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AIR TECHNICIAN TRAINING – AN INTEGRATED FUTURE

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TABLE OF CONTENTS

Chapter 7 – TECHNOLOGY ENABLERS

Chapter 8 – THE MODEL

CONCLUSION

LIST OF FIGURES AND TABLES

ABSTRACT

The Canadian Air Force, in step with the Canadian Forces (CF), is progressing organizational transformation to meet the challenges of the 21st century. Underpinning the success of an operationally relevant and responsive Air Force is the availability of a modern and adaptive Air Technician training system to support the large investment in flight line technology. Whilst training requirements to support an increase in operational tempo have been recognized and budgets adjusted accordingly to address production issues, the many years of funding neglect, coupled with the increasing cost of training, created a technology lag in the training system.

The Air Force currently benefits marginally from joined-up information technology based training initiatives to accommodate smart training design and delivery. The methodology and cost of all training programs requires close scrutiny to ensure that maximum effort is being expended towards efficiencies derived from modern standardized training practices and technology enablers. The existing training delivery system fails to leverage the full benefits available from an e-Learning networked training loop that can provide flexibility and economies of scale. The Air Force aircraft maintenance community requires a technology enabled training strategy that provides a methodology and the technological framework to guide all aspects of technician development, from basic occupation training through to advanced courses. As a prelude to a fully integrated training network, phased implementation of standardized key technology training enablers are required to promote versatility and flexibility along with shared training objectives to demonstrate not just improved training delivery, but quantifiable training system cost savings.

AIR TECHNICIAN TRAINING – AN INTEGRATED FUTURE

CHAPTER 1

INTRODUCTION

> *"I got into what was supposedly one of the best colleges in the country
> for technology. The professors were all from MIT. But in class all they
> did was read to us from their textbooks. I quit!"*[1]

- a former college student

A transformed Air Force requires a transformed training system. After years of decline throughout the 1990s, recent federal budgets have resulted in a welcomed trend upwards in funding reinvestment in the Canadian Forces (CF) to support increased personnel strength levels along with new equipment acquisition programs for all three environments. The 2005 federal budget represented a significant increase in defence spending with a 12 billion dollar commitment in new money over a five-year period.[2] Promoted as 'Delivering on Commitments,' the announced 2005 defence budget in support of CF expansion, capital equipment acquisition and operational sustainability was the largest increase for a five-year period in the last 20 years. Utilizing the post 9/11 security sensitive environment as a backdrop, the current Conservative government ran on a platform that included initiatives to further strengthen national defence through increased spending to effect increased personnel levels along with acknowledgement that

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[1] Marc Prensky, *Digital Game Based Learning* (Toronto: McGraw-Hill, 2001), 3-1.

[2] Department of Finance, *Budget Brief 2005* (Ottawa: Department of Finance Distribution Centre, 2005), 16.

new equipment acquisitions would receive high priority.[3] For the Air Force, major

capital acquisition projects over the next few years will result in the delivery of new

fleets of aircraft to support Canada's role, whether it be leading or supporting, in a

complex operating environment. While the Air Force is currently benefiting from a

funding infusion to support training revitalization, we can expect a levelling off, and a

likely return to the lean budget years, and as such must build the training infrastructure to

support an extended period of time.

Major Air Force equipment programmes over the next few years include the C-17

strategic lift transport, CH-47 medium lift helicopter, C-130J strategic/tactical airlift, new

fixed wing Search and Rescue (SAR) aircraft and Uninhabited Aerial Vehicles (UAVs).

These new aircraft fleets are characterized by ever-increasing complexity of weapons

systems that demand specialized training; the Air Force requires investment and support

for innovation to ensure the availability of multi-skilled and adaptable technicians to

support these new aircraft fleets at home and during deployed operations. It is also worth

noting that the next generation of training systems, procedures and protocols will actually

be developing recruits who will be expected to fight in the battlespace of 2020.[4] Thus,

planning for training system upgrades must be viewed in terms of the technical

complexity of new and future weapons systems delivery.

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[3] Stephen Harper, *Stand Up For Canada: Conservative Party of Canada Federal Election Platform 2006*, http://www.conservative.ca/media/20060113-Platform.pdf; Internet; accessed 20 January 2007. 45.

[4] Department of National Defence, *DND/CF Concept Paper Produced by the Symposium Working Group, Ottawa, 1 November, 2000*. http://www.drdc-rddc.gc.ca/seco/documents/DND-CF_Concept_Paper_e.html#ch6; Internet; accessed 22 March 2007.

Between 1989 and 2003, Air Force downsizing was carried out commensurate with the strategic environment.[5] Decreased intake targets and recruiting resulted in a significant reduction in training throughput for aircraft technicians, commonly referred to as MOC 500 series, from the Canadian Forces School of Aerospace Technology and Engineering (CFSATE) at 16 Wing, Borden. In addition, during the same period the Aircraft Technician (Air Tech) trade structure was reorganized to consolidate 13 aircraft occupations into three. Post 2001, coincidental with an increase in operations tempo, the Air Force experienced a rise in the technician attrition rate leading to problems with the availability of qualified technicians to maintain aging aircraft fleets. Further demographic modeling suggested that technician throughput would have to be addressed forthwith to meet current and future flight line maintenance tasking requirements.[6]

Key to the generation of aircraft technicians is an efficient and responsive training system to deliver highly skilled technicians in the minimum amount of time. Given that aircraft technicians comprise approximately one-third[7] of the uniformed Air Force, a robust and responsive training system is paramount. The transition to an expeditionary Air Force necessitates a deployable and remote training capability to support new training requirements or refresher training for perishable skill sets. Air Force technical training has not significantly evolved for several generations, certainly not to keep pace with available information technology (IT) instructional enablers and the learning

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[5] Department of National Defence, *The Aerospace Capability Framework* (Ottawa: Director General Air Force Development, 2003) 22.

[6] A4 Maint Rdns Briefing Note, *Aircraft Technician Operationally Functional Point* (1 Cdn Air Div Winnipeg: file 4975-500 (A4 Maint Rdns)), 17 December 2002.

[7] Department of National Defence, *D MIL C Ottawa, Projected Status Report FY 2007/2007: Occupations AVS MOSID 00136, AVN MOSID, 00135, ACS MOSID 00138*. Effective Date 02 October 2006.

requirements for a new generation of students. In essence, the Air Force still operates the classic schoolhouse with fixed class sizes using a set curriculum and a rigid training schedule, a system that is inherently fraught with inefficiencies. An enhanced electronic learning (e-Learning) environment is key to overcoming deficiencies and inefficiencies with the current Air Tech training continuum. With the required IT infusion to establish and support a networked architecture to support an e-Learning environment, the Air Force could markedly ameliorate the quality and quantity of training delivery in support of technician development. This thesis is assessed relative to the merits of employing various IT strategies and standards in comparison to the status quo.

This paper examines the Air Force's current aircraft technician training strategy, the demographic environment, available technology enablers and the implications for sustainability. It will demonstrate that while the Air Force has a plan to provide technician training to support current operations, it does not fully recognize student learning requirements or take full advantage of available training technologies and methodologies. Much can to be done to improve overall training system effectiveness and efficiency to meet the future support requirements for new aircraft fleets and their accompanying technologies. The most significant arguments presented will support a paradigm shift in effective learning strategies from the traditional schoolhouse to an e-Learning based system for new recruits seeking an aviation career with the CF.

The aim of this paper is to demonstrate that Canada's Air Force must transition from a decentralized traditional aircraft technician training system to an IT based e-Learning Technician Training Network (TTN).

CHAPTER 2

BACKGROUND

Defining the Problem

The Air Force currently administers a mature and rigorous training programme for developing the approximately 3700[8] aircraft technicians at the rank of Private through Master Corporal. The training programme for Aviation Technicians (AVN), Avionics Technicians (AVS) and Aircraft Structures Technicians (ACS) has evolved marginally over time to include limited forms of learning that is delivered digitally (e-Learning), including Computer Based Training (CBT) and Blended Learning strategies using synthetic trainers and simulation technologies to complement classroom instruction and hands-on practical skills development. The technician training continuum, depicted below in figure 1, starts with Basic Occupation Training (BOT) at CFSATE, Borden, followed by on-job-training (OJT) at operational units before proceeding to aircraft type specific training at dispersed fleet training schools.
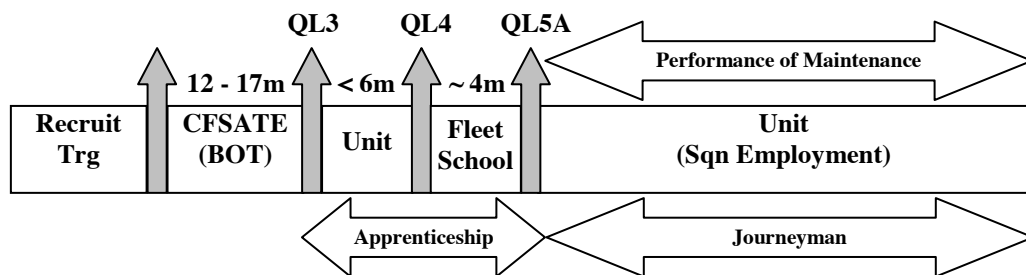
Figure 1 – Aircraft Technician Training Continuum

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[8] Ibid.,2.

It is only after reaching Qualification Level 5 (QL5) that the technician is considered truly productive for the performance of on-aircraft maintenance actions, to the extent that he/she can be fully employed with a minimum of supervision.

With the amalgamation of the 13 aviation trades into just three in 1996, technician overall occupation knowledge requirements increased substantially. As part of the trade amalgamation process a decision was taken where the primary responsibility for the conduct of hands-on practical training, previously included with BOT, was devolved from CFSATE to the operational units, otherwise, the course length for BOT would have been extended considerably. With this action, the role of CFSATE in junior technician development was largely relegated to theory and knowledge instruction with a minimal amount of hands-on practical training. This approach worked well for a number of years while Air Wings and Units were enjoying the benefits of a low operations tempo, low attrition rates and often an excess number of technicians to fill established positions. However, the trend was gradually reversed and in recent years the Air Force has experienced an increase in operations along with increased Air Tech attrition rates. On the flight line, the requirement to use experienced technicians to teach and supervise junior technicians placed considerable burden and strain on maintenance organizations to provide the necessary resources to complete high quality training while maintaining an increasing maintenance workload due to aging aircraft fleets. The technician availability constraints imposed by the training encumbrance led to overall reduced maintenance experience levels and operational readiness being compromised by aircraft maintenance. Further exacerbating the problem, based on normal attrition rates, in the ten-year period from 1992 – 2001, the CF recruited less than one third of the technicians necessary to

sustain healthy MOC 500 series occupations.[9] The result, as depicted in figure 2, led to

the Air Tech occupation's demographics becoming skewed relative to a balanced and

sustainable model.
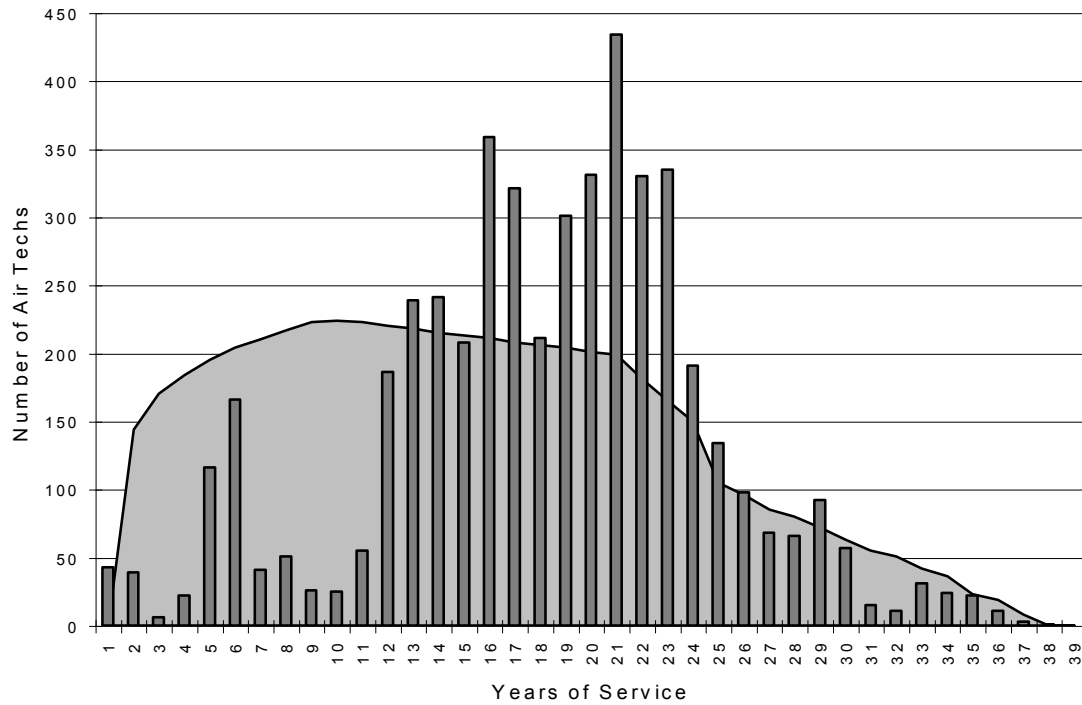
Figure 2 - 2002 Air Tech Demographics[10]

When extended out to the year 2010 (figure 3), the demographic profile model would

cause great concern for the projected Air Tech experience levels and the overall health of

the Air Force Air Tech occupations.

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[9] A4 Maint Rdns Briefing Note, *Aircraft Technician Operationally Functional Point* (1 Cdn Air Div Winnipeg: file 4975-500 (A4 Maint Rdns)), 17 December 2002.

