RCAF TRAINING MODERNIZATION STRATEGY

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National Defence
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FORCES ARMÉES CANADIENNES

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FOREWORD

For over half a century, the Royal Canadian Air Force (RCAF) has relied on its current training infrastructure to educate its members. This system gradually evolved to meet the challenges of each era, serving the Air Force admirably by producing skilled personnel capable of meeting the demands of both conflict and peacetime operations. However, as we are now faced with a period of unprecedented technological advancement and Air Force modernization, it has become increasingly apparent that our training framework is inadequate for a future Air Force whose operational capacity is augmented with modern, complex aircraft and support systems.

The time has arrived for a comprehensive transformation of the RCAF's training apparatus into a modern, integrated training ecosystem that not only leverages cutting-edge technology but also embraces contemporary andragogical approaches. We must prepare our aviators to work effectively with the complex aircraft and support systems that are integral to the RCAF operations of today and the future.

In formulating this new system, we must incorporate insights gained from operational experiences, understanding that future missions will be multifaceted and diverse, shaped by shifts in global power dynamics and the emergence of novel technologies and threats. Our training system must exhibit the agility and adaptability necessary to sustain operational excellence within this ever-evolving landscape. Moreover, we must recognize the critical role of the RCAF's training regimen in instilling its members with the ethos and values inherent to Canada's Air Force.

Furthermore, we must prioritize the efficient and fiscally responsible attainment of our objectives, fostering collaboration with other branches of the Canadian Armed Forces (CAF), allies, industry, and academia to capitalize on synergies while maintaining alignment with broader defence renewal and CAF training-modernization initiatives.

The future effectiveness of the RCAF is contingent upon our capacity to operate autonomously or in conjunction with our allies and partners across a wide spectrum of missions. The RCAF's training infrastructure forms the foundation of its force generation capability. Through the transformation of our training system, the RCAF will emerge as a more agile, adaptable, and proficient force that is fully equipped to confront the challenges of tomorrow.

Brigadier-General John Alexander
Commander 2 Canadian Air Division
Training Authority of the RCAF

EXECUTIVE SUMMARY

This *RCAF Training Modernization Strategy* (*TM Strategy*) describes a coordinated approach to the development and support of a future technologically enabled, integrated Air Force training system, referred to as the "FAFTS." Throughout this document, links will be made to the *RCAF Strategy*'s strategic objectives and related *RCAF Campaign Plan* lines of operation that clearly demonstrate how the *TM Strategy* supports the greater RCAF vision.

Instability in the global defence and security environment is increasing due to the actions of both state and non-state actors around the world; an agile training system is needed for this environment. The FAFTS will consist of individual training and education, operational training and collective training. This training continuum is the foundational system that supports RCAF readiness, force generation and operational excellence. Lessons learned and analytics must feed back into the system to ensure training is improved continuously.

The operating strategy describes how the RCAF will train. As the overarching enabling strategy in this document, it informs the following:

a. **The technology-enabled learning strategy** provides a framework with which new aircraft/asset programmes can assess procurement options for technology-enabled learning (TEL). It is based on four design principles that are enabled by a digitalized learning environment, or Total Learning Architecture: distributed learning, multi-purpose reconfigurable trainers, ubiquitous learning and networked training.

b. **The training-management strategy** centres on organizing the current training model of schoolhouses into an RCAF Campus construct. Fully aligned with CAF individual training and education modernization, the RCAF Campus construct will provide an efficient training organization that is more closely aligned with modern instructional design and delivery techniques, better enables training management, and permits economies while integrating the legacy schoolhouses into a single system of systems.

c. **The operational training–infrastructure strategy** enables effective and sustainable infrastructure and supports acquisition strategies by laying the path to modernizing and consolidating infrastructure, supported by a robust learning support centre. This concept builds upon the existing designs of Canadian learning institutions to combine training into a single environment.

d. **The capability development, support and sustainment strategy** conceptualizes the entire FAFTS as a distinct capability. Emphasizing good governance and an understanding of stakeholder roles, this enabling strategy outlines the development, support and sustainment of the FAFTS.

