

Archived Content

Information identified as archived on the Web is for reference, research or record-keeping purposes. It has not been altered or updated after the date of archiving. Web pages that are archived on the Web are not subject to the Government of Canada Web Standards.

As per the [Communications Policy of the Government of Canada](#), you can request alternate formats on the "[Contact Us](#)" page.

Information archivée dans le Web

Information archivée dans le Web à des fins de consultation, de recherche ou de tenue de documents. Cette dernière n'a aucunement été modifiée ni mise à jour depuis sa date de mise en archive. Les pages archivées dans le Web ne sont pas assujetties aux normes qui s'appliquent aux sites Web du gouvernement du Canada.

Conformément à la [Politique de communication du gouvernement du Canada](#), vous pouvez demander de recevoir cette information dans tout autre format de rechange à la page « [Contactez-nous](#) ».

2002 NEW HORIZONS

**SIMULATED AND LIVE TRAINING: THE NEED FOR A BALANCED
APPROACH TO ENABLE THE CANADIAN FORCES TO MEET THE
CHALLENGES OF THE 21ST CENTURY**

By:
Major R.A. Geddes

This paper was written by a student attending the Canadian Forces College in fulfilment of one of the requirements of the Course of Studies. The paper is a scholastic document, and thus contains facts and opinions that the author alone considered appropriate and correct for the subject. It does not necessarily reflect the policy or the opinion of any agency, including the Government of Canada and the Canadian Department of National Defence. This paper may not be released, quoted or copied except with the express permission of the Canadian Department of National Defence.

The competitive marathon race was first run at the 1896 Athens Olympic Games. Of the 17 runners, 13 were from Greece and they had all been selected after completing a realistic training run of the course. The four foreign competitors were all experienced distance runners, albeit at shorter distances - they did not appreciate, and did not complete realistic training for, the unique challenges of a marathon race. These Olympic contenders included the three top finishers in the 1500-meter run, Edwin Flack of Australia, Arthur Blake of the United States, and Albin Lermusiaux of France, along with Hungary's Gyula Kellner. More

than halfway through the race, those four held the top four spots. Then an uphill stretch took its toll and the unanticipated realities of this new contest saw those who had completed realistic training prevail. Blake dropped out and Lermusiaux collapsed just before the 20-mile mark. Flack had never come close to running 25 miles before and Spiridon Louis caught and passed him at about the 21-mile mark. Two and a half miles further on, Flack fell and was carried off the course. Charilaos Vasilakos finished second, more than seven minutes behind Louis. Kellner took third place.ⁱ

INTRODUCTION

The Canadian Forces (CF) have receded below the critical mass necessary to guarantee a sustained and effective capability to train personnel to meet the military requirements of the 21st century.ⁱⁱ This sorry state is further reflected by LGen (Retired) Évraire's conclusion that "the general readiness, deployability and sustainability of the CF remain in doubt".ⁱⁱⁱ Regrettably, the lengthy post World War II period of peacetime, largely earned for Canada by others, ushered in a decline towards a more "business-like" organization and away from a traditional military - as opined within this post-unification rumination:

There seems to be a concerted effort to prevent the advancement of any young officer who deviates from the nice, neat, grey middle ground. ...those people with the greatest lust for life are the ones most likely to attempt, in defiance of all logic, to achieve the "impossible" goal.^{iv}

Nevertheless, modern military training requirements are characterized by an ever-increasing complexity of weapons systems, as well as ever-mounting constraints upon the resources needed to complete realistic training.

Furthermore, as the ultimate marshals of national force,

military leaders are obliged to "...exercise...Inferior Officers and Men..."^v to ensure that the necessary training is completed by subordinate individuals and formations. Moreover, military service is a high-risk undertaking, a reality most recently reinforced by the tragic loss of four Canadian soldiers in the Afghanistan theatre of the current war on terrorism. Indeed, more than 100 Canadians have lost their lives while on peacekeeping duty^{vi} and the Royal Canadian Air Force (RCAF) lost 2,367 lives in the British Commonwealth Air Training Plan located throughout Canada during World War II - 14% of all RCAF casualties suffered during the whole war^{vii}. A CF commitment to excellence in realistic training is absolutely essential to face the current complexities and constraints associated with the attainment of military readiness while reducing the risks to Canadian service personnel.

This essay comprises three main sections entitled military readiness, technology advances and the training continuum. Initially, a discussion of military readiness considers the relevance of experience within the context of traditional realistic training. Also covered in this section are the costs associated with such training, the increasing obstacles to conducting realistic training, the consequences of not conducting realistic training and the subsequent steady recent decline of military readiness. The second section considers various technological advances that have

been employed to augment live training. These solutions include simulation, virtual reality and distributed interactive simulation. A review of some of the human factors related to training and interaction with advanced technology is also included in this section. Moreover, the experience and opinions of serving Army, Navy and Air Force officers are also provided in this section. Much of this military specialist input has been garnered from papers written while these officers attended military Staff Colleges. Although it may be argued that such works do not always represent the epitome of academic rigor, collectively they are deemed most pertinent to the challenges of delivering realistic training for current and future members of the CF. The third and final section includes material related to ongoing efforts to implement a balanced realistic training continuum with live fire military exercises augmented by - not replaced by - technological simulations.

This paper will develop the position that a careful balance of both simulation and live training is required to achieve the realistic military training necessary to face CF challenges in the 21st century. Technological solutions have been successfully employed to satisfy many military training requirements; however, although continuing to improve, they remain insufficiently realistic to obviate the essential military requirement for regular live fire exercises.

Allied nations have recognized that a realistic contemporary

military training continuum (including a range of elements from low technology solutions, increasingly complex computer simulations, networked assets, as well as the essential retention of live fire training) is an essential expenditure to ensure operational military readiness. The CF must continue to invest in a realistic military training continuum including regular live fire exercises augmented by evolving technological simulations.

