acceptance of exponentially increasing fatigue levels. The findings regarding 12, 13, 14 and 15 hours, respectively, indicate that accident risk due to fatigue becomes significantly measurable in this range and that fatigue levels beyond 13 hours are of specific concern. As such, the 13-hour mark could be viewed as an optimal upper limit. A 15-hour duty period may be acknowledged to contain an increase in accident risk acceptance beyond this optimal limit, which in the context of military aviation may be necessary to achieve operational objectives, especially for high-intensity specialty roles. This may also be in line with overall risk acceptance parameters for military duty. The finding that fatigue again increases steeply beyond 15 hours suggests that duty periods beyond 15 hours may carry such significant levels of accident risk that they warrant further justification of their necessity, whereby a qualifying risk assessment may be appropriate. Further scrutiny could be applied to missions with duty limitations beyond 15 hours and, in particular, to the necessity of approving extensions beyond the standard limits.

CF Photo: Cpl Denis Matte

1 Canadian Air Division (1 Cdn Air Div) Orders currently provide very mission specific distinctions in duty limitations but address only peripherally the need to consider fatigue implications beyond the immediate duty period. These orders contain numerous provisions to extend stated duty limitations, although the levels of authority required for such approvals vary widely.[23] For example, in different cases the authority rests with the aircraft commander, the unit commanding officer or remains vaguely specified. In the case of tactical aviation, it simply states that the wing commander shall develop unit plans for such authorized extensions. This approach would likely be inconsistent within an overarching fatigue risk-management programme.

These orders do not account generally for fatigue-avoidance aircrew-scheduling protocols, the effects of circadian shift and the impact of accumulated sleep debt over longer periods. Further analysis of these orders by an RCAF operational aircrew fatigue working group would provide more insight to specific focus areas, such as:

- aircrew-scheduling protocols that account for cumulative fatigue beyond a 1–3 day period;
- maximum length of duty periods;
- levels of authority required for duty period extensions;
- circadian phase shift impact of successive duty periods and appropriate crew-rest provisions for the correction of sleep debt; and
- the effects of night-vision imaging systems and other specialized tasks.

National Defence Flying Orders contain only a cursory paragraph on aircrew duty limitations.[24] The statement regarding the number of hours flown narrowly focuses on the need for instructions regarding any individual 24-hour period, and there is no specific

inclusion of the need for crew rest. The only reference to fatigue cites a singular specific case of exposure to the maximum allowable hours on two or more successive days. This instruction is inconsistent with the fatigue research results, as it only makes provision for a very specific case which has unnecessarily constrained consideration for multiple duty cycles, which could impose significant sleep debt even if the maximum duty periods are not fully reached. There is no direction on the requirement for a comprehensive approach to fatigue management, which should be substantially improved.

Conclusion

For the most part, current RCAF regulations address the core of the concerns arising from aviation fatigue research. However, the aircrew duty-day regulations may be viewed as somewhat incomplete given the research recommendations, in that they do not account for all of the specific issues and, in particular, are not holistically supported by fatigue doctrine and a comprehensive fatigue risk-management programme. The flying orders typically only address immediate duty period considerations. Some areas could be improved in light of available research, and further analysis by an operational working group would be required to determine specific recommendations for amendments to flying orders.

The RCAF may wish to initiate an operational working group to conduct a thorough review of both *National Defence Flying Orders* and *1 Cdn Air Div Orders* to assess the consistency of current regulations with fatigue research results with a goal of recommending appropriate amendments to the flying orders. As well, there may be value added through the development and implementation of a comprehensive fatigue risk-management programme, to include fatigue risk education and training as well as oversight and review authority of fatigue-related regulations. The Canadian Forces Aerospace Warfare Centre, in conjunction with the aerospace medical community, may be a logical choice to develop and promulgate appropriate doctrine on fatigue management issues for the Air Force.

CF Photo: Cpl Pierre Habib

Lieutenant (N) Tracy Coulthard is a bioscience officer and human factors analyst. She is currently posted to the Canadian Forces Environmental Medicine Establishment (CFEME) at Defence Research Development Canada, DRDC Toronto. Prior to joining the Canadian Forces, Lieutenant (N) Coulthard earned an Honours Bachelor of Science degree in Kinesiology at the University of Waterloo and a Master of Science degree in Mechanical and Materials Engineering at Queen's University. Her multidisciplinary academic background is complemented by several years of industry experience. She is a Canadian Certified Professional Ergonomist (CCPE) and holds the Canadian Forces Human Factor Engineering national qualification. Lieutenant (N) Coulthard has completed basic and advanced flight safety courses at 1 Canadian Air Division and continues to provide human factors advice to the RCAF, including Directorate Flight Safety.

Abbreviations

1 Cdn Air Div	1 Canadian Air Division
CF	Canadian Forces
DRDC	Defence Research Development Canada
FAA	Federal Aviation Authority
FS	flight safety
ICAO	International Civil Aviation Organization
RCAF	Royal Canadian Air Force

Notes

1. A-GA-135-001/AA-001, *Flight Safety for the Canadian Forces* (Ottawa: Department of National Defence, March 20, 2007, Change #6, September 4, 2012), 1-1/8.

2. Michel A. Paul and others, DRDC Toronto TR 2010-002, "Management of Circadian Desynchrony (Jetlag and Shiftlag) in CF Air Operations" (Toronto: Defence R&D Canada, DRDC Toronto, December 2010), 29.

3. Both quotes, Ibid., i.

4. Bob Cheung and others, DRDC Toronto TR 2010-056, "General Recommendations on Fatigue Risk Management for the Canadian Forces" (Toronto: Defence R&D Canada, DRDC Toronto, April 2010), 1.