Together, these enabling strategies set forth the *TM Strategy*'s vision: an integrated system of training aligned with the force-development, force-generation and force-employment systems that is based on sustainable, scalable and flexible system-design principles as well as rooted in our aviation heritage, ethos and leadership philosophy. Implementation of the *TM Strategy* will allow the FAFTS to provide the degree of training flexibility and scalability that is necessary for the RCAF to meet readiness requirements and the challenges of a complex and uncertain future global threat environment.

CHAPTER 1: INTRODUCTION

This *RCAF Training Modernization Strategy* (*TM Strategy*) describes a coordinated approach to the development and support of a future technologically enabled, integrated Air Force training system (AFTS). For the purposes of this document, the term "future AFTS" (FAFTS) includes all aspects of training, education and professional development (PD). This *TM Strategy* is the keystone document by which future training capability-development plans should be informed. It is subordinate to the *RCAF Strategy* and CAF individual training and education (IT&E) modernization as well as aligned with the Royal Canadian Air Force Aerospace Warfare Centre's (RCAF AWC's) collective training (CT) modernization efforts. As such, the *TM Strategy* is broadly focused on the full spectrum of aerospace training as an integral part of the RCAF's force generation (FG) system and how this system will integrate within the greater CAF training system.

> The *TM Strategy* describes, at the strategic level and for the benefit of RCAF stakeholders, how the AFTS will be modernized to accomplish its future FG mission and to enable the RCAF's training system to successfully transition to its future capabilities. The *TM Strategy* lays the foundation for evolving the RCAF's business of training to a modernized model based on optimized training methods, technologies, infrastructure, management, support and sustainment systems. An important element of this strategy is achieving reform while preserving critical elements of RCAF culture. Ultimately, the *TM Strategy* will enable the priority—excellence in operations—by efficiently generating highly competent individuals and teams.
>
> (*RCAF Strategy / RCAF Campaign Plan* [*CP*] – Value our people and invest in their future)

STRATEGIC VISION

The FAFTS will be an integrated system of training aligned with force development (FD), FG and force employment (FE) systems. It will be based on sustainable, scalable and flexible system-design principles; rooted in our aviation heritage, ethos and leadership philosophy; and enabled by technology to produce world-class training, enhanced readiness and excellence in operations.

STRATEGY OVERVIEW

This system of training is intended to bring together all elements of the aerospace training spectrum and link them to other RCAF and CAF FD, FG and FE systems to provide the RCAF with an agile, coherent, sustainable, interoperable and well-supported means of generating aerospace forces.

The *TM Strategy*'s approach is divided into five parts. These five parts are the following enabling strategies: operating strategy; TEL strategy; training-management strategy; operational training–infrastructure (OTI) strategy; and capability development, support and sustainment strategy. Together, they articulate how the FAFTS will generate highly interoperable forces capable of working within complex joint and coalition operating environments and focused on delivering operational excellence.
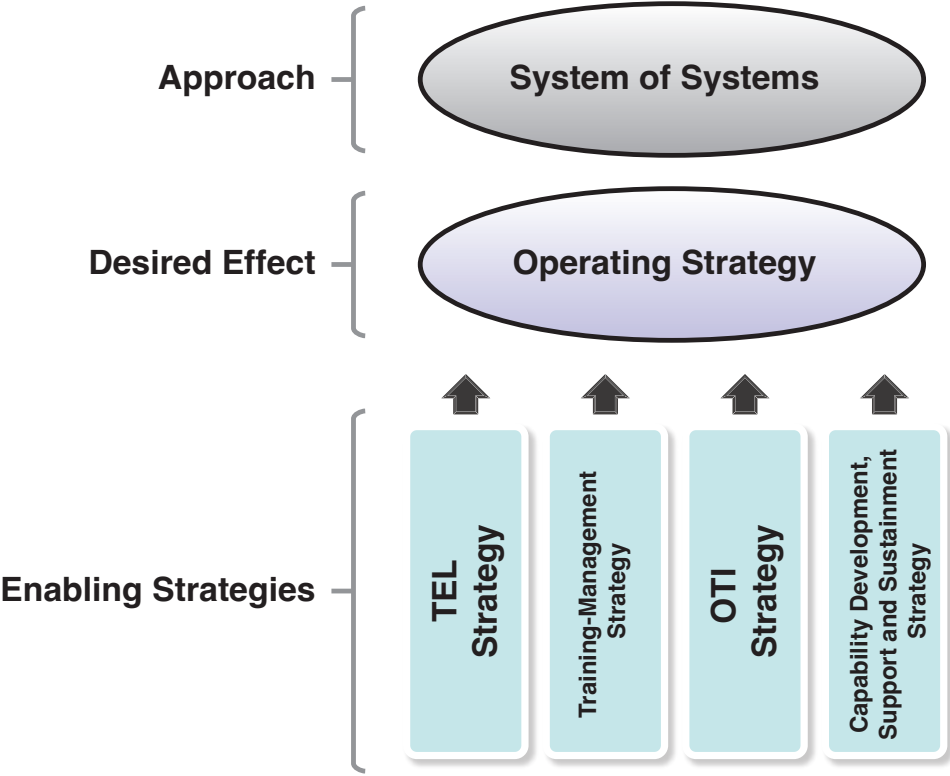