SECTION ONE - READINESS

Experience is essentially that quality allowing one to reach back into a wealth of actual observations dealing practically with real events. On July 23, 1983 the crew avoided catastrophe when an Air Canada 767 airliner ran out of fuel and made an emergency power off landing at Gimli, Manitoba. The emergency sequence of events was completely unforeseen and no 767 crew training existed to prepare them to carry out a safe landing under such conditions. The remarkable outcome, characterized by very minor injury to people and little damage to the aircraft, was attributed to the experience of the crew. The pilot at the controls was a skilled glider pilot and he employed these talents to safely land the "Gimli Glider" using a non-standard glide path approach while avoiding a large number of people, vehicles and equipment engaged in using the runway for drag racing. The co-pilot was an ex-military pilot familiar with the

Gimli airfield - which was the only possible place for the disabled aircraft to land.^{viii} Arguably, another crew in that identical situation, and without the relevant experience, may have been unable to achieve the same very favourable outcome. The modern, albeit streamlined, training provided to these pilots by the airline had to be augmented by their unique experiences in a fashion that demands consideration for future military training to be bolstered, and made increasingly realistic - to counter reduced experience levels and increasingly constrained opportunities to complete live training.

Clearly it would be ludicrous to suggest that only experienced warriors can successfully conduct war. However, it is widely accepted that real battle experience offers a large advantage to those confronting foes with no prior exposure to the horrors and fog of war. The challenge to maintenance of military readiness, particularly during periods of extended peace, is to blend the thoughts of visionaries with the experiences of others to form realistic training methods which can equip uninitiated soldiers to function effectively and survive during military operations. All military training short of real war will be, by definition, a simulation of sorts. The requirement, then, is to achieve a level of simulated realism sufficient to develop relevant experiences allowing soldiers to

effectively fight, survive and win in future arenas against, as well as alongside of, those who are experienced.

During extended periods of peacetime the development of military experience depends heavily upon realistic training. Experience is a vital element for the leaders and members of military units. Indeed, Lieutenant-Colonel Horn has concluded that the decreased intake of experienced leaders and soldiers into the Canadian Airborne Regiment was a key factor in the "ultimate ruin of the Regiment".^{ix} This concept is echoed at Squadron Leader Birtwistle's examination of the USAF pilot retention crisis. He concludes that the vicious spiral of downsizing, funding cuts and reduced flying rates limit the opportunities for gaining relevant experience and "there is no substitute for time in the cockpit - when it comes to addressing the supervisory vacuum developing."^x Unfortunately, experience cannot always guarantee an appropriate military decision-making process. An analysis of the factors contributing to the crash of a B-52 bomber at Fairchild Air Force Base in June 1994 explored the failures of experienced pilots and supervisors that contributed to a "state of apathy and non-compliance".^{xi} Ironically, this accident revealed a very skilful pilot who had often demonstrated bad judgement while flying but was nevertheless able to rise unchecked to a senior position where he directly caused the tragic loss of life. Realistic military training must develop those

positive and useful experiences that Lieutenant-Colonel Horn and Squadron Leader Birtwistle recognize as necessary to allow personnel to effectively and innovatively deal with the challenges of military leadership. Moreover, this ongoing training must include sufficient standards to identify and quash such flaws as those which contributed to the B-52 bomber crash at Fairchild Air Force Base in June 1994.

In 1995 Lieutenant-Colonels John T. Davee and James A. Colley II examined lessons learned during conflicts from the Vietnam War through the Gulf War and their work reinforced the critical requirement for realistic air combat training. They described how exercise Red Flag was developed, following an analysis of failures in the Vietnam air war, to significantly increase the survivability of new aircrew by a highly realistic replication of their first ten combat missions. They also depicted exercise Air Warrior, another highly realistic training exercise, conducted to develop USAF and US Army interoperability, specifically for close air support operations. Moreover, their study emphasized that "the key to success now in the face of growing world uncertainty, declining budgets and continuing force reductions is to regularly conduct realistic joint and combined training."^{xii} Augmenting this line of thought, in 1999 Major Whiddon argued for doctrinal development as a critical element of evolving realistic training.

Specifically, he concluded that the USAF success in Operation Desert Storm should not be viewed as a laurel upon which to rest, but rather argued for "doctrinal development to deal with growing asymmetric threats and increasing op[erational] tempo in regions of world uncertainty".^{xiii} Therefore, effective realistic training must strive to wisely learn and apply the lessons of the past and present while ensuring the development of experiences and judgement able to deal with the challenges of the 21st century.

Military readiness requirements demand continual threat analyses to ensure that adequate investment in realistic training, especially in the face of diminishing defence expenditure, is made to sustain forces at the required level for employment.^{xiv} World War II represented a period when both the resources and commitment to realistic training were not lacking. In his World War II pre-Normandy invasion "Some General Notes on What to Look for When Visiting a Unit", Lieutenant-General B.L. Montgomery demanded realistic collective training^{xv} and it was this time-consuming, systematic approach that directly contributed much to the remarkable success of the Allied amphibious operation in Normandy during June 1944. The contemporary situation is reflected by the following statements, from the Conference of Defence Associations and the Standing Committee on National Defence and Veterans' Affairs, which both depict the eroded ability of the CF to conduct what these two

entities see as appropriate levels of realistic military training:

There are insufficient funds in the [Canadian] D[eartment of] N[atational] D[efence] budget for the sea, land and air elements to carry out appropriate levels of collective training. As a result, over the last number of years, there has been an erosion of operational skills at the tactical, operational and strategic levels.^{xvi}

The brigade is the critical mass required for effective joint training and there has not been a brigade level exercise in over nine years. This has serious implications for both combat effectiveness and leadership.^{xvii}

Indeed, this erosion of military readiness is not unique to Canada, according to US General (Retired) Wesley Clark, former Supreme Allied Commander Europe:

"One of the most obvious features of the conflict [in Kosovo] was the West's lack of preparedness when conflict actually began. This is likely to be a pattern which we will see again, despite all efforts."^{xviii}

In short, realistic training is critical to military readiness but the ability to complete live training, especially at the joint and combined levels, has been seriously compromised as a result of steadily declining defence expenditures.