5. John A. Caldwell and others, "Fatigue Countermeasures in Aviation," *Aviation, Space, and Environmental Medicine* 80, no. 1 (January 2009): 29–59.

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14. Cheung, 35.

15. Caldwell, 30–31.

16. H. Weinberg and G. Kenny, Transport Canada TP 13804E, "Measurement and Monitoring of the Effects of Work Schedules and Jet Lag on the Information Processing Capacity of Individual Pilots: Phase 2" (Ottawa: Transport Canada, Transportation Development Centre, June 2001), 6.

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18. Folkard, 98.

19. Goode, 311.

20. Powell, 1049–50.

21. Sarah Schmidt, "Pilots Question Transport Canada Stance on New Fatigue Guidelines," Air Canada Component of CUPE, http://www.accomponent.ca/en/news/pilots-question-transport-canadas-stance-new-fatigue-guidelines (accessed November 30, 2012).

22. *1 Canadian Air Division Orders*, Vol 2, 2-003, 1 Canadian Air Division, http://winnipeg.mil.ca/HQSec/1cadordr/orders_pdf_e.htm (accessed November 30, 2012).

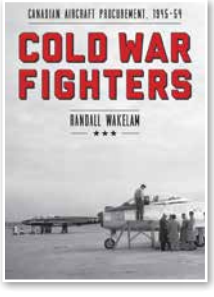
23. Ibid.

24. B-GA-100-001/AA-000, *National Defence Flying Orders*, Book 1 of 2, *Flight Rules* (Ottawa: Department of National Defence, May 2001) 2-2/4, http://winnipeg.mil.ca/cms/Libraries/ICP_Library/B-GA-100_-_Book_1_of_2_-_CH8_-_english_1.sflb.ashx (accessed November 30, 2012).

CF Photo

BOOK REVIEWS

COLD WAR FIGHTERS: CANADIAN AIRCRAFT PROCUREMENT, 1945–54



By Colonel Randall Wakelam, PhD, (Retired)

Vancouver:
UBC Press, 2011
187 pages
ISBN 978-0-7748-2148-3

Review by
Colonel Simon Sukstorf, CD, MBA, PEng

When reflecting on the development of aircraft in Canada in the 1950s, the Canadian psyche is dominated by the decision to cancel the Avro Arrow on February 20, 1959. What is often overlooked is that during this same period the same company designed and built the CF100 Canuck that served in the Canadian Forces inventory until 1981 and that another Canadian company, Canadair, produced almost 2000 F-86 Sabre aircraft for the rapidly expanding Royal Canadian Air Force (RCAF) as well as international customers. Herein is found the motivation for Randall Wakelam's superb book, *Cold War Fighters: Canadian Aircraft Procurement, 1945–54*. In the author's own words: "The genesis of the research was a combination of doing some RCAF history in an area (the strategic-operational-procurement interface in the years before the Arrow) which, ... receives little attention. ... I wanted to see what had happened behind the scenes."[1] In essence, this work reflects an expansion on the thesis he wrote for his Master's of Arts in War Studies while studying at the Royal Military College of Canada (RMCC).

Wakelam is a retired Air Force colonel who is currently serving as an assistant professor of history at RMCC. His meticulous research within the holdings of both the Library and Archives Canada (LAC) and the Department of National Defence's Directorate of History and Heritage (DHH) provides tremendous insight into the dynamics at play within the Chiefs of Staff Committee (the senior leadership from each of the services), the Cabinet Defence Committee, and the interplay between the two. Using original

source material, the book explores how the creation of the North Atlantic Treaty Organization (NATO) in 1949 as well as the perceived threat posed by the Soviet Union in central Europe created uncertainty regarding the structure of the RCAF within the strategic decision-making bodies in the Government of Canada and how this led to the production of the CF100 and F-86. The author's exploration of the links between government fiscal and industrial policy, the RCAF's requirements, and aircraft production options is particularly insightful when one considers how similar dynamics are shaping current aircraft procurement strategies.

The first three chapters of the book capture the debate behind the desired post-war force structure during the later stages of World War II and the immediate post-war period. Chapter 4 shows the dramatic change in thinking by the government of the day when the Soviet threat is first considered a real danger in early 1947. The ensuing three chapters examine the dramatic changes in the RCAF force structure and the willingness of the government to open the purse strings for RCAF procurement during the late 1940s and into 1950. Chapters 8 and 9 examine the challenges of implementing the rapid RCAF expansion due to orders having been placed for 790 F-86s and 728 CF100s by the end of 1951. In the final chapter, Wakelam reflects on the achievements and pitfalls of the era 1945–54 and notes the government's concerns that the increased size of the military may be unsupportable in the long term for a country the size of Canada.

In reading through the events and strategies employed by the RCAF and government leadership, one pauses to reflect on how the challenges faced in the early fifties have striking similarities to today. For example, the development of a communication strategy to convince Canadians of the need for the purchase of an American fighter aircraft (F-86) is strikingly similar to the approach taken in promoting the acquisition of the current American offering (F-35). From limitations imposed by the transfer of American technology to Avro, to the lobbying by unions for production work to be done in Canada, *Cold War Fighters* provides astute analysis of the factors that shape government decision making in major crown projects. Of particular interest is the exchange of letters between the Deputy Minister of Defence Production and Avro outlining the shortcomings with the company's management of the CF100 project, which uncannily foreshadows the inability of the company to effectively manage costs during development of the Avro Arrow.