[10] Ibid.
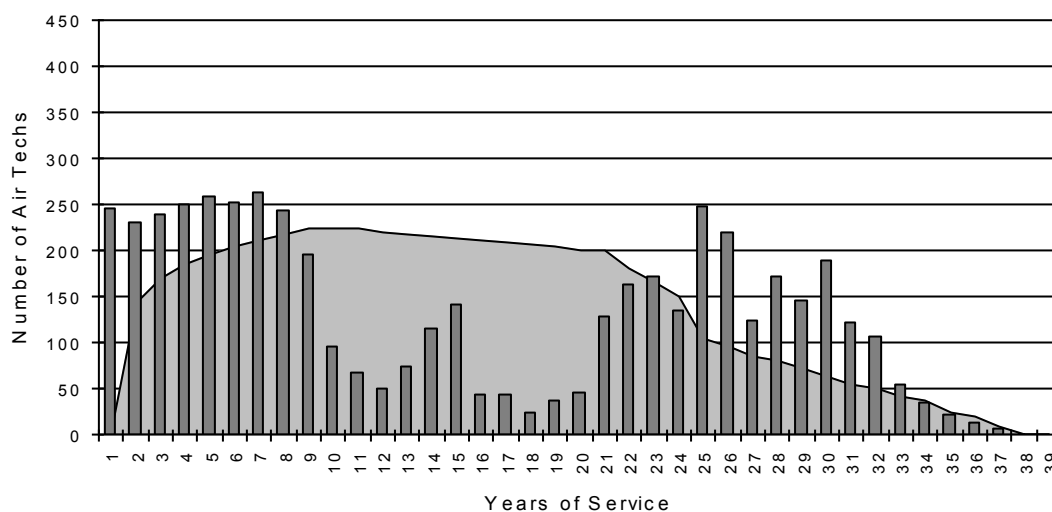
Figure 3 - 2010 Air Tech Demographics[11]

A 2001 MOC 500 Occupational Analysis (OA)[12] identified shortcomings with the current Air Tech training regime, particularly with course content and practical skills competency. As a result the Air Force initiated a concerted effort to overhaul the Air Tech occupations through adjustments to the occupation structure and training realignment. With an understanding of the demographics, action was also taken to address the issues of recruiting and retention with the goal of producing a sustainable quantity of suitably qualified technicians to support future CF operations, at home and abroad. In the 2003 *Aerospace Capability Framework* document, it was recognized that training transformation was required to accurately reflect the stage of development at

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[11] Ibid.

[12] Colonel N, Jodin, *Occupational Analysis (OA) Report Aircraft Technicians MOCs 514, 526, and 565* (National Defence Headquarters Ottawa: file 5555-119-2 (MOSART)), 12 May 2003.

which a junior technician becomes truly effective[13] while Vector Six of the Air Force 2004 *Strategic Vectors* reiterated the requirement for an Air Force comprised of multi-skilled and well-educated people.[14] To address the near-term challenges of aircraft technician availability, in 2002, the Commander 1 Canadian Air Division (1 Cdn Air Div) established the Aircraft Technician Training Oversight Committee (ATTOC) to guide the training transformation required at CFSATE Borden and the individual fleet training schools dispersed across the country.[15] The resultant revitalization programme is being conducted under the auspices of the Aircraft Technician Transformation (ATT) coordinated by the 1 Cdn Air Div, Air Force Training (AF Trg) and the Air Technician Training Renewal (ATTR) programme, coordinated by the National Defence Headquarters (NDHQ), Director of Air Requirements (DAR). ATT is primarily concerned with today's problem of rebuilding and transforming the training system to re-establish training capacity to meet operational requirements, in the shortest period of time. In addition to revamping the technician training programme, additional initiatives including contracting in instructional personnel, outsourcing components of BOT training to Canadian Aviation Maintenance Council (CAMC) accredited community colleges and employment of a CF subsidized education plan to address the challenge of throughput capacity. ATTR has been given a longer-term mandate to explore how we can provide and integrate modern training aids into an up-to-date training environment. During phase

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[13] Department of National Defence, *The Aerospace Capability Framework* (Ottawa: Director General Air Force Development, 2003) 48.

[14] Department of National Defence, *Strategic Vectors* (Ottawa: Director General Air Force Development, 2004) 49.

[15] AF Trg, *Air Force Strategy For The Use of Technology in Training: Project Charter* (1 Cdn Air Div: file 4500-1 (AF Trg)), February 2006. 1.

one, ATTR will address training enabler deficiencies at CFSATE through the acquisition of modern training technologies followed by phase 2 which will acquire training equipment for the fleet schools. When completed the ATTR Project will enhance the training delivered by both CFSATE and the fleet training schools.[16]

With practical skills proficiency used as the measure or standard for an operationally effective technician, high priority was given to overhauling the Air Tech training delivery programme to reintroduce practical skills training to BOT. In addition to complementing theory and knowledge skills with practical reinforcement, this construct would also serve to lift the heavy training burden from the operational units allowing them to direct their attention, and scarce experienced personnel resources, to generating mission-ready aircraft. In order to support the increased knowledge requirements resulting from trade amalgamation along with the related practical skills development, the new CFSATE Air Tech training programme would require a 120% increase in the time required to generate a basic qualified AVN technician (started in 2004) and a 100% increase in the time required to graduate an AVS technician (started in 2006).[17] ACS training, considered to be less problematic than AVN and AVS, has yet to be redesigned. The lengthy BOT course gave cause for concern, but it was rationalized that the additional time spent in training at Borden would pay dividends towards the overall and longer-term generation of operationally functional technicians. Concurrent with CFSATE training realignment, revitalization work was also carried out at the aircraft fleet schools, however, the recognized centre-of-gravity to defeat the Air Tech

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[16] Ibid., 1.

[17] Lieutenant-Colonel H.J. Kowal, "Transforming the Schoolhouse." Paper No 1512, Inter-Service/Industry Training Simulation and Education Conference (I/ITSEC) 2004. 5.

availability problem was to resolve long standing and significant issues with BOT production.

During the same period that BOT training was being overhauled, technician attrition rates continued to rise requiring the employment of aggressive recruiting strategies to abate the problem. In contrast with recruiting difficulties experienced for the CF at large for many of the Non-Commissioned Members (NCM) occupations, intake targets for the Air Tech trades remained achievable. As well, these trades remain popular for in-service reclassification, particularly from the Combat Arms. Although satisfied with the new technician intake numbers, the successful recruiting practices created a new problem in the form of a BOT over-capacity issue and a backlog of personnel awaiting training (PATs). The inability of the CFSATE training system to accommodate the full complement of new recruits means that at times as many as 200 individuals will spend from three months to in excess of one year awaiting BOT at 16 Wing Borden. During this low-level learning period highly motivated new technicians are growing impatient, frustrated and sometimes questioning the basis of their decision to join an organization that promised a rewarding and exciting career. To maintain their motivation, improve occupation situational awareness and enhance the learning environment, there is a concerted effort to deploy PATs to operational units for OJT. However, lacking the basic skills and knowledge their employment requires close supervision and thus becomes onerous and severely restricted, resulting in a programme with good intentions but limited utility for both the student and employing organization. The current Air Tech training regime has no provision for accommodating self-study initiatives that could be used by PATs to enhance the most basic of technical skills, professional development

attributes or general knowledge of the CF and Air Force while serving to make productive use of time spent awaiting formal courses.

To achieve and sustain a healthy Air Tech programme, it is expected that the increased training volume will continue for at least a decade.[18] ATT and ATTR are key elements in a well-developed Air Tech training strategy and are making progress towards achieving their respective mandates. Accepting that short-term production is a high priority, it is important that while the Air Force works hard to overcome the training capacity issues of today that we do not fail in constructing a training system that will support our future requirements.

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[18] Colonel D.B. Millar, *Record of Decisions: A4 Maintenance Council Meeting, Winnipeg 21-22 October 2003* (1 Cdn Air Div Winnipeg: file 1180-7 (A4 Maint Coord)), 14 November 2003.

CHAPTER 3

STRATEGIC DEMOGRAPHIC CONSIDERATIONS

"Today's trainers and trainees are from totally separate worlds. The biggest underlying dynamic in training and learning today is the rapid and unexpected confrontation of a corps of trainers and teachers raised in a pre-digital generation and educated in the styles of the past, with a body of learners raised in the digital world…The two groups…are so different in their approach, outlook, style, and needs that they can hardly communicate. And the result is disaster. The trainees…find today's training (and education) so incredibly boring that they don't want - and often refuse - to do it."[19]

- Prensky, author of Digital Game-Based Learning

Changing Aircraft Technician Demographics

Year on year technology continues to drive social and radical organizational change for both civilian and military environments. For the Air Force, fundamental to building a sustainable Air Tech training system is a consideration for the potential student population demographics. Changing demographics will continue to have a strategic influence on Canada and will bear relevance to both the availability and type of individuals considering a career with the CF. The aging Canadian workforce will put the CF in direct competition with industry for new workers, making it increasingly challenging to attract new recruits. CF recruitment is sustained by images of an organization that is relevant to individuals and communities in Canadian society.[20] When trying to attract potential recruits to an exciting and high-tech military aviation

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[19] Marc Prensky, *Digital Game Based Learning* (Toronto: McGraw-Hill, 2001), 13.

[20] Department of National Defence, *Military HR Strategy 2020: Facing the People Challenges of the Future* (Ottawa: Minister of National Defence, 2002). 12.

environment, the CF is in direct competition with the availability of a high number of attractive technology centric employment opportunities in the civilian sector. Recruiting challenges will be compounded if the CF training system does not offer a learning environment with the requisite cutting edge training tools and techniques that will interest prospective students.

The elevated recruiting rates and technician intake throughout the 1980's has translated into a substantial cadre of highly skilled and experienced (20 years [+] service) personnel. In the field of aircraft maintenance it is extremely difficult to substitute for experience which translates into a genuine concern when considering the large number of Air Techs that are already eligible for retirement from the CF (figure 3). The shortage of skilled workers is a global issue and the Canadian Aviation Maintenance Council acknowledges that meeting the future civil aviation market demand for skilled technicians will be a challenge and recognizes that highly skilled CF aircraft technicians will continue to be a valued commodity to fill vacancies within civil aviation maintenance organizations.[21] Unlike the military where occupation and professional development is a necessary cost of doing business, industry has the advantage of being able to recruit specific skill-sets and experience levels, thus minimizing their training investment requirements. The scenario of experienced technicians leaving the CF for attractive civilian employment will place an increased burden on the Air Tech training system to maintain full capacity production in order to generate a sufficient number of skilled technicians to support a continuous turnover in personnel. The issue of knowledge transfer from an aging workforce is not unique to the Canadian Air Force, but

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[21] Canadian Aviation Maintenance Council, *A Human Resources Study of the Canadian Aviation Manufacturing and Maintenance Industry* (Ottawa: CAMC, 2002), 160.

indeed is a phenomenon common across many military and industry segments, particularly the aerospace industry. The United States (US) National Aeronautics and Space Administration (NASA) is aggressively pursuing the development of an Advanced Learning Environment (ALE) to address the requirement to replace more than 50% of its workforce that is eligible for retirement in the next few years.[22] The long-term goal of the NASA ALE is to provide an effective means of training professionals and technicians in a broad range of engineering disciplines considered critical to sustaining a robust and safe aerospace sector.

Experience is undoubtedly a key component in achieving Air Tech competency, and while it often commented that there is no way to shorten or compensate for five years of experience, it must also be recognized that the quality of training provided will greatly influence the experience gained: *Quality over Quantity*. New aircraft and integrated weapons system procurements necessitate technical support which is significantly different from yesterday's aircraft platforms with their discrete mechanical, electrical and avionics systems. Increased systems integration and technological complexity will result in a swing from the traditional large number of trained support personnel to ensuring the right people with the right skills for the right job. The forecasted demographic situation will place the Air Force in stiff competition with industry to attract personnel with the right skill sets for onward development into multi-skilled and specialized technicians. The Joint Strike Fighter (JSF) programme, the largest ever US Department of Defense (DoD) acquisition programme, with Canada as a committed partner, continues to set new

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[22] Ahmed K. Noor, "New Links For Learning in a Changing Profession," *AIAA- Aerospace America Online*, October 2002. http://www.aiaa.org/aerospace/Article.cfm?issuetocid=266&ArchiveIssueID=31; Internet; accessed 20 January 2007, 3-8.

standards in development of advanced technologies and technology transfer, including training. Commencing with vehicle design, training will be embedded into the aircraft avionics with an emphasis on simulation. With an eye to the future, designers are seeking innovative techniques for the inclusion of virtual, constructive and live training systems to support leading edge integrated technologies. In 2002, Lockheed Martin's Training System manager was quoted: "JSF training systems must appeal to kids who are 10 years old today, what's out there [now] is not of interest to us."[23]

The Air Force has long been able to attract recruits with the promise of an exciting career and the chance to work with leading edge technologies. In addition, during periods of slow economic growth in Canada, a career with the Air Force was oftentimes considered an attractive employment option. As increased competition with industry for potential candidates becomes a reality, the option to join the CF will become one of choice rather than economic necessity.

Over the past number of years, the technological gap with industry as closed significantly, to the point where military technology is now often leveraged from commercial technologies rather than vice versa. In a continuously changing technical environment, in order to stay competitive, the Air Force will have to continue to advance training methods used to educate new recruits. In order to exert influence over potential recruits and ultimately succeed, the CF must give due consideration to the near future demographic situation and build a training system that in addition to being effective will serve as a recruiting tool to attract the best and the brightest from society.

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[23] Paul Harris, "How the Military is Reinventing Training," *ASTD Learning Circuits*, November 2002. http://www.learningcircuits.org/2002/nov2002/harris.html; Internet; accessed 7 February 2007, 3.

Defining the 21st Century Learner

The last 25 years have resulted in tremendous advances in the use of technology

to assist with learning. Throughout their formative years, 21st century youth have

embraced a media culture that is progressive and supports ever-changing methods for

learning. Today's potential military recruit was likely born in the mid to late 1980's,

making him/her a member of a cohort referred to as Generation Y, or the millennials.

Extremely comfortable with the information age, their world has been technologically

complex from the start and they regard various types of e-Learning and multimedia as the

norm rather than advanced training enablers. They are capable of processing

considerably more information than older generations and are comfortable working in a

self-directed multi-task environment.[24] Rather than learn by rote the ins-and-outs of a

"new thing, or concept" the Generation-Y's remember the tags and "where to access" the

information - knowing that if they ever need the information in the future, they'll use the

"tags" to grab the info.[25] Generation Y workers have a reputation for being graphic and

visual while possessing a low boredom threshold and easily frustrated with slow-paced

environments, traditional learning strategies and technology that is only slightly outdated.

They live in the moment, excel at working in remote teams and require constant

feedback.[26] The traditional CF training methodology based on instructor delivery of

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[24] Timothy VanSlyke, "Digital Natives, Digital Immigrants: Some Thoughts From the Generation Gap." The Technology Source Archives at the University of North Carolina, May/June 2003. http://technologysource.org/article/digital_natives_digital_immigrants/; Internet; accessed 14 January 2007.

[25] Nick Hodge, "In the Digital Generation Gap," http://www.nickhodge.com/blog/archives/category/generationx/; Internet; accessed 02 April 2007.