The United States (US) military is committed to train as they will fight and recognize that training and testing ranges are central to continued military readiness - "realistic combat training requires operations on actual ranges".^{xix} However, the availability of realistic training is rapidly eroding within the US because of competing pressures for real estate, airspace and the electromagnetic spectrum.^{xx} That said, almost all Canadian military ranges have been subjected to ongoing political, environmental or

developmental pressures. The Cold Lake Air Weapons Range^{xxi} in Alberta is an example where the military is being actively challenged by the indigenous Dene Sulene community while also sharing the range with very active oil industry developers. In sum, the CF must strive to maintain access to essential live training ranges. If not within Canada, then access to ranges outside of this country is considered essential to ensure military readiness or preparedness or both.

Realistic training is expensive - but the cost of not doing it is much more expensive when the consequent casualties or mission failures, or both, occur. The "Report of the Standing Senate Committee on National Security and Defence, Canadian Security and Military Preparedness", concludes that an increase of one billion dollars per year for five years and an increase to an effective strength of at least 75,000 regular force members is essential just to stabilize the CF. With respect to ensuring interoperability with allied nations, the report also concludes that Canada will have to additionally increase the level of military expenditures.^{xxii} With the costs associated with procuring and operating military equipment increasing, while environmental policies restrict the military's ability to conduct exercises, opportunities for training with operational assets are likely to continue to diminish. Given the conclusion that, in order to be effective, training must be conducted in a

realistic operational environment alternatives must be found to compensate for the reduced availability of live training. Captain Chris Waite of the Royal Navy voices what has become an increasing desire to employ technology for some portions of realistic military training. He anticipates that rapid advances in the use of synthetic environments will contribute to providing a cost effective alternative to much of the training currently conducted with operational assets^{xxiii}.

SECTION TWO - TECHNOLOGICAL ADVANCES

Modern weapons systems are characterized by an increasingly complex human/machine interface. Indeed, they often have the potential to rapidly overload their operators' own capabilities, and thus the developers "must support careful empirical evaluation of new interface and support technologies to ensure that the problems prevalent during [earlier developments] are not re-created anew".^{xxiv} Beyond individual weapons systems, modern battlefield environments include both the rapid generation and distribution of enormous volume of data to decision makers. "Team situational awareness becomes increasingly difficult, especially as technology allows greater team member dispersal".^{xxv} For example, within the modern battlespace, the reconnaissance role is an extremely demanding one resulting in challenging issues for the development of

operator workstations, crew task distribution and maintenance of situational awareness.^{xxvi} In response to this challenge, the CF continues Intelligence Surveillance Target Acquisition and Reconnaissance (ISTAR) implementation as an "essential contribution to the commander's capability to be cognizant of the battlespace".^{xxvii} This ongoing ISTAR evolution will demand the development of new operator interfaces and the requisite realistic joint and combined training to effectively employ this capability. Complexity and cost argue against the completion of all such training during live exercises. However, the critical nature of this evolving capability demands that personnel be trained within scenarios made as realistic as possible.

Simulation can provide realistic, safe and relatively cheap training but, as will be shown in the following examples, it has not yet been perceived as a panacea. For example, the USAF F-15 Air-to-Air Combat Simulator (AACS) allows a fighter element to conduct realistic training at one-eleventh the cost of employing operational aircraft to meet the same training objectives. Major Randy Taylor, a combat experienced F-15 pilot strongly endorses the AACS as greatly enhancing operational capability but goes on to recommend that the currently allocated annual flying hours per pilot should not be reduced.^{xxviii} Although not deeply elucidated in his report, this position is consistent with Army and Navy observations as shown in the following examples. In 1998

Major R.B. Ewing concluded that the Canadian Army should increase the use of simulation, but only to augment - not replace - live training.^{xxix} The Weapons Effect Simulation Project^{xxx} represents Army commitment to the increased use of simulation. In 1999, LCdr W.S. Truelove concluded that, from a Naval training environment perspective, over-reliance on simulation in training could be counter-productive and potentially dangerous.^{xxxi} Specifically, the theme will be seen to emerge that while simulations can allow excellent controlled training, there are many aspects of the real world experience which cumulatively contribute to the completely realistic training deemed essential to the development of military experts and leaders. This line of reasoning is particularly abhorrent to managers who would seek to save money by absolutely minimizing the opportunity to employ operational military equipment and instead rely almost exclusively on simulation systems to sustain military readiness. Another common theme in these examinations is the need for specialized simulator instructors. These individuals are critical to the success of simulator training and, until the simulator is exactly like the real thing, there should be no expectation that any operator can optimally instruct on the simulator without achieving and maintaining a specialized qualification. These examples illustrate common tri-service perceptions that simulation can provide realistic training, but in an augmentation capacity to - rather than a replacement for - live training.

Returning briefly to the running analogy, modern gymnasiums offer sophisticated simulated alternatives to outdoor running. Air conditioning, panoramic displays, computer controlled treadmills, incorporating programmable speed and slope changes, can all be combined to provide remarkable simulations - one can even "almost" run the original marathon race with Spiridon Luis. However, these hamster-like environs don't yet take runners through the extremes of hypothermia, heat exhaustion and dehydration that real running offers. Furthermore, it is very difficult to replicate the sights, smells, sounds and outright energy that comes from running among thousands of others, let alone the vagaries of weather to overcome and the intricacies of strategy which must be mastered to finish with a planned time. The Army's Small Arms Simulation experience is instructive in a similar vein. During the efforts in the 1990s to reduce costs, increase training effectiveness and reduce Army infrastructure, there ensued a rush to simulation - including the rapid procurement of a small arms simulator. When a Directorate of Army Training trial was eventually conducted to validate the system it was determined that certain light, temperature and weather conditions were not simulated well enough to consider the training realistic for the shooters. Therefore, the trial report recommended a blended training approach employing the simulation system as well as live fire training.^{xxxii}

Simulator performance is constrained by both the completeness and accuracy of requirements specifications as well as by the existent technological limitations to the fidelity of simulated outputs. These not atypical simulator deficiencies/idiosyncrasies are a significant factor in the development of specialized simulator instructors who must facilitate the training experience while maximizing the training value achieved.