In his review of the book *Empire of the Clouds: When Britain's Aircraft Ruled the World*, Dr. Sean Maloney muses that "[o]ne day a Canadian should write an equivalent work on our parallel national experiences ... ."[2] With the publication of *Cold War Fighters*, that day has arrived. Wakelam uses his previous experience in the Air Force and within the aircraft procurement environment to contextualize the archival material he has unearthed to render an exceptional examination of aircraft procurement that is as relevant today as during the 1950s. *Cold War Fighters* will be of interest to not only Air Force enthusiasts but also to military and civilian defence planners for gaining a better understanding of elements of a successful off-the-shelf procurement, as compared to the challenges in pursuing a developmental project. In the first instance, producing the F-86 at Canadair based on a standard American design illustrates the off-the-shelf approach, and in the second case, designing and producing the uniquely Canadian CF100 at A. V. Roe brings to light the risks associated with designing a new aircraft. As we look towards acquisition of the next generation of RCAF aircraft such as the F-35 and a replacement for the Buffalo, it is well to remember that old adage that "those who cannot remember the past are condemned to repeat it."[3]

Colonel Simon Sukstorf is currently the Director of Programmes at the Canadian Forces College. Previously, he worked within the Assistant Deputy Minister (Materiel) group on the Aurora Modernization Project and, most recently, for the Vice Chief of the Defence Staff as the section head charged with the review and staffing of all RCAF aircraft procurement projects.

Abbreviations

RCAF	Royal Canadian Air Force
RMCC	Royal Military College of Canada

Notes

1. Randall Wakelam e-mail to the author, December 19, 2011.

2. Sean Maloney, review of "Empire of the Clouds: When Britain's Aircraft Ruled the World," by James Hamilton Patterson, *The Canadian Aviation Historical Society Journal* 45, no. 1 (Spring 2011): 7.

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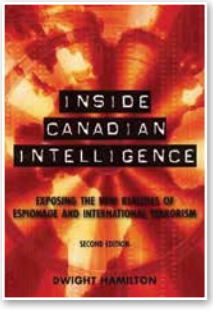
INSIDE CANADIAN INTELLIGENCE: EXPOSING THE NEW REALITIES OF ESPIONAGE AND INTERNATIONAL TERRORISM, 2ND EDITION



Edited by
Dwight Hamilton
Toronto:
Dundurn, 2011
316 Pages
ISBN 978-1-55488-981-7

Review by
Second Lieutenant Adam Rietman

Upon first glance, I could not help thinking to myself that this book was going to be a very quick read. The two words "Canadian" and "intelligence" are so seldom seen side by side that the notion of Canada having an intelligence branch seems preposterous. With the CIA (Central Intelligence Agency), FBI (Federal Bureau of Investigation), NSA (National Security Agency), DEA (Drug Enforcement Agency), and countless other acronyms from our neighbours to the south dominating the media and pop culture, it's no wonder our own agencies fall by the wayside. *Inside Canadian Intelligence* seeks to remedy this shortcoming and manages to do a fantastic job at providing insight into this neglected subject area.

Dwight Hamilton, with help from Kostas Rimsa, John Thompson, and Robert Matas, somehow manages to overcome the red tape associated with writing a book on a typically covert subject by giving the reader a detailed, unclassified view into the world of Canadian intelligence. The book does an effective job at covering most—if not all—angles of the overall theme by utilizing the experience and different perspective that each writer contributes. It starts off with a chapter titled "Know Your Enemy." This is a great way to start off the book because it describes in detail the type of enemy that the Western world is dealing with in the 21st century. If there is only enough time to read one chapter, I would highly recommend reading this one, and I would suggest that all military members read this chapter to gain a better understanding of the type of person we are fighting. The remaining chapters cover a wide variety of Canadian agencies including the Royal Canadian Mounted Police (RCMP), the Canadian Security Intelligence Service (CSIS), Army intelligence, and special operations forces (SOF) as well as a few of their operations, and more.

The book is an eye-opener for the Canadian population. It portrays the hard work individuals put into their jobs every day to maintain peace and security and protect this nation's interests. Unfortunately, there are still many problems that need to be overcome. There are two primary concerns which are addressed in this book. The

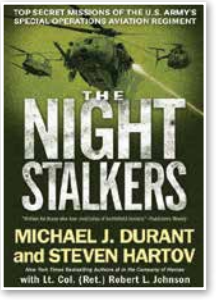
first, common to every government agency, is the lack of funds. While the RCMP and CSIS are doing a fine job with the amount of funds they are given, it is difficult to protect a nation as large as Canada while being understaffed and without the proper equipment. The second is a little disturbing, and that is the government's inability to act on the information it is given. Fortunately, the authors not only point out the problems with Canadian intelligence but also provide possible solutions to remedy these difficulties.

Overall, this is a well written book. I was quite surprised to find myself enjoying what normally would seem to be a dry topic. The style of writing and pace keeps the material entertaining, while maintaining the natural flow a book should have. The only thing to keep in mind when reading this book is that it was written by ex-members of Canadian Forces Intelligence Branch, RCMP, and CSIS. The tone makes this point quite evident, so do not be surprised if you find yourself scrutinizing the content, especially some of the solutions provided. I would recommend this book not only to anyone interested in learning more about the shady world of intelligence but to all Canadians, because Canada is not this pipe dream we typically perceive it to be, and upon reading *Inside Canadian Intelligence*, it is quite evident that action needs to be taken to strengthen our defences against international terrorism.

Second Lieutenant Adam Rietman graduated from the Royal Military College of Canada with a bachelor's degree in Physics and Space Science. He is currently employed at the Canadian Forces Aerospace Warfare Centre and is awaiting pilot training.