[26] Catherine Finnegan, "Engaging Millennials and Answering to Boomers: Tales From a Gen-X, Technology Researcher," http://alt.usg.edu/publications/Engaging_Millenials_Answering_to_Boomers.pdf; Internet; accessed 12 March 2007. 20.

training material to achieve set performance and enabling objectives simply does not fit anymore. In 2003, during a meeting of the 1 Canadian Air Division (1 Cdn Air Div) Aircraft Maintenance Council, it was verbalized that when overhauling our training system we must take into consideration the students desire to be challenged along with their intuitiveness with respect to new technology. The old way of training may not be stimulating enough to the new breed and we should focus our training and development to allow technicians to progress more quickly towards achieving their technical competency authorizations.[27] Moreover, as the Air Force considers modernization of the Air Tech training system, caution must be exercised when the responsibility for design of a modern integrated learning environment is allocated to pre-digital generation trainers who tend to focus more on the abstract concepts. The instructors that grew up in yesterday's world and the students of today are substantially different in their approach, outlook, style and needs, to the extent that a technological communication gap exists.[28] In some areas adaptation of new instructional techniques using advanced technologies requires actual un-learning previous methods and discarding customary thinking and training standards. It may be that a complete training system design is preferred over an upgrade of the current system. Instructors must be able to leverage information technologies to enhance the classroom environment and must be both comfortable and proficient users of the technologies themselves.

Training and education play a critical role in arming CF personnel with the professional and personal knowledge and skills they need to succeed in the complex and

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[27] Colonel D.B. Millar, *Record of Decisions: A4 Maintenance Council Meeting, Winnipeg 21-22 October 2003* (1 Cdn Air Div Winnipeg: file 1180-7 (A4 Maint Coord)), 14 November 2003.

[28] Marc Prensky, Digital Game Based Learning, (Toronto: McGraw-Hill, 2001) 13.

technologically challenging environment of today and tomorrow, and in their careers and personal lives.[29] To help sell the product (a career with the CF) and maintain the interest of a new generation of students, the Air Force must institute a learning environment that is stimulating, relevant, accessible and challenging. To motivate and maintain the interest of the new recruit, in-service technical training must be an engaging experience, reflective of the learning culture to which the student is accustomed. Recognition of this fact is but the first step towards designing and implementing a solution.

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[29] Lynne Bermel, "Wired For Learning: An Enterprise Approach with the Defence Learning Network," *Canadian Forces Personnel Newsletter*, Issue 4/06, 26 April 2006, http://www.forces.gc.ca/hr/cfpn/engraph/4_06/4_06_dtep_dln_e.asp; Internet; accessed 04 April 2007.

CHAPTER 4

TRAINING IN THE CANADIAN FORCES

The CF Training System

All approved Individual Training and Education activities for the CF are conducted in accordance with the Canadian Forces Individual Training and Education System (CFITES).[30] As the recognized training authority, CFITES governs individual training and education (IT&E) activities for all CF organizations and members, regular and reserve force. The three fundamental principles of performance orientation, systems approach and optimum efficiency are used to guide training management. Vol 4 of the CFITES manual provides direction and guidance for the design of instructional programmes, including technology-based instruction. Throughout, CFITES recognizes, and indeed endorses, the increasing role that IT plays in the delivery of all types of training conducted within the CF.

Consistent with the aim of this paper is a recent project approval for the CF Defence Learning Network (DLN), a joint Chief Military Personnel (CMP) and Assistant Deputy Minister (Human Resources – Civilian) [ADM (HR-Civ] initiative. The DLN is designed to foster an environment of continuous learning by providing "anywhere, anytime and just-in-time" access to learning, training and professional development programmes and services for Department of National Defence (DND) civilian and CF

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[30] Department of National Defence, A-P9-000-001/PT-000, *Canadian Forces Individual Training and Education System (CFITES)* (Ottawa: DND Canada, 2003).

personnel.[31] The DLN goals along with system design and architecture closely resembles that required for an Air Force TTN where a Learning Management System (LMS), a standardized policy framework and knowledge management repositories are used to deliver integrated training activities better and faster. The DLN is increasing its visibility, accessibility and effectiveness through alliances with other CF and civilian learning organizations that use compatible learning strategies and technologies. The DLN in partnership with the Canadian Defence Academy (CDA) has implemented an interim online delivery capability branded DNDLearn, available to all DND members and CF employees via the Defence Wide Area Network (DWAN) or the Internet. While the DLN is still undergoing a 'proof of concept' with full implementation scheduled for 2009, the initiatives embodied in the DLN support the shift towards the CF becoming a learning organization with an embedded learning culture.[32]

The DLN components include a network of Learning and Career Centres (LCC), hubs and satellite/kiosk locations across the country, a test lab and a virtual training centre for on-line education using the LMS and a support services group. The benefits of an e-Learning system are reflected in the relatively quick adoption of DNDLearn to facilitate learning activities across the CF.[33] In March 2007, the Canadian Forces College (CFC) Toronto used DNDLearn to coordinate all aspects of an extensive and complex two week staff exercise used to train more than 100 senior CF and international officers

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[31] Defence Learning Network, "Home Page," http://www.dnd.ca/dln-rad/engraph/home_e.asp; Internet; accessed 12 March 2007.

[32] Department of National Defence, *Military HR Strategy 2020: Facing the People Challenges of the Future*. (Ottawa: Minister of National Defence, 2002). 22.

[33] Defence Learning Network, "Home Page," http://www.dnd.ca/dln-rad/engraph/home_e.asp; Internet; accessed 12 March 2007.

in joint and combined planning for conventional war-fighting at the operational level. DNDLearn provided for easy access to updated guidance, exercise documentation, discussion/chat forums and integrated e-mail services. Orientation via a 30 minute pre-exercise group training session was sufficient to allow students to start using the system with considerable proficiency. The proven success of DNDLearn and recognition of its potential will result in the migration of additional components of the CFC curriculum for delivery via DNDLearn commencing in summer 2007.

To access and expand learning opportunities for CF members, the CDA has established a Memorandum of Understanding (MOU) with OntarioLearn,[34] a consortium of 22 Ontario Community Colleges who have partnered to develop and deliver on-line courses. Whether in Canada or on deployed operations, this service allows CF members and DND employees to access in excess of 500 college level courses.

"The DLN is the future," commented Vice-Admiral Greg Jarvis, Chief Military Personnel (CMP). "Technology has put a premium on speed and responsiveness. To train faster and more efficiently is becoming increasingly important in the digital age. The CF cannot afford to continue to do business in old ways."[35]

Air Force Technical Training – Current Training System Construct

Training support for Air Force technicians is highly decentralized and organized along platform and functional lines. The maturity of existing learning technology

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[34] OntarioLearn.com, "Home Page," http://www.ontariolearn.com/; Internet; accessed 12 March 2007.

[35] Lynne Bermel, "Wired For Learning: An Enterprise Approach with the Defence Learning Network," *Canadian Forces Personnel Newsletter*, Issue 4/06, 26 April 2006, http://www.forces.gc.ca/hr/cfpn/engraph/4_06/4_06_dtep_dln_e.asp; Internet; accessed 04 April 2007.

applications and concepts varies from Wing to Wing.[36] The training process commences

with basic occupation or ab initio technical training delivered at the CFSATE, Borden.

Graduation from CFSATE ensures the junior technician possesses the requisite basic

knowledge and skills to commence formal OJT as part of an apprenticeship programme

at an operational unit before follow-on aircraft type specific training and advancement to

the journeyman level (figure 1). Type training is delivered at one of the fleet training

schools located at 4 Wing Cold Lake for the CF-188, 12 Wing Shearwater for the CH-

124 Sea King, 14 Wing Greenwood for the CP-140 Aurora, 8 Wing Trenton for

Transport Aircraft and 438 Escadron Tactique d'helicoptere (ETAH), St. Hubert for the

CH-146 Griffon. Other smaller fleets such as the CT-114 Tutor, CC-138 Twin Otter and

the CT-142 Dash 8, train their technicians locally using small training sections embedded

with the operational squadrons.

A deficiency and inefficiency with the current training system model is the

absence of an end-to-end standardized training loop accessible and shared by the various

aircraft fleets and supporting schoolhouses that could leverage the benefits of an

integrated training environment. A properly designed, funded and implemented

networked technical training system (TTN) has the potential to deliver improved learning

as well as efficiency of training delivery, training management and learning performance

measurement capabilities for the Air Force. The extant training approach is not seamless

and as such fails to deliver efficiencies inherent to an integrated learning continuum

strategy. At any one of the five fleet training schools, the training approach, while

complying with CFITES and approved training plans, is carried out in accordance with

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[36] ADGA Group Consultants Inc., *Final Report on Canadian Air Force Blended Learning*, Report Prepared for D Air PPD 3-3, 31 March 2003. 1.

the respective school standards using a curriculum approved by 1 Cdn Air Div for use at that school. That is to say that technicians receiving instruction on a particular maintenance procedure, system or component that might be similar or perhaps even identical in design and operation may be subject to different training standards and techniques, depending on the training school. As well, should the technician change aircraft fleets, he/she may be required to relearn the entire system.

Traditionally, practical training experience was achieved by using training aids assembled from aircraft systems, parts and components along with cut-away and working models. It is unreasonable to suggest that training on the 'real thing' is not effective, however, potential effectiveness is often compromised by the availability of a limited number of sometimes very expensive and difficult to replace hardware trainers. As well, significant cost and loss of valuable training time can be incurred with routine training aid maintenance and the requirement for reconfiguring these trainers. Since 2002, considerable effort and expense has been invested into ensuring that CFSATE has the training tools necessary to support an increased number of courses as the Air Force strives to meet training production requirements. In the 16 Wing 2006/2007 Strategic Plan – 'Training For Success,' the Wing Commander acknowledges the value of technology insertion as an essential requirement of training transformation.[37] As part of the Air Tech revitalization, a wide variety of training equipment and technology has been procured from a variety of sources, but because the focus has been on production, new equipment has not always been introduced with the foresight of a fully integrated

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[37] Lieutenant-Colonel H.J. Kowal, Wing Commander, "16 Wing Strategic Plan 2006/2007: Training For Success," http://16wingweb.borden.mil.ca/16WingHQ/images/Strategic_Plans_e.pdf; Intranet (DWAN); accessed 29 January 2007. 4.

approach. At the same time the individual fleet schools are progressing an agenda to revamp their trg requirements to meet operational demands and complement the training provided at CFSATE. An important aspect of the revamped Air Tech training programme is the success achieved with implementing a programme with output quality that is on par with, or exceeds, aircraft engineer training provided by colleges across Canada. Having an in-service training institution which complies with training standards set by the Canadian Aviation Maintenance Council serves as an excellent recruiting tool as it demonstrates a commitment to develop technicians in such a manner that when he/she leaves the military, qualifications will be easily transferable making the integration into the civilian workplace much easier.

Training System Inefficiencies

Despite the good intentions and noted success of the Aircraft Technician Training Oversight Committee, the Air Force lacks a coherent strategy to link or network the many disparate training systems. The pressure exerted by the requirement to ensure that the short-term training capacity is achieved makes it difficult to focus on a longer-term strategy to implement a training programme for the future. Without the imposition of system-wide training standards, reflective of a training continuum, a great deal of time and money will continue to be expended without due consideration for a joined up approach. As long as they are unable to benefit from an integrated training system approach, schoolhouses will continue to be divergent and inefficient in their training delivery.

Inefficiency is exemplified by the process in which the current linear training system requires that all new technicians receive the full BOT package without any flexibility for tailoring training to meet the individual's future job requirements. Depending on the aircraft type to which the technician is posted there will be a range of specific competencies required, commensurate with the nature and scope of the employment that may be better taught at a point in time when they are needed. For example a technician posted to a CH-146 Griffon helicopter unit will benefit marginally from receiving extensive training in complex CF-188 and CC-130 systems during his/her BOT. If the technician should be subsequently posted to one of these aircraft fleets it would make sense to provide the training at point when it is needed and the learning is more relevant; *just in time training*. A prescribed amount of introductory and cross-training on different aircraft types and technologies is necessary to endure that technicians have a solid technical foundation, however, depending on the assigned employment stream, knowledge requirements for technicians graduating from BOT may vary significantly. Under the extant CFSATE training programme, all students receive the same comprehensive training package, regardless of employment stream. Adoption of a just-in-time training philosophy using a distributed learning strategy would greatly enhance efficiency while ensuring that competencies are met.

Training System - Missed Opportunities

The current linear approach to training is capacity limited resulting in a backlog of trainees that are often required to wait several months for the next available training slot. Personnel awaiting training (PATs) at 16 Wing Borden, require the dedication of

already scarce training support personnel resources to coordinate and supervise employment that is often irrelevant to their career technical development. Without formal training and qualifications in the simplest of aircraft maintenance procedures and flight line operations, the opportunity to use PATs for meaningful employment is extremely limited. The pre-training employment programmes offered are at best described as little more than make-work projects to keep the students busy, contributing limited training value and sometimes proving to be less than productive, or even a satisfying experience. Using Computer Based Training and Distance/Distributed Learning strategies, positive steps can be taken towards self-directed learning that can result in students attaining basic knowledge qualifications or at the very least greatly improve their subject threshold knowledge before commencing formal course training. The students would welcome the opportunity to contribute to their professional and technical development.

With the increased integration of e-Learning tools for Air Tech training, the traditional 'push' approach to training will become increasingly inappropriate in a training system that focuses on the individual's ability to 'pull' tailored material in support of his/her learning objectives.[38] The Air Force must consider a new training delivery paradigm that is non-sequenced and capitalizes on bringing/delivering training to the student, not the student to the training. A rolling start approach using e-Learning strategies takes advantage of the ability for students to learn and progress at individual rates. In addition to balancing the schoolhouse training programme, rolling starts would

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[38] Department of National Defence, *DND/CF Concept Paper Produced by the Symposium Working Group, Ottawa, 1 November, 2000*. http://www.drdc-rddc.gc.ca/seco/documents/DND-CF_Concept_Paper_e.html#ch6; Internet; accessed 22 March 2007.

help attrite the PAT situation which is exacerbated by students in the training loop

spending considerable non-productive time waiting for other students.