Although the fidelity of currently available simulations cannot totally replace the need for live training, promising research and development is ongoing. For example, current visual systems do not provide the 20/20 visual acuity required for visual detection and identification of targets at realistic ranges. However, coordinated research, behavioral research and technologists are developing a 20/20 Immersive Visual Display for 2005^{xxxiii} that will improve the ability to conduct weapons and flight training with simulation systems. Contemporary simulation fidelity deficiencies are one key area requiring the retention of live training to ensure that the required levels of realistic training are provided to candidates.

A CF Recruiting Education and Training System (CFRETS - stood down 1 April 2002 and reformed as the Canadian Defence Academy) study stated that use of virtual reality systems could provide significant training and education benefits.

However, CFRETS did not have a virtual reality/simulation production capability and considered it unlikely that one would be established within the CF. Furthermore, CFRETS recommended that, wherever possible, equipment or vehicle simulators should be included as part of the initial capital acquisition process; any related development should be contracted out; and the Department of National Defence should satisfy requirements through commercial-off-the-shelf purchases.^{xxxiv} In 2002, Major Bruce Ploughman examined recent technology developments and the NATO research and technology organization efforts related to virtual reality. He concluded that virtual reality (characterized by three-dimensional sensory interfaces) strengths in Air Force training applications lie in shortening the pathways for perception and comprehension of information, and in engaging the subconscious mind, through experiential learning, which facilitates retention and recall. Its weaknesses stem from a hardware-centric focus that has, to date, neglected many critical human factors issues.^{xxxv} Also in 2002, Commander G. A. Crewe examined a variety of recent NATO country research and experience with systems incorporating computer-linked helmet-mounted displays and tactile feedback devices. Identified problem areas included simulator sickness, potential to portray simulations more complex than expected in the real world and an inability for current technology to complete all training requirements. He concluded that although virtual reality can be employed for realistic Naval

training it must still be complemented by actual "live-world" training.^{xxxvi} These recent efforts remain consistent with the theme that, while technology continues to offer novel and attractive training mechanisms, there remains a necessity to exercise diligence by retaining live exercises in the balanced pursuit of realistic military training.

A significant evolution of simulation is the distributed interactive structure that enables a collaborative visualization allowing people to remotely view data from different parts of the world. In the US, there is a growing trend toward distributed tactical training simulators, to allow attack helicopter crews, ground troops and fighter aircraft pilots to train together. Moreover, there are increased demands for coalition training - using synthetic environments, whereby British, American, French and German forces can plug into the simulated battlespace with different types of trainers. However, joint training is not yet easily achieved as the US Army and the USAF have their own programmes that are not currently compatible.^{xxxvii} In 1996 Major Fournier concluded that joint, combined training is too expensive, hard on the environment and difficult to conduct - thus should be conducted with distributed interactive simulation.^{xxxviii} In 2001 Major Dave McComb observed that distributed mission training is the future of combat training, can ensure combined and joint interoperability, is in line with Defence Planning Guidance

and is key to Joint Strike Fighter development.^{xxxix} Despite delayed inroads at both the academic and headquarters levels, distributed interactive simulation has sparked interest within the Canadian Army and Air Force and offers a significant potential ability for a technological solution to contribute to realistic joint and combined military training.

SECTION THREE - TRAINING CONTINUUM

As new military weapons systems are developed and implemented, it is to be expected that more training, rather than less, will be required. Therefore there will be more emphasis on live, virtual and constructive training including the need for live fire ranges. Widespread defence related resource reductions have resulted in recognition of common interests among training, procurement and evaluation agencies. Compelling benefits to uniting the efforts of these different fields include maximizing the employment of common resources, achieving high fidelity training at one-tenth the cost of joint field training exercises^{x1} and widening the employment opportunities for highly specialized CF simulator experts. The establishment of an effective and realistic military training continuum, able to meet the requirements of the 21st century, will require regular detailed coordination and cooperation among training,

procurement and evaluation agencies - traditionally accustomed to more independent activities.

The US Army, under the Virtual Leader Effects Trainer initiative, is pursuing a blended approach to training where live, virtual and constructive approaches are balanced to take maximum advantage of low technology simulations, increasingly complex technologies and also the critical inclusion of live fire exercises.^{xli} The Apache Longbow attack helicopter (AH-64D) training programme exemplifies this blended approach by taking candidates immediately from the primary training helicopter and immersing them in a 67 day schedule including 57 flying hours on the AH-64D, forty hours in the simulator and part-task trainer, as well as completion of interactive multi-media training packages.^{xlii} The Aviation Combined Arms Tactical Trainer (AVCATT) is designed to enable US Army Aviation to enhance and sustain the collective combat skills of its helicopter pilots by providing a collective training environment for platoon and company-level training. It will also be possible to conduct battalion-level training exercises with this capability.^{xliii} Additionally, the Rotary-wing Advanced Networked Tactical Simulators (RANTS) trial is being conducted under a Cooperative Research and Development Agreement between the US Army Research Institute (ARI) and CAE Electronics, Ltd. of Montreal, Canada. This project seeks to identify the characteristics and best practices for the use of simulation

across the full range of rotary wing pilot training: from initial qualification through advanced qualification to unit and collective skill acquisition and maintenance.^{xliiv} These ongoing US initiatives demonstrate successful application of a realistic training continuum and can constitute useful models for similar CF developments.

The Canadian military has amassed a great deal of positive experience with simulation solutions, in the past primarily for training but now increasingly for both evaluation and simulator-based acquisition. As this three-pronged way ahead develops it is necessary to devise, implement and embrace a coherent CF simulation "futures process" in line with the Strategy 2020 (strategic framework for Canadian Defence planning and decision-making jointly issued in September 1999 by then Deputy Minister of National Defence and the Chief of the Defence Staff) initiative.^{xliv} The Canadian Army has taken positive steps with the establishment of the Army Simulation Centre (ASC), which is responsible for synthetic environment support to training, Army operations, and combat development. The ASC is a diverse organization that includes four sub-directorates located at CF Base Kingston (Training, Army Experimentation, Army Synthetic Environment Co-ordination office, and Support) and four de-centralized Area Simulation Centres located in each of the Land Force Areas. The ASC, as the Army National Technical Authority for all simulation,

ensures consistency and uniformity in the simulation as well as in the configuration of the systems used for simulation^{xlvi} and represents a model worthy of consideration while establishing a coherent and all inclusive CF simulator strategy.