Abbreviations

CSIS	Canadian Security Intelligence Service
RCMP	Royal Canadian Mounted Police



THE NIGHT STALKERS: TOP SECRET MISSIONS OF THE US ARMY'S SPECIAL OPERATIONS AVIATION REGIMENT

By Michael J. Durant and Steven Hartov with Lieutenant-Colonel Robert L. Johnson (Retired)

New York:
G. P. Putnam's Sons Publishers, 2006
335 pages
ISBN 0-399-15392-6

Review by
Captain Scott Fuller, CD (Retired)

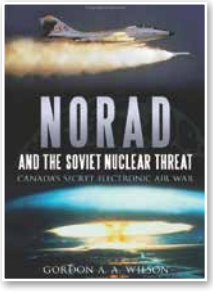
The authors of the best-seller *In the Company of Heroes* provide a rare insight into the covert and clandestine missions of 160th Special Operations Aviation Regiment (SOAR).

The book outlines the origins and development of the operational air capabilities and describes advanced night flying in several combat helicopters, including the MH-60L and K Black Hawks, the AH-6 Little Bird, and the MH-47E Chinook. The authors tell their tales in a frank, open and honest forum and provide many personal first-hand experiences in night-flying special operations missions.

The photography in the book adds a rare view of the air and ground crews of the 160th SOAR and provides a "face" of the human factor in air combat. The final chapter provides the names and memories of those killed on special operations and is a fitting tribute to their tenacity, courage, and dedication to their nation.

Recommended reading for professional development to everyone associated with tactical helicopter operations, doctrine, training, and aviation history.

Scott Fuller served 32 years in the Regular Force and 8 years in the Primary Reserve before accepting a position with the public service and is currently the Senior Procurement Officer at the Ottawa Detachment of the Canadian Forces Aerospace Warfare Centre. He is also a Director at Large for Policy Development for the North Atlantic Treaty Organization (NATO) Veterans Organization of Canada and a technical advisor to the Honours, Awards and Decorations Advisory Committee at Rideau Hall.



NORAD AND THE SOVIET NUCLEAR THREAT: CANADA'S SECRET ELECTRONIC AIR WAR

By Gordon A. A. Wilson

Toronto:
Dundurn, 2011
288 pages
ISBN 978-1-4597-0410-7

Review by **Officer Cadet Joe Huntley**

The topic of North American Aerospace Defence Command (NORAD) is one that should be of interest to any Canadian Forces (CF) member whose name tag sports a blue embroidered eagle. Reading about the institution from a first-hand observer (a former fighter/interceptor pilot, no less) was a particular treat. Gordon A. A. Wilson, author of *NORAD and the Soviet Nuclear Threat: Canada's Secret Electronic Air War*, certainly has the experience and professional connections to offer an "I was there" account of some of the operations and exercises conducted by NORAD. He provides great detail on the employment of the Avro CF100 Canuck and CF101 Voodoo aircraft. Unfortunately, his book provides only a sample of what went on in certain NORAD centres. As well, it is filled with mostly technical jargon, acronyms, and theory that most CF members would not find interesting.

The author's apparent intention when deciding on the format for this book was to provide readers with enough material in the early chapters to understand and appreciate the description of the exercise given in the final chapter, "Sparks in the Night Sky." While the information provided is undeniably directly related to the operations of NORAD, the author provides too much technical detail in some areas, resulting in some dry reading. An example of this can be seen in Chapter 7, where he provides the particulars on the evolution of the wing tip pod design for rockets used by the CF100 Canuck subsequent to a tragic flight test.

In the first chapter, "The Cold War," Wilson justifies the creation of NORAD by describing events leading to its development. The author provides an exhaustive chronology of events surrounding the cold war from the 1940s to the 1970s, spanning pages 20–31. The chronology describes certain key events such as the defection of Igor Gouzenko, the Korean War, the Cuban Missile Crisis, and the Vietnam War. Wilson provides the sequence of Russia's development of nuclear missiles, from early bomb tests to the successful launching of intercontinental ballistic missiles (ICBMs). Also included are the dates of events leading to the construction of the Berlin Wall; a physical representation of the divide between East and West. The entire first chapter successfully depicts the ideological war happening mainly between two superpowers: the capitalist United States of America (USA) and the communist Union of Soviet Socialist Republics (USSR). Chapter 1 seems quite relevant to the subject matter and is an interesting read, but it also marks the end of any engaging material for the reader until the final chapter.

The intervening chapters deal with the components that make up NORAD. The author describes how the governmental agencies of Canada and the USA came together in a joint effort to safeguard the North American continent when it was determined it was no longer out of reach of Soviet weapon technology.

The specific aircraft employed by Canada during the cold war years are described in detail, down to the pre-flight procedure followed by a Voodoo pilot. The operation of various radar systems that comprised the Pinetree Line, Mid-Canada Line, and the Distant Early Warning (DEW) Line are also explained in these chapters. However, the author provides too much detail on how radar works by defining terms such as *pulse size/width*, *pulse repetition time*, *pulse repetition frequency*, *scan patterns*, *signal-to-noise ratio*, and *receiver gain*.[1] Wilson also provides the frequencies used during the exercise that is described in the final chapter: "The band widths used in the AMALGAM MUTE exercise were the Delta (D) band, 1,000–2,000 MHz [megahertz], and Echo (E) / Fox (F) band, 2,000–4,000 MHz, for the ground-based search and height finder radar. The India (I) band, 8,000–10,000 MHz, was used for the airborne interceptor (AI) radar."[2] All of this information seems extraneous and appears to simply act as filler material to increase the page count of the book.