Cost of Training

Within the corporate world, new learning programmes are often developed with

profitability margins in mind. In a different context, the Air Force too can derive

profitability margins that are measured in time required to achieve technical competence

rather than monetary value. The wide range of factors contributing to the overall cost of

training makes it difficult to provide a precise breakdown. Measuring value and return

on investment (ROI) for Air Tech training remains important, but paramount to the Air

Force is assurance that the training they're spending money on actually meets the set

training objectives. The problem is defining the appropriate metrics for measuring ROI

for learning. Is it student throughput, time to master the skills or perhaps failure rates?

ROI is a traditional financial measure based on historic data but tends to be a backward-

looking metric that yields no insights into how to improve the business results related to

training in the future.[39]

To calculate an actual monetary ROI, the Air Force would first have to identify

the total financial benefit drawn from a learning programme and then subtract from that

the total investment made to develop, produce, and deliver that programme. Though it's

difficult to measure all of the costs associated with training and even harder to isolate the

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[39] Marcia L. Conner, "How Do I Measure Return On Investment (ROI) For My Learning Program," *Training and Learning Facts Learnativity.com*, http://learnativity.com/roi-learning.html; Internet; accessed 12 March 2007.

financial benefits from the training delivered, this exercise is worth completing so as to determine a baseline from which to better define training cost-effectiveness and ROI.

$$\underline{\text{(total benefit - total costs)}} \quad = \quad \underline{\quad\quad\quad} \quad \text{X 100 = ROI}[40]$$
$$\textbf{total costs}$$

Total benefits include money saved by the organization and anything that adds directly or indirectly to the bottom line. Total costs can be quite broad in scope and include the obvious and the not-so-obvious: development costs, learner's overhead including physical materials, overhead of instructors, support personnel, accommodations, meals, facilities and cost of coordination.[41]

In the 1 Canadian Air Division Level II Business Plan for 2007, the Commander highlights training and regeneration imperatives as key goals related meeting the strategic priorities established by the Chief of the Air Staff.[42] Total planned expenditures for the Air Force for fiscal year 2007/2008 amount to 621 million dollars.[43] Attempting to clearly define the Air Tech training costing relative to the overall Air Force budget is particularly difficult because training budgets and expended funds involve inclusion of costs related to many rolled-up activities and separating direct and indirect costs. The 1 Cdn Air Div, Air Force Training Directorate (AF Trg) oversees a budget in the order of 25 million dollars to support individual training and education costs, including temporary duty costs, travel, tuitions, training system reinvestment and in some cases Reserve

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[40] Ibid., 1.

[41] Ibid., 2.

[42] Major General J.J.C. Bouchard, *1 Canadian Air Division Business Plan 2007* (1 Cdn Air Div: file 1950-1(A5)), 06 December 2006. 2.

[43] Ibid., 6.

personnel training salaries.[44] What is generally not included in the funding allocated to

AF Trg is the resources required to conduct the training (direct costs, instructors, training

facilities, equipment, consumables). These costs are distributed throughout the

organizations holding the responsibility for conducting training.

The costs associated with training Regular and Reserve Force personnel,

including fiscal and the time away from their home unit is significant. Often Air Tech

Reservists take an inordinate amount of time to acquire even the most basic qualifications

simply because they cannot release themselves from other commitments to attend lengthy

courses at CFSATE or any one of the fleet schools. Sometimes Reservists with excellent

potential and motivation for service as Air Techs are simply unable to pursue their

dreams because of the inflexibility of the training system to accommodate their

availability; this cost is very difficult to quantify. E-learning can be used to reduce the

amount of time required for residential training by allowing the Reservist to complete

part, or perhaps even all, of the knowledge portion of the training package in accordance

with his/her other priorities.

Traditionally, when budget cuts are necessary, training is often viewed as an easy

target. In a 2002 Review on UK Defence Training it was reported that strong evidence

existed to suggest that e-Learning can improve the quality of training and in some cases,

particularly residential training, reduce course length by up to one-third.[45] While delivery

of residual benefits such as reduced costs is alluring, caution must be exercised that an e-

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[44] Maj Don Hamilton (1 Cdn Air Div, AF Trg Sp), telephone conversation with author, 3 April 2007.

[45] United Kingdom. *Ministry of Defence*, *Modernising Defence Training*: *Report of the Defence Training Review* (London UK: MOD Printing, 2002). 32.

Learning strategy is not implemented solely for the potential savings resulting from training factors such as reduced travel costs and the requirement for fewer instructors. The savings accrued in some areas may also be neutralized by the significant initial start-up cost to implement an e-Learning system across a network. Potential savings resulting from transitioning to an e-Learning environment must be qualified over the long-term with constituents related to desired profitability margins closely considered. When all factors are taken into consideration, the Business Case should provide the impetus for adopting an innovative approach to training using the TTN. Transitioning to an e-Learning environment does exhibit potential for long-term cost savings, however, in the final analysis, regardless of accrued economic contributions, the only meaningful metric for the success of an Air Force e-Learning environment is measured operational effectiveness relative to technician contributions on the flight line.

Capacity to Train

Following the 2001 Occupational Analysis,[46] CFSATE commenced an aggressive transformation project to address concerns related to course content including the re-introduction of practical skills development to complement the knowledge and theory portions of BOT. To address training throughput concerns, CFSATE proposed a six-phase growth strategy named 'Flexible Approach.'[47] The CFSATE transformation approach was largely directed towards meeting the assigned short-term capacity and

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[46] Colonel N, Jodin, *Occupational Analysis (OA) Report Aircraft Technicians MOCs 514, 526, and 565* (National Defence Headquarters Ottawa: file 5555-119-2 (MOSART)), 12 May 2003.

[47] Lieutenant-Colonel H.J. Kowal, "Transforming the Schoolhouse," Paper No 1512, Inter-Service/Industry Training Simulation and Education Conference (I/ITSEC) 2004. 3.

production growth targets and did not specifically focus on technology integration as an enabler.

CFSATE student production has increased year on year since 2003, but still falls short of production targets. For Fiscal Year (FY) 2006/07 CFSATE will produce approximately 62% of the required Annual Military Occupation Requirement (AMOR) throughput for the three aircraft technician occupations.[48] A number of factors contribute to the underproduction, including access to training aids and the reduced productivity of a limited number of available personnel who are required to contribute to training transformation activities while at the same time manage an increased number of courses are programmed to satisfy a significant increase in Air Tech production requirements. The fleet schools are able to come closer to their training output targets, however, transformation at the Fleet Schools will require down-stream production increases relative to the increase in CFSATE training throughput. Under the current training strategy, increased training production is effected through an increased number of courses requiring an increased number of instructors, support staff along with training aids, etc., all at a time when fiscal realities and manning ceilings preclude the infusion of additional personnel and new infrastructure. Transformation initiatives introduced through ATT are helping with CFSATE throughput, but given the imposed budgetary training system restraints, innovation vice transformation holds greater potential to deliver effective training against assigned production targets. With the network infrastructure already in place, the Air Force must take advantage of an opportunity to implement a training system that will go beyond addressing the single issue of capacity.

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[48] Colonel W.R.R. Cleland, *CFSATE Steady-State Capacity Requirements* (1 Cdn Air Div Winnipeg: file 4983-1 (AF AETT0), 27 February 2006.

CHAPTER 5

EXPLOITING THE INFORMATION AGE

"The number one benefit of information technology is that it empowers people to do what they want to do. It lets people be creative. It lets people be productive. It lets people learn things they didn't think they could learn before, and so in a sense it is all about potential."[49]

- Steve Ballmer, Chief Executive Officer of Microsoft Corporation

Learning in a Changing Technology Based Environment

Information Technology and training have become inextricably interwoven to the extent that each can be considered subordinate to the other. The purpose of using technologies in learning is to accelerate and improve the quality of the learning experience and ultimately to achieve better performance in the workplace.[50] IT has changed the access to knowledge, the process of learning, and the delivery of education and training. With teaching and training available outside the traditional schoolhouse environment, the individual who has been an occasional student becomes a continuous consumer of knowledge available anywhere and anytime.[51] Militaries are renown for adapting to the fast paced change resulting from technological advances and traditionally militaries have led the way in the development and employment of technologies such as

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[49] Steve Ballmer, "AACIS Unlimited Potential Grant Announcement," February 17, 2005. http://www.microsoft.com/presspass/exec/steve/2005/02-17aacis.mspx; Internet; accessed 29 January 2007.

[50] ADGA Group Consultants Inc., *Final Report on Canadian Air Force Blended Learning*, Report Prepared for D Air PPD 3-3, 31 March 2003. 1.

[51] Wayne Hodgins, "Into the Future, A Vision Paper." *American Society for Training and Development (ASTD) and National Governors' Association (NGA)* February 2000. http://www.learnativity.com/download/MP7.PDF; Internet; accessed 26 January 2007. ii.

simulation and virtual reality to enhance training. When addressing the issue of integration of technology into military learning, futurists Alvin and Heidi Toffler commented:

> "militaries place a massive emphasis on training and education at every level ….. As in business, learning, de-learning and re-learning has become a continuous process in every occupational category in the military. Training organizations are rising in the power-pecking order within the various military services. In all branches advanced technologies are being developed to speed learning."[52]

The potential for benefit from IT insertion into the classroom is widely accepted, however, numerous studies on the use of media in education also show that technology insertion without an appropriate learning strategy is unlikely to achieve the desired outcome. Multimedia is not necessarily more effective just because it uses a range of text, audio, video, animation and simulation delivered by computer based systems. While technologies like animation can be powerful tools to explain complex processes, the critical factor is the integration of the various media.[53] Through use of digital technologies and high-speed broadband connections, an array of instructional techniques using synchronous (real-time) or asynchronous transfer offer the promise to deliver effective training using computer-based interactive and distance learning strategies.

We now better understand that for effective learning to take place it is necessary to comprehend the overall context of the subject being taught. It is accepted that effective learning involves more than just listening but is facilitated by participation,

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[52] Alvin and Heidi Toffler, *War and Anti-War: Survival at the Dawn of the 21st Century*, (New York: Little, Brown and Company, 1993), 172.

[53] Serge Ravet and Maureen Layte, *Technology Based Training: A Comprehensive Guide to Choosing, Implementing, Managing, and Developing New Technologies in Training*. (New York: Golf Publishing Company, 1997), 5.

social interaction and a real-time feedback loop.[54] The use of visual models as stimulants

to enhance training was recognized and documented well in advance of the arrival of

digital technology and the Internet. The concept first gained attention in 1946 when

Edgar Dale, often cited as the father of modern media in education, developed from his

experiences in teaching and observation of learners the "Cone of Experience," depicted

below in figure 3.
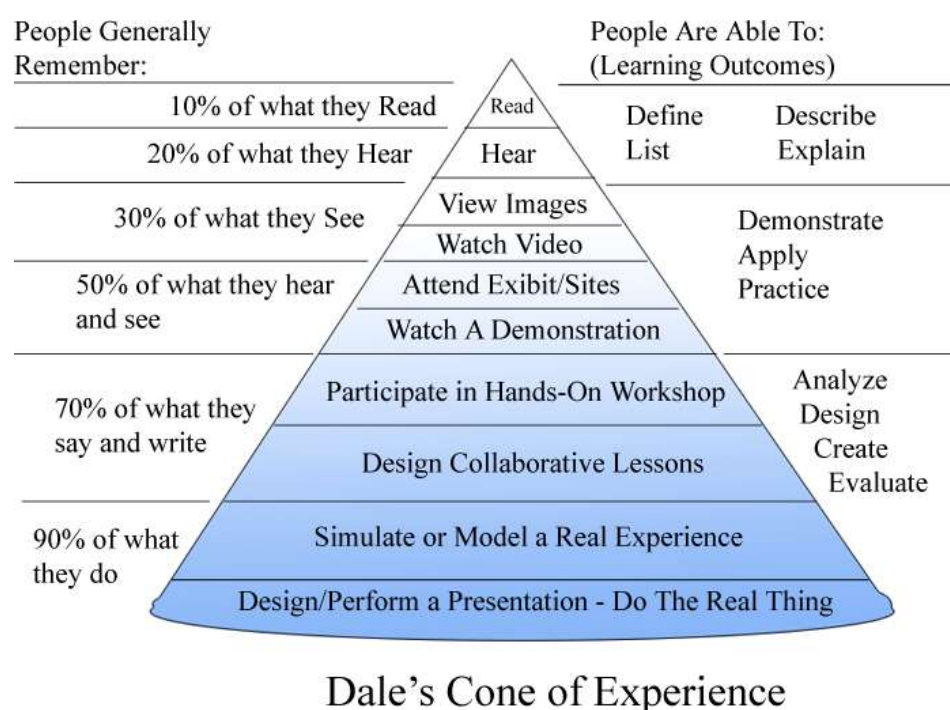
Figure 3 – Dale's Cone of Experience

The cone continues to be used today to demonstrate the relationship between educational

experiences and real life, suggesting that direct experience is the single most effective

form of learning. Dale contended that learners could make profitable use of more

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[54] Marcy P Driscoll, "How People Learn (and What Technology Might Have to Do With it)," *Eric Digest,* http://www.ericdigests.org/2003-3/learn.htm; Internet; accessed 05 March 2007. 2.

abstract instructional activities to the extent that they had built up a stock of more concrete experiences to give meaning to the more abstract representations of reality.[55] With straightforward readability to interactive 3D modeling, simulation and blended learning environments, the cone directly supports the concept that direct purposeful experience (concrete experiences) results in a much greater level of retention than simply reading about, or being instructed on the subject material. The selection of instructional materials, therefore, will depend on the amount of sensory experience required for a particular topic of a lesson. The cone can help select the preferred communication strategy for the message being conveyed.[56] The CFSATE reintroduction of practical skills development to complement classroom knowledge and theory lessons reaffirms that the cone's utility in selecting instructional resources and activities is as practical today as when first created some 60 years ago.

Increasingly IT is accepted as an integral part of teaching and learning in practically all educational institutions. Participant learning is strongly influenced by individual attitudes and perceptions of technology, learning tasks, peers, and facilitators.[57] Younger students, having grown up with computers and video games, are more comfortable with technology and tend to be more receptive to an IT enhanced environment where they thrive and benefit from interactive learning. Aviation, both civilian and military, characterized as a technology-driven, knowledge-intensive and a

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[55] Edgar Dale, *Audio-Visual Methods in Teaching*, *3rd ed*, (New York: Holt, Rinehart and Winston, 1969), 108.

[56] Ibid., 132.