Figure 1. The *TM Strategy*'s approach, desired effect and enabling strategies[1]

CHAPTER 2: THE FUTURE THREAT, TRAINING AND OPERATING ENVIRONMENTS

In 2021, an RCAF TM initiative was created to investigate and design the FAFTS as well as to synchronize this effort with other CAF and RCAF renewal efforts. The formal delegation of training authority (TA) to Commander (Comd) 2 Canadian Air Division (2 Cdn Air Div) in 2015 enabled renewed focus on the legacy training system and consideration of alternative approaches. A rebalancing examination of Level 2 (L2) authorities in 2017 reaffirmed Comd 1 Canadian Air Division's (1 Cdn Air Div's) responsibilities for RCAF operational training (op trg) / CT elements and the RCAF AWC supporting functions. 3 Canadian Space Division (3 CSD) has since been integrated as an additional operational L2 with unique training needs. Clarified roles and responsibilities, coupled with accelerating digitalization and a surging innovation mindset, provide ideal conditions for the development of a modern training system. Notwithstanding, a number of current challenges must be considered when defining the future training environment:

a. **Not conceived as a system of systems**. The current training system is encumbered by a few key structural impediments that limit its ability to take advantage of technological and learning advances. Organically grown over several decades of successive and progressive upgrades to RCAF fleets, the present training system's structure is the result of local incremental changes that have not necessarily been executed within a systems approach to training,[2] with the result being an organization in need of greater organizational coherence, effectiveness and flexibility.

b. **Inconsistent exploitation of technology**. Modern recruits arrive with an educational background that has leveraged technology, and they have developed a degree of technological ease and familiarity with a modern educational system that is fundamentally different from the present traditional training environment. Next-generation projects have ushered in an era of technological complexity that demands changes in the tools and methods necessary to train our personnel. Furthermore, the widespread use of networks in operations allows for a more integrated technological solution to knowledge development. Therefore, the RCAF needs to establish a proper balance between technological sophistication and affordability in the training system.

c. **Ageing physical and digital infrastructure**. Much of the training system's current infrastructure and support systems were built during the post–World War II era and are quickly reaching the ends of their useful lives. Furthermore, the design and construction parameters of this era prohibit or limit the full use of new instructional methodologies and technologies. The FAFTS, therefore, must include modernized infrastructure to support the expectations of learners and future training technologies.

d. **Not regarded as a capability**. Without a forward-leaning and sustained investment plan, the training system will degrade. Like weapon systems and aircraft fleets, the FAFTS must be treated as a capability. It must be agile and able to adjust to new equipment and RCAF materiel capability programmes. To keep pace with the RCAF's increasing complexity and sophistication, the FAFTS must be considered as an investment and be managed through the RCAF FD mechanisms.

e. **Resistance to change and lack of cultural adaptability**. As the RCAF seeks to transition into more modern, integrated forms of training and readiness, one of the major challenges will be overcoming resistance to change within the organization. This resistance can stem from various levels, including leadership, instructors and even the trainees themselves, who may be accustomed to traditional methods. The resistance is often rooted in a fear of the unknown, complacency, or scepticism about the efficacy of new technologies and methodologies. To fully implement the modern training methodologies and other advanced techniques involving the greater use of technology and simulation, there must be a cultural shift that embraces innovation and adaptability.