The final chapter describes an actual exercise that occurred on May 10, 1973, known as AMALGAM MUTE. The chapter describes how a CF100 Canuck was used as a target aircraft representing a Russian bomber infiltrating Canadian airspace and how CF101 Voodoo were used to intercept the simulated threat. The exercise is described in great detail. The author, while not participating directly, had direct contact with the participants and was able to provide a tremendous amount of information to help the reader visualize how the exercise played out.

Wilson quite obviously wrote this book for a specific target audience: military history buffs and pilots. The book offers countless technical tidbits that only historians would be concerned with and is written in such a fashion as to further glamorize (if that is possible) the pilot occupation in the CF. There are several instances of repeated material and comments making it appear that the book was written such that each chapter was independent of the others and that the editing process seems to have failed both the author and the reader. This book might be found interesting by those Air Force officers in the aerospace controller occupation who have followed the air weapons controller stream, but no other members would find this material relevant unless they were avid aviation historians looking to fill a one-inch gap on their bookshelf. This book should not be deemed as required reading for Air Force officer development, as it contains no material that would prove to enhance an officer's leadership toolset.

Officer Cadet Joe Huntley is presently in an on-job training program with the Canadian Forces Aerospace Warfare Centre in Trenton, Ontario, where he is engaged in various research assignments. He is in the midst of pursuing a Bachelor of Science degree at the Royal Military College of Canada in Kingston, Ontario, having completed two years in the Computer Science program.

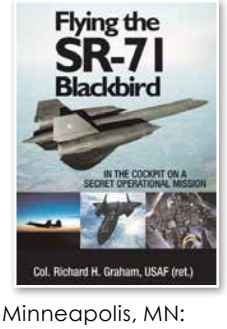
Abbreviations

CF	Canadian Forces
MHz	megahertz
NORAD	North American Aerospace Defence Command
USA	United States of America

Notes

1. Gordon A. A. Wilson, *NORAD and the Soviet Nuclear Threat: Canada's Secret Electronic Air War* (Toronto: Dundurn, 2011), 86–87.

2. Ibid., 86.



FLYING THE SR-71 BLACKBIRD: IN THE COCKPIT ON A SECRET OPERATIONAL MISSION

By Colonel Richard H. Graham, USAF (Retired)

Minneapolis, MN:
MBI Publishing Co., 2008
288 pages,
ISBN: 978-0-7603-3239-9

Review by **Captain Scott Fuller, CD (Retired)**

"It all begins with a desire," says the author, "a desire to fly the world's most secretive, highest and fastest plane."[1] The SR-71 aircraft was conceived, designed, tested, and flown by Lockheed's most famous division, The Skunk Works (also now chronicled in its own book by the same name), which was the highly secretive aerospace developer of the F104, the U2, the Have Blue stealth prototype of the F17, the B1 and B2 bombers, and other air assets. The SR-71 project was a joint development project of the United States Air Force (USAF) and the Central Intelligence Agency (CIA) to provide a platform to conduct very high altitude reconnaissance and surveillance and to acquire real-time intelligence imagery for national security.

The book reveals many facets of previously highly classified technical details of the SR-71 and its capabilities, most of which were once considered beyond top secret. It reveals the nickname of the SR-71 was "Habu," a common name for a poisonous black pit viper of Southeast Asia. It takes the reader from mission planning, preflight preparations, crew preflight protocols, the full range of instrumentation, preflight to takeoff procedures, and such operational aspects as mid-air refuelling (the Blackbird burns a *lot* of gas at high speed and requires several dozen mid-air refuellings during its flight operations). The author takes the reader through a full and formal briefing of conducting mid-air refuelling, cruising at Mach 3+ and deceleration, "hot" rendezvous with tankers, recovery of the aircraft on landing, and the conduct of operational mission debriefings. A final chapter deals with the subject of the demise of the Blackbird and its retirement.

The book contains considerable pilot information, including details of aircrew selection and training; however, as no flight simulators were ever used, there is considerable coverage of just how pilots dealt with a learning curve that indeed was that of the curvature of our planet, as seen from the cockpit of the SR-71.

Its author is a veteran of 15 years of top secret operational SR-71 missions, with considerable prior USAF combat flight time in 210 combat missions in Vietnam piloting the F-4C/D Phantom. He also had a post-USAF career in which he amassed a further 13 years as a commercial pilot for American Airlines, thereby acquiring another 8,000 flying hours. The author has written two additional SR-71 Books: *SR-71 Revealed: The Inside Story* and *SR-71 Blackbird: Stories, Tales and Legends*.

It is, without question, an exceptional source of flying and technical information on the SR-71 Blackbird. The book is highly recommended for all Canadian Forces aircrew and ground crew.

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Abbreviation

USAF United States Air Force

Note

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Saving NATO with Airpower

By Dr. Panayotis A. Yannakogeorgos and Dr. Adam B. Lowther

In the wake of the North Atlantic Treaty Organization's (NATO) fledgling victory in Libya, airpower has again moved into the limelight. Not since the air war in Kosovo (1999) has airpower played such an instrumental role in achieving American—and NATO—objectives. Whether Western-style democracy comes to power in Libya remains to be seen, but airpower enthusiasts have already learned an important lesson: airpower can play a decisive role in warfare. Even more dramatically, an alliance, whose relevance is coming into question, was able to perform such a feat. Operation UNIFIED PROTECTOR offered not only a victory but also an opportunity for NATO advocates to re-examine the relevance of airpower in the alliance as it tries to maintain significance in a world that, according to United States (US) Secretary of State Hillary Clinton, is pivoting toward Asia.[1]

Editor's note: This article has retained the American spelling and writing conventions.