The CH146 Griffon helicopter simulator in Gagetown represents a situation, all too common in the Canadian Air Force. An absence of funding for regular upgrades within simulator life-cycles compromises the optimization of simulator training. Consequently, the employment of operational aircraft is required to cover this gap - over and above that proportion of flying essential to maintain an appropriate balance between live and simulated flight. Frankly, Canadian Air Force aircraft simulators are usually acquired and implemented without a pre-planned commitment to upgrade these highly valuable aircrew training devices both to outpace obsolescence and to keep up with available, operationally enhancing, technology. Consequently, there is a painfully obvious capability differential, easily seen by visiting the various simulators available to the Canadian Air Force fleets. Furthermore, when and if these multiple simulators are upgraded, it is not with any overarching plan to ensure a uniform quality of training to all fleets, or on the basis of a planned and funded five-year upgrade philosophy, but rather only on the basis of what scarce monies can be argued for on behalf of the individual fleets.

A recent paper by LCol McLeish proposes an upgrade to the CH146 simulator very much in line with the proven US Army AVCATT initiative described earlier in this paper. The new system is argued as essential to provide more efficient and realistic training in order to better utilize the limited number of flying hours allocated to each aircrew member.^{xlvii} Indeed, as the CH146 fleet undergoes planned upgrades with improved electronic warfare equipment and tactical radios, not to mention a stand-off reconnaissance and surveillance capability with a down link, the simulator will be employed very differently than anticipated when originally procured. This Air Force focused discussion introduces another element to the argument for balance between real and simulated training - namely the need to invest in regular technology upgrades or risk increasing the ratio of operational asset to simulator training hours.

CONCLUSION

Realistic military training is essential, complex, expensive and under a variety of pressures conspiring to force new solutions at variance with traditional training methods that exclusively employed operational assets. Technology has recently developed in a number of areas resulting in very effective and affordable methods to employ simulation, instead of operational assets, for military training. Although very promising, the fidelity of simulation does not yet do away with the requirement for a portion of realistic

training to be completed with operational assets. Nevertheless, both the US and Canada have established a firm foundation upon which to construct effective training continua. Careful design, early validation, regular upgrades and a commitment to specialized instructor training and retention are all critical elements to optimal employment of simulation. However, until an as yet undetermined future point in time where simulation can entirely replicate reality, it remains essential to combine real, live-fire exercises as a key element within any military training continuum.

It is submitted that the CF must strive to accelerate significant and balanced investments in a realistic and complete military training continuum. Elements of this continuum will rely heavily upon technological advances, which include distributed interactive simulation and virtual reality. Furthermore, it will be impossible to field a credible military force without firm commitment to realistic live fire training - best achieved by joint and combined participation in Allied exercises such as Red Flag and Armed Warrior. In the absence of such continuous and dedicated investment, the CF must expect to fail in future conflicts either alongside or against those with the commitment to sound and thorough training. Indeed, failure to sustain such commitment will ensure that we share the fate of Edwin Flack in the first Olympic marathon race - to be carried

from the field having been surpassed by a modern equivalent to Spiridon Louis, clever and committed enough to train effectively for "new" contests.

End notes:

ⁱ <<http://www.hickoksports.com/history/marathon.shtml>> [Accessed 01 April 2002].

ⁱⁱ This conclusion is drawn from a reading of the report by the Auditor General of Canada, 2002 Report, Chapter 5, Recruitment and Retention of Military Personnel. Therein it is stated "there are not enough trained and effective personnel in the Canadian Forces to meet occupational demands". Furthermore it is stated, "it could take the Canadian Forces as long as 30 years to achieve a stable population profile". The report also found that "... units ... important to future operational effectiveness ... and units needed for policy and planning were short-staffed." Moreover the report identifies an impending large-scale departure of highly experienced personnel and notes that "People must be trained and gain experience before they can be promoted to fill the empty positions, especially positions whose responsibilities include leadership." A key recommendation of this report is that yet another specialized classification (human resource management) should be established within the ouroboros that the Canadian Forces has been forced to become.

ⁱⁱⁱ Lieutenant General (Retd) Richard J. Évraire, "CDA - The Way Ahead", ON TRACK, Conference of Defence Associations Institute Volume 7, No 1, 29 March 2002.

^{iv} Lieutenant-Colonel Nicholson, "Where Have All the Tigers Gone?" Canadian Defence Quarterly, August 1990, reprinted from Volume 2 Number 4 Spring 1975, Baxter Publications, Toronto.

^v Canadian Armed Forces Officers commissioning scroll 1979.

^{vi} Carol Off, The Lion, The Fox & The Eagle: A Story of Generals and Justice in Rwanda and Yugoslavia, Vintage Canada, 2000. Page 363. ISBN 0-679-31138-6.

^{vii} Dr. Jean Martin, "The Great Canadian Air Battle: The British Commonwealth Air Training Plan and RCAF Fatalities During the Second World War", Canadian Military Journal, Vol.3, No.1, Spring 2002. Published under authority of the Minister of National Defence by the Royal Military College, Kingston.

^{viii} Wade H. Nelson, "The Gimli Glider", Soaring Magazine, the Soaring Society of America, Hobbs, New Mexico.

<<http://www.frontier.net/~wadenelson/successstories/gimli.html>> [Accessed 2 April 2002].

^{ix} Lieutenant-Colonel Bernd Horn, page 18, Bastard Sons: An Examination of Canada's Airborne Experience 1942-1995, Vanwell Publishing Limited, St. Catharines Ontario, 2001. ISBN 1-55125-078-0.

^x Squadron Leader R.W. Birtwistle, RAF, "How Much for the 'Right Stuff'", Ex New Horizons CSC 24, April 1998.