[57] Barbara J. Daley, Karen Watkins, Saundra Wall Williams, Bradley Courtney, Mike Davis, and Darryl Dymock, "Exploring Learning in a Technology-Enhanced Environment," *Educational Technology and Society*, Vol. 4, no. 3 (July 2001): 6, 8.

constantly changing discipline lends itself very well to training in an integrated learning environment, where technology itself acts as a collaborative tool to enhance learning by using the visual component to stimulate creative thinking. Complicated systems and concepts are much better represented by multimedia, 3D animation and simulation than the traditional study manual text accompanied by pictures or illustrations. To a large extent, technology in the Air Tech classroom has been used primarily for word-processing and enabling PowerPoint presentations. Advanced learning concepts promote increased use of technologies into the classroom to deliver virtual simulation and self-paced tutorials across networks.

In traditional learning styles like that currently practised at CFSATE, knowledge is viewed as adapting information where an instructor or supervisor is viewed as the subject matter expert responsible for transmitting knowledge to students. Supporting technical applications designed to aid this learning model were also based on the assumption that students learn best 'from' rather than 'with' technology. Using a 21st century approach to training, where the "with" – approach is practiced, the technology forms part of the students' tools for selecting, collecting and sharing information with other learners. In this model, the technology acts as a tool for collaborative creative thinking and learning, not just as a source for data gathering and processing.[58]

A University of Southern Indiana study of science students was conducted to determine if the use of computers as a presentation tool along with the incorporation of internet to facilitate access to learning material would impact knowledge retention and

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[58] Teemu Leinonen and Pekka Rissanen, "'KUOMA'-Learning Environment - An Implementation of Collaborative Project Learning in the World Wide Web," http://matriisi.ee.tut.fi/kamu/kuoma/short.doc; Internet; accessed 19 March 2007. 2.

exam scores. The data was compiled over three years (1997 –2000) using four

Universities and a comparative analysis methodology. The final results indicated that

students found the on-line access to training material to be of great benefit with average

exam results showing an improvement of as much as 23%. Results for comprehensive

final exams showed a marked increase of 11%, suggesting overall better examination

preparation and improved retention for the IT enhanced classroom.[59]

In an effort to deal with recognized deficiencies with United States Navy training,

in 2000, the Chief of Naval Operations chartered an Executive Review of Naval Training

(ERNT) to report and provide recommendations on how to evolve Navy training

procedures. The final report 'Revolution in Training,' released in 2001, determined that

the Navy technical training system was performing well below optimal effectiveness and

efficiency levels and recommended that the Navy quickly adopt new approaches to

learning and training to take advantage of opportunities offered through technology.[60]

The ERNT detailed analysis confirmed that by embracing training technology, the private

sector has made extraordinary leaps in effectiveness, efficiency and performance leading

to a secondary benefit of improved employee retention.[61] Acting on the ERNT report, the

Chief of Naval Operations announced his 'Top Priority' as manpower and winning the

"War for People." To win the war, the Navy felt that a commitment to education and

learning was required to empower sailors to excel professionally and personally – hence

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[59] James M. Durbin, "The Benefits of Combining Computer Technology and Traditional Teaching Methods in Large Enrolment Geoscience Classes," *Journal of Geoscience education*, Vol.50, No. 1, January 2002, http://www.nagt.org/files/nagt/jge/abstracts/Durbin_v50n1p56.pdf; Internet; accessed 05 February 2007. 56-63.

[60] *Executive Review of Navy Training - Revolution in Training,* VADM (Ret) Lee Gunn, USN and RADM David Brewer, USN, Co-Chairs. Washington DC: The Commission, 2001. 1.

[61] Ibid., 36.

the banner "Revolution in Training." Since 2001 the US Navy has embraced e-Learning strategies to the extent that the Navy's "Revolution in Training" is setting a valuable precedent that will affect the growth of e-Learning throughout the US government and the corporate sector.[62] Similarly, in recognition of the requirement for the United States Air Force (USAF) technical training to keep pace with technology, the Commander of the 82nd Training Wing, located at Sheppard Air Force Base in Texas, approved the Classroom Transformed Strategic Plan to establish goals and a model for the comprehensive introduction and management of technology in the classroom.[63] The classroom transformation is accomplished through three objectives: a) Web-based dynamic content delivery, b) Instructor and student interface software facilities monitoring of progress and appraisals in the classroom environment, and, c) Standardized web-based test and measurement software for development and delivery of test yielding common evaluation metrics and identifying areas requiring improvement.

In recent years, within the CF we have experienced a plethora of simulation technology injection to increase training effectiveness and in some cases reduce the cost of training. For select training events, simulation can provide realistic, safe and relatively cheap training. The Canadian Army uses simulators to train in the areas of weapons effect, war gaming, and even small arms simulation. Flight simulators have become a de facto part of all aircraft procurement projects. It is difficult to imagine an advanced aircraft today that would be procured without either buying a simulator or securing access to simulator facilities for aircrew training. CFSATE uses an aircraft marshalling

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[62] Paul Harris, "How the Military is Reinventing Training," *ASTD Learning Circuits, November 2002*, http://www.learningcircuits.org/2002/nov2002/harris.html; Internet; accessed 7 February 2007. 3.

[63] Gina Johnson and MSgt Larry Campbell, *Classroom Transformed, Strategic Technology Plan Outline*, *82nd Training Wing*, *Sheppard Air Force Base Texas*, 6 March 2004.

simulator to support realistic training scenarios when teaching new technicians the techniques, procedures and safety requirements of aircraft ground manoeuvring. The simulator provides a cost effective and realistic training capability to practice, and repeat if necessary, a number of scenarios using different aircraft types and selected weather and environmental conditions. Before acquisition of the simulator, due to the high cost of ground running aircraft, the students completed the training with limited exposure to a realistic operating environment.

The potential offered by simulation and synthetic environment training is of relative importance that it warrants mention in the CF Air Force Strategy document. The Air Force will develop simulation tools as part of the DND/CF synthetic environment to fundamentally alter the process of defining and acquiring training capabilities.[64] The longer-term plan will have all training devices connected via the DND/CF synthetic environment to central simulation services, including networked clients and servers.

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[64] Department of National Defence, *Air Force Strategy: A Flight Plan for Canadian Forces Aerospace Power*, Draft V1.8, March 2007. 34.

E-Learning and Networked Technologies

> *"If people are really good at processing information from lots of different sources and you don't give it to them, you stifle them."[65]*

- Prensky, author of Digital Game-Based Learning

The continuous and convenient access to training to enhance technical skills development and competence must be afforded the highest priority to ensure an operationally relevant and ready Air Force; this challenge is best met by methods of e-Learning as a direct extension of today's IT culture. It is not "Old Wine in New Bottles," is not about reducing the number of classroom instructors, or about self-study, but rather is an entirely new way to deliver training which is more relevant, efficient and effective. Although the uptake of e-Learning in the academic and general training environments is slower than originally predicted, it remains one of the fastest growing areas of the high technology sector.[66] The wide range of available technology enablers and training methodologies make it difficult to identify a standard, or even provide a generic definition for e-Learning. As well, with rapid advancements in IT such that many technologies have a lifecycle spanning a mere 18 –24 months, any system reliant on IT must be designed to be evolutionary rather than revolutionary. The phenomenal growth in the use and efficiency of Internet technology, coupled with the anytime, anywhere ease of access has increased the economic value of e-Learning in support of a global market

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[65] Marc Prensky, *Digital Game Based Learning* (Toronto: McGraw-Hill, 2001), 3-1.

[66] Charles A. Shoniregun and Sarah-Jane Gray, "Is E-Learning Really the Future or a Risk," *Ubiquity Journal*, Vol. 4, Issue 10, May 2003, http://portal.acm.org/citation.cfm?id=777948; Internet; accessed 15 January 2007.

worth 6.5 billion dollars (US) in 2003 and predicted to grow to 21 billion dollars by 2008.[67]

For the UK MoD, and equally applicable to the CF, e-Learning is a collective term used to describe training delivered by electronic means, which include web-based system, and computer and communication technologies, anywhere at anytime on demand.[68] In the CF military training environment, e-Learning is represented by technologies such as Computer-Based Training (CBT), Blended Learning, Distance Learning, Distributed Learning and Virtual Classrooms. The concept of e-Learning generally implies a physical separation between the instructor and student, that the learner uses some form of technology (usually a computer) to access learning material and that the learner uses technology to interact with the instructor and other learners, and that some form of support is provided to the learner.[69]

Information and communication technologies facilitate active learning and collaborative teaching methods. Students get to exercise their creativity and coordinate their work much more easily when aided by technology.[70] The use of networked e-Learning holds considerable potential for a distributed training system to develop aircraft technicians. A properly designed e-Learning network embraces the fundamental training

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[67] John Huddlestone and Jonathan Pike, "An Integrated Model for Learning Object Reuse," Paper No. 2649, Inter-Service/Industry Training, Simulation, and Education Conference (I/ITSEC) 2006. 2.

[68] Martin Mackain-Bremmer and Bernard Scott, "E-learning Projects and the Defence Academy at Shrivenham," *MS&T Magazine*, Issue 1, Winter 2006. http://mst.texterity.com/mst/2006-1/?pg=25; Internet; accessed 12 March 2007. 25.

[69] Dr. Helene Fournier, "E-Learning – State of the Field Report, National Research Council of Canada, Institute for Information Technology," May 2006. 5.

[70] Ben Shneiderman, *Leonardo's Laptop: Human Needs and the New Computing Technologies* (Cambridge: The MIT Press, 2003), 116.

characteristics of personalized, interactive, current and user centric.[71] When these

benefits are coupled with timeliness, accessibility and scalability they extend advantages

for just-in-time training that can be offered either in Borden, at fleet training schools, at

deployed and remote locations or self-paced training conducted just about anywhere

while students await formal courses. Access to information that is convenient to the

learner is an expectation of the 21st century student. A TTN has the potential to deliver

organizational advantages of reduced delivery costs, reduced training time, along with

much improved flexibility and convenience. Additionally, the student will benefit from a

self-paced and non-threatening training environment where general or bespoke content

delivery is consistent.

E-Learning is already an accepted, and in some areas, a mature training

methodology in the CF with several examples of enhanced training using various types of

IT. The **DNDLearn** Enterprise Platform is accessible from both the DWAN and Internet

and currently supports in excess of 48 training and education institutions across all

environmental Managing Authorities (MA). DNDLearn combines all the features and

functionality found in a Learning Management System (LMS), a Learning Content

Management System (LCMS), basic portal accessability, and a Learning Object

Repository (LOR). It offers a complete web-based suite of easy-to-use teaching and

learning tools with a focus on course development, delivery and management. The LOR

capability of DNDLearn helps reduce the costs associated with the delivery and

management of large online training programmes and improves overall training and

educational outcomes while ensuring timely access to the appropriate courses and

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[71] Brian W. Ruttenbur, Ginger C. Spickler and Sebastian Laurie, e-Learning: "The Engine of the Knowledge Economy," Morgan Keegan & Co., Inc., 6 July 2000, http://internettime.com/itimegroup/morgankeegan.pdf Internet; accessed 10 January 2007, 15.

knowledge. The Canadian Army is pursuing the adoption of Blended Learning along with online training within Army individual training as a means to significantly expand capacity while improving training quality. With a mission to exploit existing and emerging technologies, learning theories, and educational practices in order to improve efficiency, effectiveness, engagement, and experiential learning, the Commander of the Army Individual Training Authority (AITA) located at CFB Gagetown, New Brunswick, has granted approval for the commencement of phased activities leading to a Blended Learning training framework commencing in September 2007.[72]

Measuring e-Learning Quality

Both the learning organizations and the students participating in an e-Learning environment want education and training outcomes that are effective and efficient. Inherent with any Canadian military training organization is a strong emphasis on Quality and Standards to ensure that training delivery is consistent with the approved training plans. CF training organizations, including CFSATE and the fleet training schools, employ regimented Quality and Standards programs to ensure compliance with the CFITES, Part II Quality Control System and the Air Force AF 9000+ Quality programme. Based on the ISO Management System, AF9000+ measures organizational products and processes for conformance to the published requirements. Audit follow-up procedures to ensure that necessary corrective action has been taken falls within the ambit of the organizations Standards Section.

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[72] Major T.P. Workman, Service Paper, *Expanding Training Capacity and Improving Training Quality Through Blended Learning and the Use of Online Environments*. 08 December, 2006, Amended 19 January 2007. 1.

A Quality program can go a long way towards fostering an environment that is conducive to change, however, for a CF schoolhouse environment, Quality Control is generally a reactive measure used to assess the performance of work in progress or work already completed. In an e-Learning environment, there are concerns related to the use of conventional quality assurance techniques and their ability to adapt to rapidly changing technologies. A quality program that is not adaptive will likely stifle innovation.[73] Within an e-Learning environment it is important to view quality development not as an add-on to e-Learning but rather as a key aspect, integral to all phases of development and delivery.[74] Without adherence to structured and rigid verification processes, Air Force training organizations will undoubtedly find it difficult and stressing to accept new ways of maintaining high levels of quality control. Like many other aspects of e-Learning, adapting to news procedures for quality management will involve a cultural change. The best quality assurance mechanism is to ensure the provision of intuitive learning resources so that students can extract the best from the learning experience.

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[73] Organisation for Economic Co-operation and Development (OECD). *Report on Conference Proceedings: OECD/Canada/Alberta Conference on E-Learning in Post-Secondary Education: Policies, Practices and Research*. *26-28 June 2005*. http://www.education.gov.ab.ca/oecd2005/FinalReportEnglish.doc; Internet; accessed 25 March 2007.

[74] Ulf-D. Ehlers, "Quality in e-Learning from a Learners Perspective," *European Journal of Open, Distance and E-Learning*, http://www.eurodl.org/materials/contrib/2004/Online_Master_COPs.html; Internet; accessed 12 March 2007.

CHAPTER 6

TECHNICIAN TRAINING NETWORK

"There's a tendency to teach people the way you were taught. Rather, students want to learn their way, not your way. We need to embrace the new technologies and the power it gives for teaching in novel and exciting ways."[75]

- Keith Gladstone, Military Simulation & Training, CAE Inc.

The Requirement For Change

A transformed Air Force requires innovation and technology insertion to support learning organizations. Recognition of this fact is not lost with the Air Force senior leadership. In May 2004, Air Command released a series of publications that outlined a *'Vision'* for the future of Canada's Air Force, detailing how various elements and structures will be transformed and organized to ensure success. The general, and in some cases specific direction used to guide transformation at the strategic level was detailed in a series of eight courses of action defined as *'Strategic Vectors'* (table 1 below).[76] While Strategic Vector number four (Transform Aerospace Capabilities) relates directly to the requirement for a shift to advanced learning techniques to enhance our effectiveness in operations, the remaining vectors are more general in nature and apply to all facets of Air Force operations but with direct readability to the 'why' and 'how' innovation such as establishing a TTN is important.