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Understanding airpower

When the United States Air Force (USAF) recently modified the definition of *airpower* to include air, space, and cyber power, many analysts viewed this change as a conflation of three distinct domains. However, in doing so, the Air Force emphasized that, unlike the other services, it considers space and cyber not as enablers of operations but as maneuver environments—that facilitate improved operations. This broadened understanding of airpower has the potential to offer a new framework for employing it in ways not previously contemplated. For example, the defeat of integrated air defense systems by means of cyber power reflects the capability of this new conception of airpower.[2] It also gives airpower strategists the opportunity to consider new ways in which NATO air forces can employ cyber and space power to attain the global stability sought by the alliance.

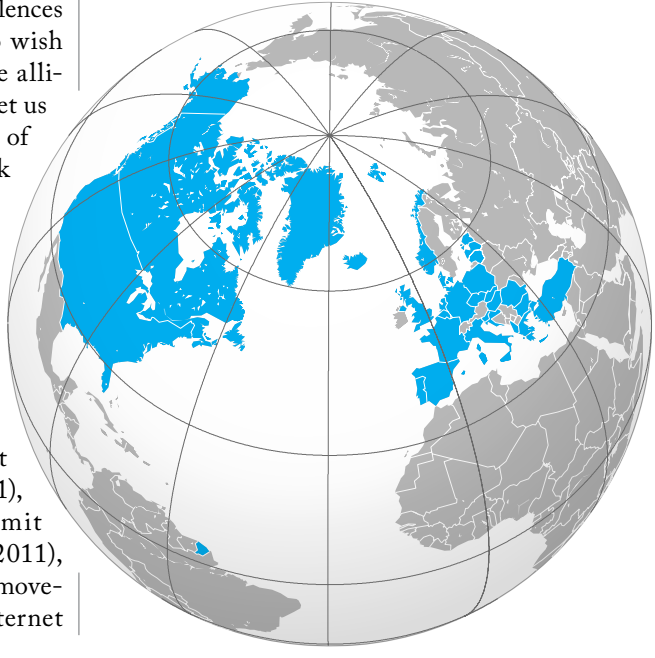
AIRPOWER
air
space
cyber

Moreover, the USAF can now supply NATO with a new sine qua non that silences the chorus of NATO opponents who wish to further reduce America's role in the alliance. To better clarify what we mean, let us offer a glimpse into the future as a way of explaining what a way ahead might look like.

Into the future

Technological advances are bridging the digital divide in the Third World.[3] Increasingly, people who enter the information society reshape both global and local politics.[4] As we have observed in recent protest movements—as in Athens (2008, 2011), Iran (2009), the Pittsburgh Summit (2009), Thailand (2010), London (2011), and the ongoing Occupy Wall Street movement—individuals use converged Internet and cellular technologies such as Twitter and Facebook to spontaneously organize themselves into groups that begin with nonviolent principles but in some cases turn into violent dissent.[5] Technological adoption is also transforming advanced air forces from those focused on air and space services—with limited space and cyber capabilities—into cyber, space, and air forces whose air assets no longer lead the way. USAF's pilot-dominated leadership and culture will soon give way to cyber and space warriors who wield information and communications technology (ICT) as their principal weapon.

Given the rapid pace of technological and organizational change, airmen must prepare for a future in which conflicts among great powers may once again prove likely. However, these wars will occur largely in the cyber and space domains.[6] In light of the revised definition of *airpower*, air forces will play a leading role in future conflicts; nevertheless, NATO member nations cannot eliminate their conventional and nuclear forces. The success of these capabilities will drive adversaries to challenge the West in space and cyber—where its advantage is least perceptible.



CF Photo

Further, the dispersion of ICT and its enabling of new forms of innovation will pose significant challenges to sovereignty and security across NATO as well as globally. Non-state actors (empowered by ICT, networked organizational dynamics, and financial assets that may surpass those of the countries in which they operate) may begin to erode sovereignty in weak and fragile states—some of them in Europe or in close proximity.[7] As we have observed in Lebanon with the rise of Hezbollah, non-state actors may even take control of the state, creating hybrid "netwar" threats.[8] Airpower (air, space, and cyber) is best positioned to combat such adversaries as they try to influence or cause harm to NATO partners.

Weapons proliferation among state and non-state actors—coupled with rapidly developing ballistic missile technologies, directed energy, high-speed computing, and artificial intelligence—presents new security risks as well.[9] Airmen—whose profession emphasizes science, technology, engineering, and mathematics—can best deal with these emergent challenges in the 21st century. Should NATO airpower play a central role in defining this new strategic environment, air force leaders will exert substantial influence on their nations' tactical, operational, and strategic options. Additionally, if airpower wishes to effectively defend global and regional stability, it must concentrate on deterrence; partnering; and the integration of air, space, and cyber capabilities to meet the dynamic hybrid issues involving conflict during this century.[10]

Admittedly, there are a variety of organizational constructs in NATO. Where, for example, the United States places much of its space capabilities with USAF, other NATO nations do not. These differences of approach will pose challenges to the vision we suggest, but as with most challenges, they can be overcome through a collaborative process.

Deterrence

Although many individuals wish otherwise, deterrence, in point of fact, remains critical to NATO, particularly in light of a resurgent Russia, China's expanding nuclear force, a nuclear North Korea, and Iran's nuclear program.[11] The nuclear umbrella,

vital to European security for more than six decades, has not diminished in importance. Deterrence, however, entails more than just a nuclear capability. Broadly speaking, the effectiveness of deterrence depends upon policies focusing on thwarting adversaries across the spectrum of threats generated by peer competitors, rogue regimes, and non-state actors—operating across all domains.

A generation after the cold war's end, nuclear-capable aircraft remain the single best means of deterring NATO's (nuclear) adversaries—through visible escalation and de-escalation.[12] One should never consider preservation of this critical capability's long-term viability as a simple task. It is not. Airmen must position themselves to develop effective policies that will both deter the most likely threats to allied interests and ensure the sustainability of extended deterrence.