^{xi} Anthony T. Kern, Maj, USAF, Darker Shades of Blue: A Case Study of Failed Leadership - The Command Climate at Fairchild Air Force Base as a Causal Factor in the Crash of Czar 52, Fort Leavenworth, Kansas, 1995.

^{xii} John T. Davee and James A. Colley II, Lt Cols USAF, Air Power Training in the USAF: Realistic and Joint, Air War College Air University, Maxwell Air Force Base, Alabama, 1 March 1995.

^{xiii} Major Jeffrey L. Whiddon, United States Air Force, "The 'Mighty Casey' Syndrome: Aerospace Power's Potential Fall from Grace", Ex New Horizons CSC 25, 28 April 1999.

^{xiv} Major Mike Voith, CD, "Military Readiness", The Army Doctrine and Training Bulletin, Vol.4, No.2, Summer 2001, Army Publishing Office, Land Force Doctrine and Training System, Kingston, Ontario. Electronic version available at <<http://www.army.dnd.ca/ael/>>.

^{xv} John A. English, "Appendix A, Some General Notes on What to Look for When Visiting a Unit", Failure in High Command: The Canadian Army and the Normandy Command, The Golden Dog Press, Ottawa, 1995. ISBN 0-919614-60-4.

^{xvi} "Did You Know?" Conference of Defence Associations/La Conférence des Associations de la Défense, <<http://www.cda-cdai.ca/CDA-GMs/didyouknow.htm>> [Accessed 2 April 2002].

^{xvii} State of Readiness of the Canadian Forces: Response to the Terrorist Threat, Interim Report of the Standing Committee on National Defence and Veterans Affairs, David Pratt, M.P. Chair, November 2001, Published by the Government of Canada 37th Parliament 1st session. Full text at: <<http://www.parl.gc.ca>> (Click: Committee Business; House of Commons; Committee Reports; SCNDVA; Report No. 3)

^{xviii} General Wesley K. Clark, U.S. Army (Retired), page 419, Waging Modern War: Bosnia, Kosovo and the Future of Combat, Public Affairs, New York, 2001. ISBN 1-58648-043-X.

^{xix} Admiral William J. Fallon, Vice Chief of Naval Operations, "Statement before the House Appropriations Committee Defense Subcommittee on Military Readiness", 21 March 2001. <<http://www.chinfo.navy.mil/navpalib/testimony/readiness/fall010321.txt>> [Accessed 27 March 2002].

^{xx} Dan Burton, Chairman, "Opening Statement, Challenges to National Security: Constraints on Military Training", <http://www.house.gov/reform/hearings/05.09.01/opening_statement.htm> [Accessed 1 April, 2002].

^{xxi} Joint Statement by the International Indian Treaty Council and the Kuna Youth Movement, "Working for the Rights and Recognition of Indigenous Peoples", Item # 4: "Indigenous Peoples and the Right to Development", United Nations Working Group on Indigenous Populations, 18th Session July 23 - July 27, 2000, <http://www.treatycouncil.org/section_21141721.htm> [Accessed 7 April 2002].

^{xxii} Canadian Security and Military Preparedness, Report of the Standing Senate Committee on National Security and Defence, The Honourable Colin Kenny, Chair, February 2002. Published by the Government of Canada 37th Parliament 1st session. Full text at: <<http://www.parl.gc.ca>> (Click: Committee Business; Senate; Recent Reports; Canadian Security and Military Preparedness).

^{xxiii} "RN flying training into 21st century", Equipment, Training and Support (ETS) News, Captain Chris Waite, the Fleet Air Arm's chief staff officer for operational capabilities, talks to ETS News about the service's training strategy. <<http://www.ets-news.com/naval2.html>> [Accessed 01 April 2002].

^{xxiv} Dr. Malcolm J. Cook and Dr. L. Elder, University of Abertay Dundee, UK and George Ward, ESE Associates, Yately, Hampshire, UK, "Communication Requirements in the Cockpit", Article 19, Collaborative Crew Performance in Complex Operational Systems, 04 December 1998, North Atlantic Treaty Organization Research and Technology Organization Human Factors Medicine Panel Proceedings at Edinburgh UK (20-22 Apr 1998) 4, December 1998.

^{xxv} Karl Perusich, Ph.D., Purdue University, South Bend, IN, USA, "Using Fuzzy Cognitive Maps to Assess Multi-Operator Situation Awareness", Article 17, Collaborative Crew Performance in Complex Operational Systems, 04 December 1998, North Atlantic Treaty Organization Research and Technology Organization Human Factors Medicine Panel Proceedings at Edinburgh UK (20-22 Apr 1998) 4, December 1998.

^{xxvi} M. Thody and I.F. Ross, British Aerospace, MA&A, Farnborough Aerospace Centre, "Collaborative Crew Issues in a Future Reconnaissance Land Vehicle", Article 3, Collaborative Crew Performance in Complex Operational Systems, North Atlantic Treaty Organization Research and Technology Organization Human Factors Medicine Panel Proceedings at Edinburgh UK (20-22 Apr 1998) 4, December 1998.

^{xxvii} Captain Martin Rivard, "ISTAR Sensor Integration: A Non-Melting Pot Option", The Army Doctrine and Training Bulletin, Vol.3, No.3, Fall 2000, Army Publishing Office, Land Force Doctrine and Training System, Kingston, Ontario. Electronic version available at <<http://www.army.dnd.ca/acl/>>.

^{xxviii} Major Randy D. Taylor, USAF, "In the Budget Battle: Is Simulator Training the Key to Maintaining Combat Ready Fighter Aircrews?" Ex New Horizons CSC 19, 29 March 1993.

^{xxix} Major R.B. Ewing, "The Benefits of Using Simulation in Training - Does the Land Force Leadership Understand?" Ex New Horizons CSC 24, April 1998.

^{xxx} Weapon Effect Simulation (WES) web page, <http://www.dnd.ca/dless/wes/English/main_e.html> [Accessed 7 April 2002].

^{xxxi} LCdr W.S. Truelove, "Simulation Training - Understanding the Limits" Ex New Horizons CSC 25, 30 April 1999.