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[75] Rick Adams, "CBT For Generation M, Military Simulation and Training," *The International Defence Training Journal*. Issue2/2006. 13.

[76] Department of National Defence, *Strategic Vectors* (Ottawa: Director General Air Force Development, 2004) 49.

Vector	Vector Description
1. Results - Focused Operational Capability	will let the Air Force help keep Canadians secure domestically and protect our national interests abroad.
2. Responsive Expeditionary Capability	will let the Air Force swiftly and effectively respond to challenges at home or abroad by being globally deployable, supportable and sustainable.
3. Transparent Interoperability	so as to effectively operate with the United States Armed Forces, coalition partners, our own Army and Navy, and other government departments and agencies.
4. Transforming Aerospace Capabilities	by exploiting advanced technologies, evolving new concepts of operations, and adopting synthetic (i.e., "virtual") as well as distance and e-Learning computer-based environments to significantly enhance our effectiveness in operations.
5. Transforming - Enabling Leadership	means nurturing competent, thoughtful and ethical leadership to effectively conduct complex, high-technology operations and run the Aerospace Force of the future.
6. Multi-Skilled and Well Educated People	to provide maximum flexibility, versatility and competence at all levels of the organization for future aerospace operations.
7. Expanded Strategic Partnerships	we will *actively engage Canadians*— our business and political leaders as well as society at large - to increase their understanding of how the Air Force contributes to our national security and general well-being.
8. Improved Resource Stewardship	will let the Air Force become even more efficient with the national resources, budgetary and other - with which we are entrusted.

Table 1: Air Force Strategic Vectors

When considering the large and widely distributed Air Force student population and the associated challenges of complicated scheduling conflicts, significant training system efficiency can be derived from an e-Learning based Technician Training Network (TTN) employing a common architecture, common instructional templates using individual student account privileges and controlled access to an instructional material repository. Whether at home, at work, or just about anywhere, today's IT enabled world with easy access to networked computers and the Internet allows, if not promotes, convenience as an important component of learning.

Equally important to the development of an Air Tech's technical skills is the investment in professional development (PD) and general military skills to grow the non-commissioned leaders of tomorrow. A fully integrated learning program that is directly linked to career advancement has the potential to sustain learner participation and enhance the likelihood of retention and member success. A continuous learning environment accepts and provides a framework in which the individual willingly learns for both self-development and to enhance organizational capabilities.[77] The 2002 publication of the "CF Non-Commissioned Member in the 21st Century (NCM Corps 2020)"[78] provided the strategic guidance for the professional development of the non-commissioned members for the next 20 years and recognizes that science and technology will become an even more dominant component of military effectiveness. As such, the

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[77] Department of National Defence, "DND/CF Concept Paper Produced by the Symposium Working Group," Ottawa, 1 November, 2000. http://www.drdc-rddc.gc.ca/seco/documents/DND-CF_Concept_Paper_e.html#ch6; Internet; accessed 22 March 2007.

[78] Department of National Defence, *The Canadian Forces Non-Commissioned Member in the 21st Century (NCM Corps 2020)*, http://www.cda-acd.forces.gc.ca/2020/engraph/ncm/doc/NCMCorps2020_ShortVersion.pdf; Internet; accessed 12 December 2006. I.

future challenge will be to create the appropriate CF doctrine along with organizational structures for the effective use of technology.[79] Today's recruit belongs to the first true generation of the life-long learners who are comfortable with a more learner-centered environment and constructing their knowledge from multiple resources.[80] The extent to which technology can be used to motivate career modeling is expressed by the US Naval Postgraduate College's Modeling, Virtual Environments and Simulation (MOVES) Academic Group who are using digital game-based learning projects to support US Army recruiting and career projection. Using the 'Career Game,' players visualize future scenarios to develop the relationship and connections between skills acquisition and lifestyles through a simulated army career.[81] Networked training technology will allow for an enterprise training delivery system, accessible by all Air Force NCMs, to deliver specific occupation or professional development training during garrison and deployed operations, whether in Canada's North or Afghanistan. Potential for success is directly linked to capability and the Air Force community does not have sufficient in-house experienced to fully exploit the potential of e-Learning while many CF and civilian training organizations have considerable expertise and experience. Partnering with other e-Learning institutions or e-Learning specialists is essential if investment in e-Learning strategies is expected to yield the best returns.[82]

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[79] Ibid., 3.

[80] Janice Ware and Rosemary Craft, "The Boomer-Millennial Convergence: Designing Instruction for the Learners of Tomorrow." Paper No. 2986, Inter-Service/Industry Training, Simulation, and Education Conference (I/ITSEC) 2006. 3.

[81] Marc Prensky, *Digital Game Based Learning* (Toronto: McGraw-Hill, 2001), 8.

[82] ADGA Group Consultants Inc., *Final Report on Canadian Air Force Blended Learning*, Report Prepared for D Air PPD 3-3, 31 March 2003, C-2.

CHAPTER 7

TECHNOLOGY ENABLERS

"Information technology permits teachers and students to project themselves across space and time, to locales and circumstances that best meet learner needs, with substantially less degradation than was possible with predecessor technologies."[83]

- William F. Massey
National Center For Postsecondary Improvement.

An effective TTN will employ a mix of Distributed Learning along with Distance Learning using networked Computer Based Training (CBT) and Blended Learning strategies. Advanced Distributed Learning (ADL) standards are recommended with overall management through use of a Learning Content Management System (LCMS).

Computer-Based Training:

The CF defines Computer Based Training (CBT) as: Course or educational material presented on a computer, primarily via CD-ROM or floppy disk.[84] Unlike Web-based training, CBT does not require the computer be connected to a network and typically does not provide links to learning sources outside the course. The concept of Computer Based Training (CBT) or Computer Assisted Instruction (CAI) can trace its history back to the 1960's using time-sharing computers where communications took place over dumb terminals connected to a mainframe using dial-up telephone lines. As

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[83] William F. Massey, "Life on the Wired Campus: How Information Technology Will Shape Institutional Futures," *National Center For Postsecondary Improvement*, 1997, http://www.stanford.edu/group/ncpi/documents/pdfs/6-02_wiredcampus.pdf; Internet; accessed 02 March 2007. 4.

[84] Department of National Defence, A-P9-000-001/PT-000, *Canadian Forces Individual Training and Education System (CFITES)* (Ottawa: DND Canada, 2003), Vol. 1, 8.

early as 1969, the US government experimented with dedicated phone lines for data exchange to connect researchers with remote computer centres as part of the Advanced Projects Agency Network.[85]   The true potential of CBT/CAI wasn't realized until the introduction of the Internet with a global network of networks and information repositories that made access to information easy and inexpensive.

The training of maintenance technicians has come of age with interactive and high fidelity courseware able to replace the traditional classroom delivery methods.   Today computers with greatly improved processing power and high-resolution graphics offer many advantages for improving access to, and using training content. Computer simulations and computer-based micro worlds also offer appropriate contexts for learners to explore and come to understand complex phenomena in a variety of subject areas. The popular SimCity video game is cited as an example of an interactive game that enables learners to explore what it is like to build and manage complex aspects of city management.[86] The same concept can be applied to technical training where assembly and dismantling of complex aircraft systems is the learning objective. In the CFSATE context, through a server, students can access specified technical lessons, topics of general interest, work through the topic on-line or download for later use, access student chat rooms and access detailed reference material.

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[85] Kjell Erik Rudestam and Judith Schoenholtz-Reed, *"Handbook of Online Learning – Innovations in Higher Education and Corporate Training* (London: Sage Publications Thousand Oaks, 2002), 4.

[86] Marcy P Driscoll, "How People Learn (and What Technology Might Have to Do With it)," *Eric Digest*, http://www.ericdigests.org/2003-3/learn.htm; Internet; accessed 05 March 2007. 2.

Blended Learning

The training and development of technicians will continue to employ a variety of instructional methods to ensure optimal delivery of knowledge and enhancement of skill proficiency. From our understanding and application of Dale's "Cone of Experience" we are reminded that a fundamental principle of teaching is the use of any number of communication mediums to effectively convey the desired message to the target audience. High-resolution 3D visualization and simulation will be the cornerstone of knowledge delivery and understanding in the coming decades. In a world characterized by increasingly complex information sets, our ability to acquire and understand them quickly will become central to effective performance.[87] In the generally accepted context of Blended Learning defined as multiple approaches to teaching, by using a combination of classroom presentations, assisted instruction and practical training, CFSATE has employed Blended Learning strategies for many years. However, in today's context, Blended Learning is usually expected to involve a strong information technology component. The CFITES definition is even more expansive, referring to Blended Learning as combining the four types of e-Learning (instructor led, self-paced, electronic support systems and informal learning).[88] In 2003, the American Society for Training and Development identified Blended Learning as one of the top ten trends to emerge in

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[87] Wayne Hodgins, "Into the Future, A Vision Paper," *American Society for Training and Development (ASTD) and National Governors' Association (NGA),* February 2000, http://www.learnativity.com/download/MP7.PDF; Internet; accessed 26 January 2007. 9.

[88] Department of National Defence, A-P9-000-001/PT-000, *Canadian Forces Individual Training and Education System (CFITES)* (Ottawa: DND Canada, 2003), Vol. 1, 5.

the knowledge delivery industry.[89] The table below details several reasons why

expanded Blended Learning should be considered for use at CFSATE as part of the TTN.

Blended Learning Advantage	Advantage Defined
Pedagogical Richness	Blended Learning approaches increase the level of active learning strategies, peer-to-peer learning strategies and learner-centered strategies.
Access to Knowledge	Access to knowledge is one of the key factors influencing the growth of distributed learning environments. Learner flexibility and convenience is of growing importance to mature learners.
Social Interaction	Many learners want the flexibility offered by a distributed environment, and, at the same time, do not want to sacrifice the social interaction and human touch they are use to in a traditional classroom environment.
Cost Effectiveness	Blended Learning systems provide an opportunity for reaching a large dispersed audience in a short period of time with consistent content delivery.
Ease of Revision	When employed with a Learning Content Management System, authoring tools provide for ease of large volume course content editing.

Table 2 - Blended Learning Advantages[90]

Whilst technology enhanced solutions such as simulation and modeling play an

important part in teaching new students the intricate mechanical and electrical workings

of a component or system, it is vitally important that new technicians also develop strong

haptic skills, which can only be matured through practical hands-on training. We have

known for a long time that people learn best by doing (Dale Model) and while simulated

or modeled reality has significant merit, there continues to be a requirement for the

technician trainee to experience cold hardware. The use of real equipment and tools on

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[89] Charles R. Graham, *Blended Learning Systems: Definition, Current Trends, and Future Directions. Handbook of Blended Learning: Global Perspectives, Local Designs* (San Francisco: Pfeiffer Publishing, 2004), 2.

[90] Ibid., 7.

the hangar floor with pre-planned aircraft maintenance scenarios remains fundamental to development of technician competencies and safety procedures. The key is to find the optimal balance of practical training and other training delivery innovations. Keith Gladstone, Senior Manager, Business Development, Military Simulation and training for CAE, acknowledges that even high-end computer based training with full fidelity simulation is not intended to be the sole method of future training. "There's a danger of applying technology indiscriminately. You must seek a balance."[91] The CF past approach to Blended Learning has been largely classroom instruction complemented with hands-on practical training using training aids drawn from actual aircraft parts. These training methods have practical merit, however, efficiency and effectiveness is compromised by having to teach at a group pace subject to the availability of a limited number of training aids. PowerPoint has become a staple in the CF learning environment and while use of 2D multimedia makes good use of information technology and does enhance the learning methodology, it is essentially still an instructor led linear delivery method amounting to little more than the visual expansion of the traditional textbook. A properly implemented Blended Learning environment is learner-centric and sensitive to the learner needs and pace of learning.[92]

An excellent example of the capability and potential offered by blended learning is the bespoke Integrated Maintenance Training System (ITMS) used by the CF and the Royal Australian Air Force (RAAF). Consisting of a replicated cockpit and interactive

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[91] Rick Adams, "CBT For Generation M, Military Simulation and Training," *The International Defence Training Journal*, Issue2/2006. 14.

[92] Donald Clark, "Blended Learning," *Epic-Partners in Learning, (2006)[white papers on-line]*; available from http://www.epic.co.uk/content/resources/white_papers/blended.htm; Internet; accessed 23 November 2006.

panels from Smart Technologies, the ITMS is used to train F-18 Hornet technicians by providing hands-on experience in system testing and troubleshooting procedures in a safe and controlled environment. Technicians gain valuable experience and learn to follow technical orders by troubleshooting from a catalogue of known F-18 technical faults. The ITMS has proven to be a very flexible training device, well suited to a modern training classroom and extremely well received by students and instructional staff.[93]

As part of an ATTR initiative, in spring 2006, NGRAIN, a Canadian company specializing in 3D performance support solutions along with CAE, a global leader in aircraft simulation technologies, teamed on a 'proof of concept' study to evaluate the potential for blended learning to increase Aviation Technician training throughput at CFSATE. The study goal was to assess the suitability of virtual training systems to achieve performance levels on specific maintenance tasks. The CC-130 Hercules propeller system with specific maintenance procedures formed the basis of the modeling. The blended learning application involved a pre-course self-paced CBT package, followed by instructor led classroom propeller system training, followed by student practice sessions involving 'hands-on' maintenance procedures by allowing component manipulation using interactive 3D simulations on a standard issue laptop. Using a representative sample of 16 new recruit technician students with no appreciable previous technical background, the results indicated a significant potential for extended benefits using a Blended Learning training methodology involving virtual simulation. All students passed the practical examination with a class average of 94% and the overall

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[93] G.R. Coulman and B.D. Melnick, "The CF-18 Integrated Maintenance Training System – ITMS." Paper # 2368, Inter-Service/Industry Training, Simulation, and Education Conference (I/ITSEC) 2005. 9.

training time expended to complete this particular module was reduced by 60% from the time allocated by the CFSATE Training Plan.[94]   Pleased with the outcome of the CFSATE Case Study, the project sponsor, Lieutenant-Colonel Rick Thompson, CAS/DAR 7 commented:

> *"We need to increase our throughput in maintenance training. The proof of concept delivered by NGRAIN and CAE supported our view that trainees can acquire knowledge faster when 3D equipment simulations supplement traditional teaching methods."[95]*

A similar study in the application of the NGRAIN technology evaluated interactive 3D solutions in facilitating air technician maintenance operations and procedures on the CH-146 Griffon helicopter. The helicopter tail rotor assembly was modeled as an NGRAIN Knowledge Object for use in training, maintenance operations and Life Cycle Materiel Management (LCMM) activities. In all respects the technology was extremely well received and for the training environment yielded a 30% improvement in training retention results over conventional training methods.[96]

E-Learning using the Air Force TTN will deliver a preferred training solution to a large portion of the student population; however, keep in mind that it need not be an all or nothing solution, nor is it poised to replace the brick and mortar schoolhouse. The traditional face-to-face instruction will not be rendered obsolete, but will replace

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[94] NGRAIN (Canada) Corporation. (2004), "Proof of Concept Study Demonstrates 60% Faster Maintenance Training for the Canadian Forces," http://www.ngrain.com/solutions/casestudies/articles/NGRAIN-CDN_Forces_Train_60_percent_Faster.pdf; Internet; accessed 19 December 2006. 1.