THE FUTURE THREAT AND OPERATING ENVIRONMENTS

In addition to these challenges, the future threat environment and resulting operating environment also dictate changes to the training environment. The general future-threat theme is one of complexity and uncertainty. At the geopolitical level, the global defence and security environment continues to evolve with great uncertainty and inherent unpredictability, but trends point towards the increasing importance of military preparedness as political competition intensifies around the world. The rapidly changing geopolitical environment brings shifts in regional and global power configurations. At the heart of this change is a resurgent Russia and a major shift in the global economic centre of gravity towards Asia's giants. This will continue to have ramifications on regional balance of power and alliances. The globalization of world economies has increased economic interdependence and fragility. Population growth and resource limitations are increasing the potential for humanitarian crises. The innovative use of simple technologies by developing nations, such as cyber warfare, adds another unpredicted element to state-on-state conflict. Furthermore, the existence of such asymmetric non-state threats has blurred traditional threat boundaries. The themes of complexity and uncertainty are expected to continue defining the nature of the threat to Canada and the operating environment and, therefore, require the FAFTS to be flexible and adaptable in its response.

With this complex and uncertain global threat environment, the security of the global commons will become more relevant. The RCAF will continue to be charged with protecting Canada and directly contributing to the defence of North America from any threat, and the operating environment will be global in nature. The RCAF will need to work with its allies and coalition partners to ensure the security of the global commons, countering adversaries using both highly sophisticated and conventional technologies. The complex threat of a more diffuse economic, political and military power means that the RCAF will need to easily shift across the full spectrum of operational roles, from constabulary to war-fighting roles. Such a diverse operating environment reinforces the need for the RCAF to become highly adaptable, agile and capable of interoperability with allies in international and coalition forces. The FAFTS must keep pace.

At the corporate level, the Department of National Defence (DND) must reconcile two competing strategic imperatives: the requirement to remain effective in future operations while being efficient in stewarding assigned resources. Consequently, the FAFTS must also possess the organization, governance and processes that can operate within these mandates.

THE FUTURE TRAINING ENVIRONMENT

It follows that the future training environment is inextricably linked to the future operating environment, and the AFTS must be defined within the context of the future training environment.

The AFTS role is to provide individuals with the knowledge, skills, and attitudes such that they can be integrated into crews/teams, which are then integrated into capabilities as part of operational units. To achieve this, the Air Force applies a training continuum consisting of three aligned components:

- **IT&E**—activities or events at the individual level that provide both initial and/or advanced knowledge, skills, and other attributes required to carry out required duties and tasks;

- **Op trg**—takes groups of individually trained personnel and forms them into the effective, operational specialist crews / sub-teams which collectively form an operational unit generated to a specified level of readiness; and

- **CT**—brings units or sub-elements together into a larger RCAF, joint or coalition force and trains them as a cohesive whole, generating a capability that better mirrors the contemporary operating environment.

> **In the past, we tended to think of each component as a discrete activity, and this has led to inefficiencies and duplication. Under the FAFTS, the three components will be treated as seamless elements of an operational CT continuum, merged over ten levels of CT as per CAF and RCAF doctrine, and supporting aerospace readiness. This will enable the RCAF to better leverage and integrate technology, infrastructure and resources to achieve increased effectiveness and efficiency.**
>
> **(*RCAF Strategy / RCAF CP –*
> Ready to conduct operations; modernize for tomorrow)**

Approaches to training will need to keep pace and evolve with rapidly changing threats and operating environments. Individuals and teams will need to adapt as well as act with agility and, therefore, must be trained in a system that itself remains responsive to a dynamic future threat and associated operating environment.

Furthermore, the RCAF's training and educational institutions play a key role in transforming civilians into fighting aviators. This includes the inculcation of Air Force culture, ethos, code of conduct and physical fitness that are essential in producing a highly disciplined combatant force. The future training environment must maintain and reinforce these core qualities of the RCAF institution.

The current era is one of unprecedented potential with the advent of modern learning science and more economical learning technology enablers. This technological potential comes with the challenge of balancing training needs with desires and the need for a programmed view of through-life costs and configuration-management approaches as we embrace modern training methods and technologies.