^{xxxii} Major Frank Delanghe, "Validating Small Arms Simulation", MS&T Magazine Issue 6/2001.

^{xxxiii} Jeff Carr, "Research Paradigms", Military Simulation & Training Magazine, Issue 6/2001, Halldale Publishing and Media Ltd, Farnborough, England.

^{xxxiv} Lieutenant-Colonel J.J.P. Charbonneau, SSO Formation Development, Canadian Forces Recruiting Education and Training System, Technologies Applicable to Training and Education, July 1998.

^{xxxv} Major Bruce Ploughman, "Virtual Reality - A Future in the Air?" Ex Leonardo da Vinci CSC 28, February 2002.

^{xxxvi} Cdr G.A. Crewe, "Should Canada be Taking Advantage of the Latest Advances in Virtual Reality Technology for the Application of Sea Power?" Exercise Leonardo da Vinci CSC 28, 4 February 2002.

^{xxxvii} Sandra I. Irwin, "Outlook for Flight Training Market: A Mixed Bag", National Defense Magazine, Published by Lawrence P. Farrell, Jr., Arlington, Virginia, <<http://www.nationaldefensemagazine.org/article.cfm?Id=633>> [Accessed 5 February 2002].

^{xxxviii} Major J.M. Fournier, "Joint Combined Simulation: A Better Way of Training", Ex New Horizons CSC 22, 03 April 1996.

^{xxxix} Major Dave McComb, "Distributed Mission Training...A Window of Opportunity", Ex New Horizons CSC 27, April 2001.

^{xl} Chuck Weirauch, "A Call for a Training Revolution", Military Simulation & Training Magazine, Issue 6/2001, Halldale Publishing and Media Ltd, Farnborough, England.

^{xli} Virtual Leader Effects Trainer (VLET) Information Paper, ATZL-NSC-C, 21 June 2001. <http://leav-www.army.mil/nsc/tsm/vlet_info_paper.html and http://leav-www.army.mil/nsc/tsm/vlet_home.html> [Accessed 01 April 2002].

^{xlii} Paul Seidenman, "Apache Longbow Training", Military Simulation & Training Magazine, Issue 6/2001, Halldale Publishing and Media Ltd, Farnborough, England.

^{xliii} "Aviation Combined Arms Tactical Trainer - Aviation Reconfigurable Manned Simulator (AVCATT-A) Program." INFORMATION PAPER ATZL-NSC-C 17 November, 2000. United States Army Training and Doctrine Command, Fort Leavenworth, Kentucky. <http://leav-www.army.mil/nsc/tsm/avcatt_info_paper.html> [Accessed 01 April 2002].

^{xliiv} Dr. William R. Howse, "Rotary-wing Advanced Networked Tactical Simulators (RANTS) RANTS", U.S. Army Research Institute for the Behavioral & Social Sciences Fact Sheet, <www.ari.army.mil/pdf/rants.pdf> [Accessed 1 April 2002].

^{xlv} Dr. Scott Robertson, "Experimentation and Innovation in the Canadian Forces", Canadian Military Journal, Vol.1, No.2, Summer 2000. Published under authority of the Minister of National Defence by the Royal Military College, Kingston.

^{xlvi} Army Simulation Centre (ASC) homepage. <<http://armyapp.dnd.ca/asc-csat/main.asp>>

^{xlvii} LCol R. Scott McLeish, 1 Wing A5/A7, 4500-1 A7, 1Wing Integrated Simulation Training System (ISTS) Concept Paper, 25 January 2002.

BIBLIOGRAPHY

Birtwistle, Squadron Leader R.W., RAF, "How Much for the 'Right Stuff'", Ex New Horizons CSC 24, April 1998.

Carr, Jeff , "Research Paradigms", Military Simulation & Training Magazine, Issue 6/2001, Halldale Publishing and Media Ltd, Farnborough, England.

Charbonneau, Lieutenant-Colonel J.J.P., SSO Formation Development, Canadian Forces Recruiting Education and Training System, Technologies Applicable to Training and Education, July 1998.

Clark, General Wesley K., U.S. Army (Retired), Waging Modern War: Bosnia, Kosovo and the Future of Combat, Public Affairs, New York, 2001. ISBN 1-58648-043-X.

Cook, Dr. Malcolm J. and Dr. L. Elder, University of Abertay Dundee, UK and George Ward, ESE Associates, Yately, Hampshire, UK, "Communication Requirements in the Cockpit", Article 19, Collaborative Crew Performance in Complex Operational Systems, NATO Research and Technology Organization Proceedings 4, December 1998.

Crewe, Cdr G.A., "Should Canada be Taking Advantage of the Latest Advances in Virtual Reality Technology for the Application of Sea Power?" Exercise Leonardo da Vinci CSC 28, 4 February 2002.

Davee, John T. and James A. Colley II, Lt Cols USAF, Air Power Training in the USAF: Realistic and Joint, Air War College Air University, Maxwell Air Force Base, Alabama, 1 March 1995.

Delanghe, Major Frank, "Validating Small Arms Simulation", MS&T Magazine Issue 6/2001.

English, John A., "Appendix A, Some General Notes on What to Look for When Visiting a Unit", Failure in High Command: The Canadian Army and the Normandy Command, The Golden Dog Press, Ottawa, 1995. ISBN 0-919614-60-4.

Évraire, Richard J., Lieutenant-General (Retd), "CDA - The Way Ahead", ON TRACK, Conference of Defence Associations Institute Volume 7, No 1, 29 March 2002.

Ewing, Major R.B., "The Benefits of Using Simulation in Training - Does the Land Force Leadership Understand?" Ex New Horizons CSC 24, April 1998.

Fallon, William J., Admiral, Vice Chief of Naval Operations, "Statement before the House Appropriations Committee Defense Subcommittee on Military Readiness", 21 March 2001.

Fournier, Major J.M., "Joint Combined Simulation: A Better Way of Training", Ex New Horizons CSC 22, 03 April 1996.

Fraser, Sheila, 2002 Report of the Auditor General of Canada, Chapter 5, Recruitment and Retention of Military Personnel, 19 April 2002.