[95] Ibid., 1.

[96] NGRAIN (Canada) Corporation. (2004), "Independent Study Demonstrates 30% Operational Performance Improvement by Canadian Air Force," http://www.ngrain.com/solutions/casestudies/index.html#CAN.pdf; Internet; accessed 19 December 2006.

classroom instruction with a self-paced blended learning curriculum in cases where e-Learning can deliver comparable or better results. The issue of technology replacing instructors has been debated at great length for many years with evidence to suggest that good instructors cannot be replaced by technology, but they will have to take on different roles and they can become better by using technology effectively.[97] No breakthrough in instructional technology will solve the education problem. However, the transformation to the new technology in education will bring positive changes as teachers integrate and make better use of the technology.[98] Given that potential technicians will have different learning styles, to ensure the most effective approach it is necessary to strike a balance between e-Learning and the more traditional methods of instruction.

Blended learning is not without its challenges and for the e-Learning component we should not expect to be able to procure a ready to use commercial off-the-shelf (COTS) software product to deliver the required training. In most cases, the desired training package will require extensive user definition and development to ensure optimal training delivery. A decision to move forward with Blended Learning, in consort with Distribute Learning, requires identification of detailed requirements followed by extensive system design to ensure compliance with the comprehensive and complex Air Tech training program requirements.

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[97] Alan G. Chute, Melody M. Thompson and Burton W. Hancock, *The Handbook of Distance Learning*, (New York: McGraw-Hill, 1999) 15.

[98] Ben Shneiderman, *Leonardo's Laptop: Human Needs and the New Computing Technologies* (Cambridge: The MIT Press, 2003), 117.

Distance vs Distributed Learning

In the DND context, Distance Learning is a sub-set of Distributed Learning. Although the phrases are sometimes used interchangeably, it is generally accepted that Distributed Learning has a broader meaning. The primary characteristic of Distance Learning is that learning takes place independently of place and time, where instructors or facilitators and learners are separated by time or location, or both. On the other hand, the principal goal of Distributed Learning is to customize learning environments to better fit different learning styles, a physical location separation is not always the case.[99] In this new pedagogical model, students are encouraged to learn in an interactive and collaborative environment at their own pace, at a time that is convenient for them. As the Harvard University, Timothy E. Wirth Professor in Learning Technologies, Chris Dede emphasizes, Distributed Learning is based not only on new media but also on new pedagogy. Distance Learning emphasizes the learning environment, whereas the focus of Distributed Learning is on pedagogy.[100]

Distance Learning

The IT infrastructure available within the CF makes it technologically feasible to employ and support networked distance learning environments where distributed learning acts as an enabler. The required interaction with the instructor may occur in 'real-time'

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[99] Department of National Defence, A-P9-000-001/PT-000, *Canadian Forces Individual Training and Education System (CFITES)* (Ottawa: DND Canada, 2003), Vol. 1, 10.

[100] Dr. Chris Dede, Harvard Graduate School of Education: Presentation on Distributed Learning Communities and Neomillennial Learning Styles. http://hosted.mediasite.com/hosted4/viewer/Viewers/Viewer240TL.aspx?mode=Default&peid=4d2edb10-38a8-4670-a8ba-292ae1098683&pid=06ef5cbb-1b52-441d-83a1-f65a9500353d&playerType=WM7; Internet; accessed 26 February 2007.

(synchronous) or not (asynchronous). Both scholarly research and practical experience have shown that distance learning is educationally effective, offers better business value, and in many cases more cost-effective than traditional approaches.[101] When distance learning is considered as a component of the TTN, improved quality and access to training must be the motivation, and not cost savings.

The switch from a traditional schoolhouse environment to embracing an information culture may bring about the question of the effectiveness of strategies such as distance learning. Resistance to change is an inherent human quality and sceptics may view new training methods as nothing more than attempts to reduce cost at the expense of compromising educational effectiveness. Within a highly structured military environment there is ingrained belief that the system knows best and will dictate what is good for the subordinate, perhaps without due consideration for what really motivates today's student. Educators often portray themselves as open to new ideas; however, changing teaching philosophies is usually controversial. Many teachers and students find it difficult to shift from the standard lecture format to the four activities (tabled below) that are associated with new education.[102]

Learning Activity	Description
Collect	Gather information and acquire resources
Relate	Work in collaborative teams
Create	Develop ambitious projects
Donate	Produce results that are meaningful outside the classroom

Table 3: New Education Learning Activities

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[101] Alan G. Chute, Melody M. Thompson and Burton W. Hancock, *The Handbook of Distance Learning*, (New York: McGraw-Hill, 1999) 15.

[102] Ben Shneiderman, *Leonardo's Laptop: Human Needs and the New Computing Technologies* (Cambridge: The MIT Press, 2003), 131.

Because quality of education remains very important to many organizations, ample research has been devoted to ensuring quality remains paramount. Considerable practical and research evidence has largely dispelled concerns related to the effectiveness of distance learning methods. Distance learning is globally recognized as a viable means of teaching and learning while offering a variety of benefits to both students and the learning organizations.[103] With the move away from the controlled schoolhouse and classroom environment to on-line learning where students interact with their peers or other people in chat or discussion forums, there is a belief that time might be wasted with participation in non-course related activities. Recent research supports the notion that on-line groups are likely to spend the majority of their interactions focusing on task activities rather than social exchanges, notwithstanding the social interaction is also considered important.[104] Although evidence exists to substantiate distance learning cost-effectiveness, improved quality and access to training must be the motivator. However, at a time when rationalization of established positions within the Air Force, and the CF at large, is necessary, the use of e-Learning strategies may free uniformed instructor positions from the various schoolhouses by using DND civilian employees or contracted personnel as mentors or facilitators.

The US Army has embraced the distance learning strategy as a means for soldiers to remain at their home base on a more consistent basis thus causing less disruption to the

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[103] Alan G. Chute, Melody M. Thompson and Burton W. Hancock, *The Handbook of Distance Learning*, (New York: McGraw-Hill, 1999) 15.

[104] ARI Newsletter, "Online Learning of Complex Skills," (Winter 2002), [journal on-line]; available from **http://www.au.af.mil/au/awc/awcgate/army/ari_win02_complex_dl.pdf**; Internet; accessed 7 March 2007. 13.

family life, which ultimately can translate into improved Army life satisfaction, less attrition and higher re-enlistment rates.[105] When studying the effectiveness of the US Army distance-learning program no significant difference was found in the learning outcomes. However, when taking into account the considerable savings from distance learning and factoring the cost of equipment and conversion expense based on a per-student cost over a seven year period, it was estimated that use of distance learning would result in a net saving of approximately 33 %. This would suggest that substantial savings are achievable without compromising the quality of training.

Distributed Learning

Distributed Learning represents a broad categorization for the delivery of training and generally involves a distance-learning component. Distributed Learning can include the traditional 'paper-based' correspondence courses, the use of dispatched instructors to a learning site or the use of a digital network to support web-based on-line training as part of an e-Learning environment.

The costs associated with training Regular and Reserve Force personnel, including fiscal and the time away from their home unit is significant. Often Air Tech Reservists take an inordinate amount of time to acquire qualifications simply because they cannot release themselves from other commitments to attend lengthy courses at CFSATE or any one of the fleet schools. There are also cases where interested personnel cannot pursue a career with the Reserves simply because of the inflexible residential training requirement that makes up the Air Tech training program. Distributed Learning can be used to reduce the amount of time required for residential training with the

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[105] Robert A. Wisher, Mark A. Sabol, and Franklin L. Moses, "Distance Learning: The Soldiers Perspective." *U.S. Army Research Institute*, *Special Report 49*, May 2002. 18.

Reservists completing the training package in consort with other priorities. The US

Army has placed a high priority on the implementation of a Distributed Learning System

(DLS) based on the rationale of delivering immediate cost savings, even with the

delivery of a limited set of facilities, courseware and media types, and the ability of

the DLS to quickly integrate technological advances.[106]

The very expansive worldwide military training market ensures that military

needs will continue to drive the training industry, particularly trends in e-Learning. In

1997, the United States Office of the Under Secretary of Defense for Personnel and

Readiness (OUSD P&R) was tasked with leading a collaborative effort to harness the

power of information technologies to modernize structured learning to support US

defense training. What followed was the creation of the Advanced Distributed Learning

(ADL) initiative as a lead developer and implementer of learning technologies across the

Department of Defense (DoD). Today ADL employs a structured, adaptive, collaborative

effort between the public and private sectors to develop the standards, tools and learning

content for the learning environment of the future. The vision of the ADL Initiative is to

provide access to the highest-quality learning and performance aiding that can be tailored

to individual needs and delivered cost-effectively, anytime and anywhere.[107] The ADL

promotes the specifications of Shareable Courseware Object Reference Model (SCORM)

which is now a widely accepted industry standard for courseware development. For users

and developers of e-Learning and distributed learning, the SCORM standards ensure

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[106] US Army DLS Website, "About DLS." http://www.dls.army.mil/dls_about.html; Internet; accessed 25 February 2007.

[107] Grant MacDonald, "E-Learning, The Truth Shall Set You Free," *Military Training and Simulation News*, Vol. 8, Issue 2, Apr/May 2006. 12-13.

reusability of e-Learning content across courses and Learning Management Systems without proprietary constraints, thus increasing flexibility and greatly reducing cost. The CF DNDLearn system subscribes to SCORM standards and is advancing the process of obtaining certification as an authorized SCORM testing facility. Wide-scale use of SCORM in the CF will result in learning content that can be shared, re-used and re-purposed, thus significantly reducing design time and cost.

ADL originally concerned itself with setting standards for the use of technology has an instructional enabler, however, has since progressed to tabling a much larger agenda for e-Learning in the military environment. ADL delivers everything that a modern organization should subscribe to as the basis for a modern, joined-up and efficient training network. Recognizing the value and growth potential of ADL, NATO is taking an active interest in the project with a NATO working group compiling an ADL Handbook.[108] With distributed learning standards gaining in popularity across a wide range of training organizations, the table 4 *'ilities'* of ADL are commonly touted as the key to its success.[109]

The '-ilities' of Advanced Distributed Learning
Interoperability: Instructional components developed in one system can be easily used in another system.
Accessibility: Access components from and deliver to multiple locations.
Adaptability: The ability to change to satisfy different user needs.
Reusability: Use components in multiple applications, courses and context.
Durability: Withstand technology changes over time without costly redesign.
Maintainability: Withstand content evolution without costly redesign.

Table 4: Advanced Distributed Learning 'ilities'

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[108] Ibid., 12.

[109] Rick Adams, "CBT For Generation M, Military Simulation and Training," *The International Defence Training Journal*, Issue2/2006. 13.

Although we have failed to recognize or promote it as such, the Air Force has had

pockets of distributed learning activity in place for several years. With advances in

digital technology and interconnectivity coupled with the potential for system support

offered through initiatives like the DLN, the Air Force is poised to take advantage of an

enterprise solution distributed learning that will substantially enhance the approach to Air

Tech training.

Learning Management System vs Learning Content Management System

LMS

When dealing with IT enabled networked training, distance learning or distributed

learning, a major challenge in ensuring the delivery of up to date training to dispersed

audiences is employment of a system to assist with the management and timely

dissemination of training information and policies. The traditional paper-based

management process to ensure that correct information refresh is forwarded to and

implemented by the various training organizations is bureaucratic, cumbersome and

ultimately very slow. A variety of automated tools exist to facilitate the ease at which an

e-Learning environment is managed.

The backbone to a federated or enterprise Air Force technician training network is

employment of a Learning Management System (LMS), defined as a software package

that enables the management and delivery of learning content and resources to

students.[110] An LMS such as the Desire2Learn (D2L) LMS used to support the DLN is

strategically employed to automate the administration, tracking and reporting of training

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[110] Department of National Defence, A-P9-000-001/PT-000, *Canadian Forces Individual Training and Education System (CFITES)* (Ottawa: DND Canada, 2003). Vol. 1, 16.

events and can also be used to organize and track training opportunities along with facilities scheduling. A well-designed LMS provides the architecture to automate many of the administrative and training management duties inherent to a training organization for online, virtual classrooms or instructor-led sessions. Typically, LMS' are web-based to facilitate the "anytime, anywhere" access to learning content and administration.[111] An LMS is particularly useful in an e-Learning and networked environment such as that proposed for the TTN, because it requires student registration details that facilitate log-on privileges along with the delivery and tracking of learning content. As well, testing can be incorporated.

LCMS

The LMS and Learning Content Management System (LCMS) are complementary but very different. The focus of a LCMS is to provide for the capability to facilitate organization of the learning content from authoring tools for presentation to the students through the LMS. An LCMS provides a significant capability increase over an LMS by allowing a multi-use environment where learning developers, designers and subject matter experts can create, store, reuse and manage digital learning content from a central learning object repository. By accommodating the development of reusable content pieces and providing accessibility across the network, the LCMS streamlines development efforts and allowing for the rapid assembly of generic or bespoke content.[112]

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[111] Leonard Greenberg, "LMS and LCMS: What's The Difference," *ASTD Learning Circuits*, November 2002, http://www.learningcircuits.org/NR/exeres/72E3F68C-4047-4379-8454-2B88C9D38FC5.htm; Internet; accessed 09 January 2007. 1.

[112] Ibid., 2.

A LCMS is a very complex IT system requiring extensive up front end-user design considerations and dedicated in-service support.