> **Decades of incremental evolution of organization and infrastructure have served the RCAF acceptably in the past, but a modernized AFTS will drive the need for modernized infrastructure as well as rejuvenated governance and organizational structures.**
>
> **(*RCAF Strategy / RCAF CP –*
> Value our people and invest in their future;
> modernize for tomorrow)**

The future training environment that is necessary to achieve this strategic vision can therefore be characterized by

- training that fully leverages modern technological solutions;

- training that recognizes the importance of face-to-face mentoring and supervision by uniformed members to draw new Canadians into the Air Force culture;

- training that is delivered at the point and time of need and, to the greatest extent possible, in a member's geographical location using modern, technologically enabled methods and media;

- training that reduces the need for, and duration of, additional training through better human-performance principles and techniques;

- training material that is modular, upgradable and reconfigurable by design, optimizing the use of all training assets through reconfigurable trainers, infrastructure and synthetic systems across all elements of the training spectrum;

- a training organization, with proper performance measurement, that is focused on training management, governance and processes;

- modernized infrastructure that enables greater flexibility in the delivery of training and the adoption of modern training methodologies, which embrace concepts of agile configurability to reduce physical footprints and promote efficiency;

- partnerships within and outside of the RCAF; and

- a system that is both affordable and sustainable.

CHAPTER 3: THE FUTURE AIR FORCE TRAINING SYSTEM

The *RCAF Strategy* demands functional alignment of activities at both the strategic and operational levels. Furthermore, the *RCAF Strategy* calls for the development of a modernized RCAF FG model or system. This FAFTS strategy is broadly focused on all elements of RCAF training as an integral part of the RCAF's FG model and on how the training element of FG will operate and interact within the greater CAF training system. This chapter defines the training component of the RCAF's FG model and how it will align training within the overarching *RCAF Strategy* and against the wider CAF training system.

(RCAF Strategy / RCAF CP –
Value our people and invest in their future; ready to
conduct operations; modernize for tomorrow)

The RCAF is built around five core functions: FG, FD, force management, FE and force support. Whereas FD is focused on the conception, design and building of new capabilities, the FG function aims to generate force elements and force packages through personnel-, combat- and materiel-readiness activities for subsequent FE. The force-support function, on the other hand, sustains these force elements and force packages. The force-management function is directed towards activities and processes related to planning, directing, monitoring and coordinating the activities of the other functions across the span of the RCAF. At its core, the training element of the FG function, with consequent interfaces and interdependencies, is the focus of the FAFTS.

THE RCAF TRAINING SYSTEM

FG is a complex, adaptive system of systems. It is made up of three key elements: personnel readiness, materiel readiness, and training resulting in combat readiness. Personnel readiness includes activities dealing with the management, delivery and support of military personnel, both Regular and Reserve Force. Personnel-readiness processes ensure that the right number of personnel are trained economically at the right time and to the right standards. Materiel readiness includes all activities related to engineering and maintenance, logistics and infrastructure support. Training generates operationally ready personnel. The synchronization of personnel, materiel and training activities leads to operational excellence in a defined state of readiness for FE.

Personnel inputs to the training system come from CAF and RCAF personnel requirements in the form of general, specialty and job-based specifications that provide cues for training development. Doctrine provides the main cues as to how we fight and is, therefore, the prime driver for training development to ensure training generates the requisite capabilities for operational excellence. Materiel inputs to the system occur in an integrative fashion as they apply to IT&E, which supports broader operational CT. Validation of the system itself is provided through periodic feedback from those responsible for operational excellence and strategic personnel management.

SYSTEM INTEGRATION AND INTERFACES

The personnel, materiel and training elements of the RCAF's training system must also operate within the broader overall CAF training system / *CAF Campus Operational Framework*. As such, the RCAF's training system will operate within a network of shared CAF and departmental resources—the Total Learning Architecture (TLA)—to achieve RCAF and joint CAF training FG effects. It will also leverage technology and work with industry, academia and allies to the greatest extent possible to gain efficiencies both in time and resources, or when there is a marked benefit. This will give the FAFTS the ability to generate highly interoperable forces that are capable of working within complex joint and coalition operating environments.