Maintaining alliances, building partnerships, and forging coalitions

Transformation of the alliance. Historically, alliances have proven anything but static. In the case of NATO, changing political, economic, and security conditions in the post–cold war period led to its acceptance of former Warsaw Pact countries as members.[13] Even though NATO's sovereignty no longer faces a threat, it continues to evolve. Recognizing these changes, the United States remains an essential member that is effectively balancing Europe "on the cheap."

A central asset to the American effort in Afghanistan, NATO airpower provides ground forces with airlift, firepower, surveillance, and reconnaissance. Consequently, violent Islamic extremism has directed its attention to one of the least accessible and developed countries on the Earth—rather than Europe or the United States. Furthermore, recent operations in Libya illustrate an emerging trend where the United States serves as a willing and able partner, but does not take the lead.

The geostrategic reality of the Asia-Pacific region's emergence as a hub of global finance, trade, and maritime flows is shifting the axis of power east. Over the past two decades, Asia has surpassed Europe as the United States' principal trading partner.[14] As demands for social and other economic programs compete with defense investments in Europe and the United States, alliance nations will find themselves searching for ways to maintain a full range of air, space, and cyber capabilities to meet ill-defined but lethal threats half a world away. Although some aspects of US partnering have roots in current conflicts, old partnerships must persist and evolve. Preserving that continuity will demand a form of "airpower diplomacy" that leverages airpower as a tool for maintaining local, regional, and global stability by preventing conflict, providing aid and assistance, and transmitting constructive skills to those who want and deserve NATO assistance.[15]

This cost-effective approach limits the number of permanent US overseas bases and large troop deployments. Admittedly, some conflicts will necessitate rapid response and intervention. However, the deliberate application of airpower as part of a diplomatic campaign could leverage the alliance's soft-power capabilities before members exercise hard power. In a future in which defense acquisition programs face considerable competition for limited resources, the ability of airmen to conduct both soft- and hard-power missions will give policy makers valuable options to cope with complex security issues.

Coalitions of democracies. Formal alliances simply cannot address every security concern. As Operation ENDURING FREEDOM indicated, coalitions of like-minded states must come together to reach common objectives when the structures or politics within alliances prevent their members from acting. Currently, USAF supports broader diplomacy by building partnerships and maintaining security cooperation.[16]

Airmen across NATO should prepare themselves and their services to offer greater contributions to produce a wider range of constructive effects that synchronize with policy and diplomacy. As operations in Afghanistan and Iraq clearly illustrate, by the time irregular conflicts evolve into major combat operations, the price to alliances and coalitions is too high. A better strategy lies in partnering with like-minded states and using airpower capabilities (when appropriate), precluding the need for NATO ground forces.

United States Africa Command's (USAFRICOM) approach exemplifies the types of missions that combatant commanders may need to perform in the future. USAFRICOM's efforts to prevent conflict by emphasizing partnerships, peace, and stability reflect its use of soft power.[17] Africa's lack of transportation infrastructure lends itself to employing airpower to support diplomacy through a number of programs that may one day pay substantial dividends. Demand for such capabilities may intensify over the next two decades, as described in the *Air Force Security Cooperation Strategy*.[18] Thus, the alliance's airpower assets should be able to conduct a wide range of soft-power—airpower diplomacy—operations around the world as national leaders call on air forces to expand their diplomatic efforts.

Moving Forward

Integration and resourcing. As airmen move toward the future, the force structure—and, consequently, force-development programs—must change to emphasize the integration of manned and remotely piloted aircraft, space, and cyber-power projection capabilities. In other words, when formulating options to defend the nation's interests, airmen should present proposals that fully integrate air, space, and cyber capabilities into the solution.

The military is no longer confined to organizing for linear warfare. In the late 20th and early 21st centuries, militaries dealt with natural disasters, humanitarian relief operations, resource conflicts, terrorism, small-scale conventional conflicts, and insurgencies.[19] Flexible power projection is certain to prove critical to allied success in these conflicts. In a global security environment marked by the proliferation of advanced anti-access and area denial systems, alliance forces will find it increasingly difficult to establish secure bases within striking distance of great-power adversaries, a situation that demands options for long-range airpower projection.[20] Without a doubt, NATO air forces cannot offer their nations a more essential capability than successful power projection.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For air forces, power projection can take many forms, such as long-range strike, airlift,

and aerial refueling, but the future will also call for something new. As the century unfolds, countries will expect their airmen who operate in joint, alliance, and coalition environments to eschew compartmentalized solutions in favor of comprehensive options that represent the capabilities of their services.

Future conflicts may resemble the recent Russo-Georgian clash, in which a cyber offensive preceded Russia's conventional attack.[21] Cyber weapons will more frequently target critical infrastructure, as did the Stuxnet computer worm.[22] Thus, conflicts will involve more specific targeting in terms of time and space, and the first salvos of a conflict may avoid detection until the second- and third-order effects of initial strikes manifest themselves—especially in any conflict that pits NATO against Russia, whose cyber capabilities are among the best in the world. Rather than rely solely on traditional integrated air defenses, adversaries will compete for control of the air, using integrated denial strategies informed by space- and cyber-based surveillance, reconnaissance, and attack coupled with high-performance missile systems designed to complicate deployment and operations for intervening air forces.[23] These scenarios will place additional stress on airpower leaders and their forces.