Horn, Lieutenant-Colonel Bernd, Bastard Sons: An Examination of Canada's Airborne Experience 1942-1995, Vanwell Publishing Limited, St. Catherines Ontario, 2001. ISBN 1-55125-078-0.

Howse, William R., Dr., "Rotary-wing Advanced Networked Tactical Simulators (RANTS) RANTS", U.S. Army Research Institute for the Behavioral & Social Sciences Fact Sheet,

Irwin, Sandra I., "Outlook for Flight Training Market: A Mixed Bag", National Defense Magazine, Published by Lawrence P. Farrell, Jr. Arlington, Virginia,

Kenny, Colin, The Honourable, Chair, Canadian Security and Military Preparedness, Report of the Standing Senate Committee on National Security and Defence, February 2002. Published by the Government of Canada 37th Parliament 1st session.

Kern, Maj Anthony T., USAF, Darker Shades of Blue: A Case Study of Failed Leadership - The Command Climate at Fairchild Air Force Base as a Causal Factor in the Crash of Czar 52, Fort Leavenworth, Kansas, 1995.

Luhtala, Major E.P., "Simulation Training: Preparing the Headquarters for Tomorrow's Combat", Ex New Horizons CSC 15, 31 March 1989.

Martin, Dr. Jean, "The Great Canadian Air Battle: The British Commonwealth Air Training Plan and RCAF Fatalities During the Second World War", Canadian Military Journal, Vol.3, No.1, Spring 2002. Published under authority of the Minister of National Defence by the Royal Military College, Kingston.

McComb, Major Dave, "Distributed Mission Training...A Window of Opportunity", Ex New Horizons CSC 27, April 2001.

McLeish, R. Scott, LCol, 1 Wing A5/A7, 4500-1 A7, 1Wing Integrated Simulation Training System (ISTS) Concept Paper, 25 January 2002.

Nelson, Wade H., "The Gimli Glider", Soaring Magazine, the Soaring Society of America, Hobbs, New Mexico.

Nicholson, Lieutenant-Colonel, "Where Have All the Tigers Gone?" Canadian Defence Quarterly, August 1990, reprinted from Volume 2 Number 4 Spring 1975, Baxter Publications, Toronto.

Off, Carol, The Lion, The Fox & The Eagle: A Story of Generals and Justice in Rwanda and Yugoslavia, Vintage Canada, 2000. ISBN 0-679-31138-6.

Perusich, Karl, Ph.D., Purdue University, South Bend, IN, USA, "Using Fuzzy Cognitive Maps to Assess Multi-Operator Situation Awareness", Article 17, Collaborative Crew Performance in Complex Operational Systems, NATO Research and Technology Organization Proceedings 4, December 1998.

Ploughman, Major Bruce, "Virtual Reality - A Future in the Air?" Ex Leonardo da Vinci CSC 28, February 2002.

Pratt, David, State of Readiness of the Canadian Forces: Response to the Terrorist Threat, Interim Report of the Standing Committee on National Defence and Veterans Affairs, David Pratt, M.P. Chair, November 2001.

Rivard, Martin, Captain, "ISTAR Sensor Integration: A Non-Melting Pot Option", The Army Doctrine and Training Bulletin, Vol.3, No.3, Fall 2000, Army Publishing Office, Land Force Doctrine and Training System, Kingston, Ontario.

Robertson, Scott, Dr., "Experimentation and Innovation in the Canadian Forces", Canadian Military Journal, Vol.1, No.2, Summer 2000, Published under authority of the Minister of National Defence by the Royal Military College, Kingston.

Seidenman, Paul, "Apache Longbow Training", Military Simulation & Training Magazine, Issue 6/2001, Halldale Publishing and Media Ltd, Farnborough, England

Taylor, Major Randy D., USAF, "In the Budget Battle: Is Simulator Training the Key to Maintaining Combat Ready Fighter Aircrews?" Ex New Horizons CSC 19, 29 March 1993.

Thody, M. and I.F. Ross, British Aerospace, MA&A, Farnborough Aerospace Centre, "Collaborative Crew Issues in a Future Reconnaissance Land Vehicle", Article 3, Collaborative Crew Performance in Complex Operational Systems, NATO Research and Technology Organization Proceedings 4, December 1998.

Truelove, LCdr W.S., "Simulation Training - Understanding the Limits" Ex New Horizons CSC 25, 30 April 1999.

Voith, Major Mike, CD, "Military Readiness", The Army Doctrine and Training Bulletin, Vol.4, No.2, Summer 2001.

Weirauch, Chuck, "A Call for a Training Revolution", Military Simulation & Training Magazine, Issue 6/2001, Halldale Publishing and Media Ltd, Farnborough, England.

Whiddon, Major Jeffrey L., United States Air Force, "The 'Mighty Casey' Syndrome: Aerospace Power's Potential Fall from Grace", Ex New Horizons CSC 25, 28 April 1999.

WEBSITES ACCESSED

<<http://www.chinfo.navy.mil/navpalib/testimony/readiness/fal1010321.txt>>

<http://www.house.gov/reform/hearings/05.09.01/opening_statement.htm>

<<http://www.frontier.net/~wadenelson/successstories/gimli.html>>

<<http://www.nationaldefensemagazine.org/article.cfm?Id=633>>

<http://leav-www.army.mil/nsc/tsm/avcatt_info_paper.html>

<http://leav-www.army.mil/nsc/tsm/vlet_info_paper.html>

<<http://www.hickoksports.com/history/marathon.shtml>>

<http://www.treatycouncil.org/section_21141721.htm>

<<http://www.cda-cdai.ca/CDA-GMs/didyouknow.htm>>

<http://leav-www.army.mil/nsc/tsm/vlet_home.html>

<http://www.dnd.ca/dless/wes/English/main_e.html>

<<http://armyapp.dnd.ca/asc-csat/main.asp>>

<<http://www.ets-news.com/naval2.html>>

<www.ari.army.mil/pdf/rants.pdf>

<<http://www.army.dnd.ca/ael/>>

<<http://www.parl.gc.ca>>