Implementation of a TTN would allow for a national enterprise training system with management plans and set standards for use. The Canadian Air Force is in the process of acquiring tools that will facilitate the management of a stem to stern technician learning process. The Air Force Integrated Information and Learning Environment (AFIILE) program will provide a LCMS architecture to share learned lessons, eliminate duplication and allow for the upgrading of our capacity to train. Based on off-the-shelf LCMS technology, AFIILE will provide the backbone for future Air Force e-Learning with planned connection with the DLN.[113] While AFIILE is being procured as an Air Force wide tool, the Air Tech training program is poised to take full advantage of its potential. The aim of the AFIILE project is to deliver an integrated information and learning environment that will increase Air Force operational effectiveness and minimize the costs related to the delivery of training programs. This will be accomplished by leveraging both industry-wide advances in the production of learning content and the administration of training and associated resources, and the DND Learning Management Platform.[114] AFIILE contributes to the DND/CF Defence Strategy 2020 to "examine and adapt new learning strategies to provide all CF members with the common knowledge and skills required to operate in the battle space of the 21st century."[115] AFIILE will

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[113] Lieutenant-Colonel R. E. Thompson, "Air Force Modeling Simulation and Training." "Frontline Magazine" May/June 2005, www.frontline-canada.com, http://www.frontline-canada.com/Defence/pdfs/05_3_MnS_Thompson.pdf ; Internet; accessed 22 March 2007, 36.

[114] Department of National Defence, *Concept of Operations: Air Force Integrated Information and Learning Environment (AFIILE) Project No. 00000074* (Ottawa: Public Works and Government Services Canada, 2004), 1.

[115] Ibid., 2.

provide the opportunity to deliver common training tools and standards along with best practices in a multi-user, networked environment enabling training material to be delivered in an improved and standardized manner. The use of AFIILE along with improved blended learning environments will decrease time to qualification for technicians while contributing to an increase in the overall training capacity. With AFIILE serving as the backbone of the TTN, the standards of training across fleets and training proficiency levels will be established to ensure a same look and feel training system available to technicians as they advance from basic to intermediate to advance training, regardless of the fleet type.

A Request For Proposal (RFP) for AFIILE will be posted by Public Works and Government Services Canada (PWGSC) in April 2007 with a contract award expected for 2nd quarter FY 07/08. With a contract in place, phased AFIILE implementation activities will commence later in the same fiscal year.[116]

Training Support Organization Structure

The realization of a TTN requires a consortium approach of all Air Force technical training institutions partnered with technology providers. All the best work to achieve technology integration, data content and information access is defeated without consideration for a support structure to ensure proper management. An enterprise system such as the TTN requires a fundamental shift in organizational culture along with management and support services to develop and administer policy, define resource priorities and maintain system standards. Dedicated positions, civilian or military, are

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[116] Lieutenant-Colonel R.E. Thompson (DAR 7), telephone conversation with author, 30 March 2007.

required to act as instructors, facilitators and mentors. Given the wide geographical

expanse of Canada, extended hours are required to ensure timely support across all time

zones; a call-centre approach would provide the required attention.

Implementation Challenges

Undoubtedly the Air Force will face a number of challenges in transitioning from

the existing diverse and complex training system to an enterprise integrated learning

environment. Studies and past experiences have highlighted common barriers with

transitioning to a successful e-Learning environment. These common barriers include: a)

Sufficient time, money and support; b) Significant technological and systemic

requirements; c) Challenge of adapting to new technology; d) Institutional and learner

resistance to change; e) Major planning effort required to align organizations; and f)

Major communications efforts and leadership commitment needed to align attitudes. [117]

In addition to a cost-effective training support architectures and system support,

objectives towards establishing an Air Force TTN include:

TTN Implementation Objectives
▪ The creation of a physical network to support a learning system, including Learner Access Centres (LAC) across the country, and the information technology infrastructure to support it.
▪ Configuration of a Learning Management System to support the TTN.
▪ Development and maintenance of a TTN knowledge management repository.
▪ Establishment of a TTN Centre of Excellence, complete with a Test Lab and Technical Support Services.
▪ Development of a policy framework, incorporating both technical training and professional development policies.
▪ Development and implementation of integration standards with other CF learning systems such as DNDLearn.

Table 5: TTN Implementation Objectives

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[117] ADGA Group Consultants Inc., *Final Report on Canadian Air Force Blended Learning,* Report Prepared for D Air PPD 3-3, 31 March 2003. 6.

The TTN will require support from the highest levels of Air Force training management to ensure compliance across the Air Force and compatibility with new system procurements. The rapid emergence and continued growth of technological innovations, particularly digital technology, holds huge potential for the possibilities for learning in a distributed environment.[118] In evolving from a traditional schoolhouse to technology based learning it is important that the enabling technology is intuitive and properly supported so as not to detract from the learning experience. One of the recurring criticisms from online learners is that the supporting technology is problematic. At times people struggle much more with the training tools than the tasks, subtracting from potential learning activities.[119] While many of the training tools are intuitive, we often make the mistake of assuming that people will know how to use them effectively and neglect to provide the necessary user training. When integrating new technology it is essential to develop an implementation and user strategy such that the tools do not drive the learning process but rather play a supporting role.

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[118] Charles R. Graham, *Blended Learning Systems: Definition, Current Trends, and Future Directions*. *Handbook of Blended Learning: Global Perspectives, Local Designs* (San Francisco: Pfeiffer Publishing, 2004), 5.

[119] ARI Newsletter, "Online Learning of Complex Skills," (Winter 2002), [journal on-line]; available from **http://www.au.af.mil/au/awc/awcgate/army/ari_win02_complex_dl.pdf**; Internet; accessed 7 March 2007. 13.

CHAPTER 8

THE MODEL

Drawing From the Past – Looking to the Future

Imagine This …… A new group of students arrives at CFSATE Borden for training in one of the three Air Tech Occupations. Their training program commences with a welcome to the Air Force by the school Chief Warrant Officer (CWO). In addition to the customary "DOs" and DON'T's for a new Air Force NCM, the CWO discusses the dedication and commitment required to become a successfully qualified Air Tech. The exciting and wide variety of employment opportunities are linked to training requirements leading to technical qualifications and proficiency goals. The School Chief Instructor (CI) then follows with a briefing on CF and Air Force operations along with an overview of the Air Force maintenance community demographics. Next, the CI provides an introductory briefing on the TTN and the Air Tech training continuum. Students are issued individual TTN account usernames (U/N) and passwords and proceed to an on-line system tutorial. Students are assigned a mentor and/or a facilitator to assist with all facets of their training while at CFSATE. Once logged into the system the new Air Tech commences his/her career-training continuum. From this date a career training profile is initiated, accessible by a select group of people with assigned privileges. As technical qualifications and work authorizations are achieved, the TTN is used as the framework for the comprehensive technician qualification management system.

From a training perspective, the TTN offers compulsory lessons that provide introductory or threshold knowledge before proceeding to formal classroom instruction. In other instance, where appropriate, the TTN lessons replace classroom instruction. By

offering TTN anytime, anywhere access using schoolhouse computer labs or computers located in student accommodation facilities, the student has access to a repository of reusable information objects that contain self-paced lessons on a wide array of technical and professional development training subjects. Learning objects may include theory of flight, technical orders procedures, equipment operation instruction, second language training, ethics training, etc. Each training object is combined with training metadata that provides all the attributes of these objects to the level of detail commensurate with the level of training offered.

Training is menu driven and managed using a LCMS and progressed using training blocks or modules which are free-form or sequenced. Free-form lessons do not require completion in any particular order but possibly have completion time constraints imposed. Sequenced lessons are linked to classroom training and must be completed in series as well against time constraints before proceeding with classroom instruction. Examinations are administered on-line or in a classroom setting, in either case the school Standards Section provides the necessary coordination. The Standards Section is also responsible for e-Learning Quality Control through continuous monitoring of training delivery, in accordance with AF9000+ procedures, paying close attention to student feedback. The lessons offered contribute to building levels of threshold knowledge but they may also contain adaptive levels of difficulty to challenge the learner. The replay of lessons, or parts of lessons is easily facilitated. When a sufficient number of students (block) have completed the self-paced tutorials, an instructor (where required) is assigned to deliver the formal classroom instruction or coordinate the complementary skills development associated with the knowledge portion. The flexibility afforded by free-

form instruction allows the schoolhouse to operate a rolling start schedule where individual performance objectives requiring classroom instruction begin when a student block is ready rather than subscribing to fixed start dates. This rolling start approach is easily accommodated with distributed learning compared to instructor led classes resulting in greatly enhanced school efficiency and at the same time contributing to student motivation to succeed. Now imagine that these training templates and the repository of reusable training information and the accompanying metadata are available and accessible via the Internet or DWAN, anytime, anywhere.

On graduation from BOT at CFSATE, the students continue to have access to the TTN during their OJT at operational units to facilitating further knowledge enhancement using compulsory or optional lessons. When selected for aircraft type training at the individual fleet schools, technicians use the same TTN with training procedures and system interface protocols introduced and practised during their BOT and OJT.

As the students progress in their skills development and become more involved in aircraft maintenance and troubleshooting, a collateral benefit from e-Learning is the consistency with new Air Force technology deliverables such as Interactive Electronic Technical Manuals (IETMS) that provide detailed technical specifications and troubleshooting information and procedures used to maintain aircraft systems. Information formatting for IETMS is consistent with that used in a technical training environment.

The training model described above represents a significant departure from the traditional way of doing business. At the same time, the new recruit wonders how we could possibly do it any other way!

CONCLUSION

The availability of highly skilled aircraft technicians to generate serviceable and mission ready aircraft is essential to support an operationally relevant and combat effective Air Force. In the early years of the 21st century, the compounded effects of several years of funding neglect throughout the 1990's, downsizing, trade amalgamation, high technician attrition rates and an increasing operations tempo created the 'perfect storm' as a stark reminder that without immediate attention the Air Tech training system would not be able to generate and sustain the required number of skilled Air Techs to support Air Force operations. In addition to the challenge of graduating technicians with the skill-sets to support the future weapon system complexity, the demographics for the Canadian Air Force, the CF and the Canadian population at large, present a genuine concern for our ability to maintain a sustainable flow of trainees for development with the required competencies to replace an aging workforce. Air Force leadership understand the connection between training and operational effectiveness and responded with a technician 'Get-Well' oversight committee and funding infusion to support strategies to rebuild capacity. The ATT and ATTR projects are achieving milestones towards re-establishing a training system to meet short-term forecasted production requirements, however, the revitalized Air Tech training system does not take full advantage of available learning technology enablers that exhibit the potential to improve the quality of training while at the same time addressing longer-term issues of sustainability and efficiency through training innovation.

Technology is rapidly emerging as an important cost-effective enabling component of teaching and learning in schoolhouses across the world. Technological

developments continue to evolve at a rapid pace, and the longer the Air Force resists

transitioning to an e-Learning centric environment, the greater the technology lag, the

greater the loss in student output and greater overall compounded cost to fix the problem.

The information age presents significant challenges and at the same time exciting

opportunities for advancing Air Force training. Militaries across the world have long

subscribed to the adage 'Train as You Fight' and 'Fight as You Train,' a precept that

today requires the integration of sophisticated technologies to support a highly complex

operating and information environment. The Air Force can no longer afford to take an

isolated traditional approach to technician training and must exploit new information

technologies to support improved training delivery quality and efficiency. Research

shows that properly implemented e-Learning strategies can provide better and more

responsive training to support operational readiness while providing greater opportunities

for career development. A well-designed and implemented training strategy will also

project a positive image of training inside and outside the CF, leading to a secondary

benefit of enhanced retention and recruiting.

From a cost-effectiveness perspective, an information technology enabled

approach to learning will help reduce the residential element of select training courses,

resulting in less time away from the unit, home and family and over the long-term

translate into monetary savings. A TTN will provide training flexibility options to deal

with system inefficiencies related to the training of Reserve Force personnel and Regular

Force personnel awaiting formal training courses. As we look to grow the Reserve Force

component of the Air Force, e-Learning holds great potential to meet the training

standards requirements for technician trainees who are not easily accommodated by the current inflexible Air Tech training regime.

To extract the full benefits from an e-Learning environment, the Canadian Air Force must implement an adaptive and responsive technology based training network to complement the large investment in training infrastructure and instructional personnel. At the same time the Air Force, is progressing significant organizational transformation to meet the challenges of the 21st century, innovation by way of a well designed and implemented technician training network can pay dividends towards the success of an integrated and operationally responsive Air Force. E-Learning is particularly well suited to the modern need for rapid dissemination of knowledge and information, especially when operational units and training organizations that are separated by expanse geography and multiple time zones as is the case in Canada. The status of the current IT infrastructure available across the Air Force, and indeed the entire CF, makes networked and distance learning viable options. Although the various elements of a structured e-Learning programme are pervasive across the CF and the Air Force, a strategy is required for networking and standardizing processes and procedures to glean the efficiencies of an integrated training continuum. A TTN is consistent with the expanding vision for the DLN. Ultimately the TTN will harness the tremendous technical advantage of the information age to better educate and train both our new and experienced technicians. E-Learning standards will permit learning content to be easily accessed, formatted and integrated into lesson plans at any number of training institutions.

The integration of technology within Air Tech training is a balancing act; a balance between leveraging optimal effectiveness from technology and the human

element. Simulation and virtual modeling provide an effective and safe means for training aircraft technicians where expensive and a limited supply of aircraft previously used as training aids are replaced with virtual technologies. Technology itself does not provide any guarantee of enhanced learning, rather it is how the technology is integrated and used by both teachers and students that will determine its success. Air Force schools and training units will remain the key drivers of e-Learning solutions for their respective curriculums while the TTN Centre of Excellence will provide specialist assistance and guidance to propagate learning material. Implementation will be challenged by a resistance to change that is inherent to highly structured environments such as the military, however, future learning systems will certainly employ increased use of IT, e-Learning with a variety of Blended Learning solutions; it is not a function of whether they blend but rather by how they blend.

Perhaps the most important metric for the success of a training system is the economic contribution to the sponsoring organization, in our case, economic contribution is a measure of our ability to meet training targets leading to serviceable aircraft on the flight line. When fully implemented, the TTN will be a comprehensive support package to facilitate the learning challenges associated with developing highly skilled aircraft technicians. The TTN enterprise solution with its integrated collaborative tools offered through the learning management platform will facilitate a first-class, coast-to-coast, leading-edge training solution.

"The biggest obstacle to innovation is thinking it can be done the old way."

- Dr. James Wetherbe, Texas Tech

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