An irregular conflict against non-state actors may give rise to two potentially divergent missions for NATO air forces: fighting as members of joint or coalition forces or enabling partners to fight on their own. The former requires using traditional airpower assets; the latter, leveraging key tools such as training, education, and assistance. NATO air forces can conduct either mission. The leveraging of key tools, however, is proving particularly difficult. At present, USAF possesses limited capabilities, other than its Special Operations Command, to carry out such endeavors. However, this does not apply to some NATO members who have long focused on soft-power missions.

Fusing air, space, and cyberspace. NATO air forces must begin the process of fusing air, space, and cyber capabilities into existing and future platforms and systems. For example, aircraft currently rely on the global positioning system—a hybrid cyber and space asset—as well as a range of information technology systems, but much more is possible at the individual platform level and in support of command and control.[24] Integrating offensive and defensive capabilities across the three domains will prove a key enabler and force multiplier over the coming decades, suggesting the need for systems, operators, and organizations capable of producing effects in more than one domain. NATO members, therefore, should work together closely in developing interoperable systems.

CF Photo: Cpl Pierre Habib

Airpower organizations must continue to refine their unique, flexible means of power projection. For instance, in a conflict with a peer competitor that threatens national sovereignty and vital interests, the calculus for determining appropriate responses is relatively direct. However, in an irregular conflict involving limited interests, determining the appropriate course of action becomes more difficult.[25] Thus, scalable options are needed for airpower projection capabilities that often serve as the single best tool available—a challenge that has proven problematic in current warfare.

Developing remotely piloted platforms enhanced by artificial intelligence—thereby enabling lethal, autonomous operations—will support conventional airpower projection missions.[26] Moreover, such systems may prove critical psychological tools in peer competition.[27] Near-peer adversaries may also view the employment of these aircraft as a reason to cooperate with NATO.

USAF Photo: SSgt Derrick C. Goode

Undoubtedly, the alliance's members will have to design such systems within new legal and ethical frameworks, working jointly in their development.[28]

Extending the range and loiter time of existing and future platforms will have a similar effect. Improving the range of air-breathing platforms will also delay or prevent compromising one of airpower's greatest advantages: the ability to operate from secure locations outside an adversary's reach. The likely continuing drawdown in American overseas forces and the number of operating bases available globally must be offset not only through a closer relationship with US allies but also with long-range power-projection systems capable of holding targets at risk without access to nearby bases.

Offensive and defensive cyber capabilities must be fused into air and space platforms. In the near future, such capabilities may become the greatest power-projection tools in NATO's arsenal, serving as both force multipliers and an Achilles' heel. Several nations already have fielded impressive means of launching cyber attacks and exploiting vulnerabilities within control systems for commercial and critical infrastructure.[29] Despite ongoing attempts to organize, train, and equip to meet cyber requirements, airmen across the alliance must recognize that the ability to conduct robust cyber operations is essential to both the current and future operation of non-cyber elements of the force.

Finally, airmen must take a more aggressive approach to developing cyber as a capability—understanding that flying, fighting, and winning depend on seamlessly integrating cyber with air and space power. Cyber superiority will ensure the reliability of data used for decision making in all domains. The global nature of cyberspace makes alliance cooperation even more important than in the other domains, given the global extent and near light speed with which cyber disruption occurs. Ad hoc support rescued Estonia from the disruption of digital services by malicious cyber actors. These attacks did not cross the threshold of cyber war, but they highlighted the fact that the alliance did not have a strategy or doctrine of response to specific acts against partners' sovereign cyberspace. Although NATO's establishment of the Cooperative Cyber Defence Centre of Excellence "provides [the alliance] a wide range of products and services in the domain of cooperative cyber defence, it is not an operational centre, and does not fall within the NATO command structure."[30] Its mission is to "enhance the capability, cooperation and information sharing among NATO, NATO nations and partners in cyber defence by virtue of education, research and development, lessons learned and consultation."[31]

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Such a concerted effort will allow NATO to formalize strategy and maintain a doctrinal edge by fusing knowledge to develop a formidable cyber force. America's recent sponsorship of the centre, after norm entrepreneurs articulated a need for the institution, will assure its success.[32] USAF figures prominently in this endeavor by bringing its robust body of cyber knowledge forward to assist alliance members as they forge a common framework, recognizing cyberspace operations as a critical specialty for airmen.

Conclusions

Reinvigorating strategic thought within NATO air forces calls for developing an understanding of the essential capabilities the alliance will need to meet future challenges. The geostrategic environment that NATO will encounter in the 21st century is certain to bring new threats and opportunities that diverge significantly from those it confronted in the 20th century. Specifically, responding to situations that require out-of-area operations will place greater emphasis on long-range power projection by alliance air forces. Defending allied interests in the Asia-Pacific region—considered by many individuals the 21st century's center of commerce and power—will sometimes demand that NATO airmen fly long distances to reach primary operating areas either inaccessible or denied to sea or ground forces. Such challenges will necessitate innovative thinking, especially in the use of cyber power, if the alliance wishes to maintain global and regional influence during a time of constrained defense budgets. Continued success will likely come as cyber and space are integrated with traditional air capabilities—a particularly important capacity in an Asia-centered world.

The NATO alliance proved its value during the cold war and may do so in the future. Throughout its history, airpower has served as a cornerstone of that alliance and will continue as such well into the future. This status is certain to prove prophetic if Europe remains peaceful and subject to external threats. To prepare for any future scenario,

airmen must adapt their understanding of airpower to conform to the needs of evolving technological trends and their influence on the international security environment. Doing so will ensure that the alliance and individual nations continue to enjoy the benefits of freedom and security.

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Abbreviations

ICT	information and communications technology
NATO	North Atlantic Treaty Organization
US	United States
USAF	United States Air Force
USAFRICOM	United States Africa Command

Notes

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