(RCAF Strategy / RCAF CP –
Ready to conduct operations;
engage and partner for success)

To operate efficiently and effectively, the FAFTS must interface and be integrated with the various elements of the FG system and the broader CAF training-, personnel- and materiel-readiness systems. As such, the FAFTS will be characterized by

- training-management and training-sustainment processes that are well integrated as a system;

- mechanisms to rapidly incorporate lessons learned from joint and RCAF operations with the aim of adjusting training and doctrine to remain strategically agile and adaptive;

- an integration with departmental materiel and infrastructure groups to ensure the proper life-cycle management of training assets and adequate configuration control;

- interfaces with CAF-level personnel-management, recruiting and training systems; and

- interfaces with allies' training-delivery organizations, academia and industry for the provision of cost-beneficial and sustainable training support and delivery.

These interfaces and relationships are particularly important, as the FAFTS represents a paradigm shift from a stovepiped system based on traditional classroom instruction to an integrated, highly technologically enabled training environment. The FAFTS strategy is built upon this system-of-systems design.

TOTAL COST OF OWNERSHIP CONSIDERATION

As new elements of the RCAF capability are introduced during the FD process, the total cost of ownership must be considered in the selection, acquisition, design and development of new systems; additionally, the FAFTS must be engaged throughout the process to minimize the associated expenses and ensure that the training component is synchronized with the broader FAFTS strategy. Typically, the total cost of ownership of a system ranges from two to ten times the initial-capital acquisition cost of that system. The bulk of these costs—which include materiel, personnel and training—arise during the in-service phase of the equipment system's life and, from a training perspective, need to be considered as part of the procurement decisions during the FD phase. This includes not only the necessary training systems and initial cadre training but also the in-service support mechanism to sustain the training system.

CHAPTER 4: OPERATING STRATEGY

The operating strategy describes how the RCAF will train and how the training component of the RCAF's FG model aligns with other RCAF training stakeholders. It is therefore the capstone enabling strategy from which the TEL, training-management, OTI, and capability development, support and sustainment strategies flow.

TRAINING PHILOSOPHY

Excellence in operations is achieved by infusing RCAF personnel with the necessary knowledge and attributes that are forged into skills. In turn, individuals are formed into crews/teams to provide a capability in accordance with the doctrine that describes how we fight. These crews/teams form operational units, most often as formed squadrons, but other operational units exist as well. Units or subunits are combined, at times, into air task forces for greater effect, as per RCAF expeditionary doctrine. This end-to-end concept is also known as the RCAF training spectrum or training continuum. The AFTS is thus designed to bring individuals into complex aerospace and joint CAF teams. Ultimately, the system forms force elements that can operate independently or as part of a Canadian or coalition air task force or joint task force.

> By viewing training as a continuum, one can see how complexity increases as individuals progress through the system. As the complexity of tasks, skills and knowledge increases, so too does the diversity of training methods and technology. As one progresses along the continuum, more attention is given to real-life operations and individuals are trained to operate with excellence within teams in a demanding operating environment. This build approach is the essence of the RCAF's FG training philosophy.
>
> (*RCAF Strategy / RCAF CP* – Value our people and invest in their future; ready to conduct operations)

The training continuum is not linear. Individuals move back and forth along this continuum throughout their career to receive refresher and continuation training or to increase the level of training needed to fulfil operational needs. Progression and the development of a professional aviation cadre are also dependent on PD, which develops the knowledge and higher-level skills at key stages of an officer's or non-commissioned member's career to ensure success as a leader and supervisor. Whether derived from the CAF or RCAF, professional military education (PME) needs are delivered through a variety of formal methods. PME is essential to ensuring that the RCAF is effectively advancing an aviator/warrior/leader/manager model and preparing personnel to lead the profession of arms.

THE RCAF TRAINING FG MODEL

Like its counterparts in the Canadian Army and Royal Canadian Navy, the RCAF approach to training includes quality- and quantity-control processes to ensure the RCAF FG training requirements for individuals and teams are met efficiently and effectively. The quality-control process exists to ensure the design and delivery of training meets the requirements of operational excellence and supports military-occupational-structure progression. It is composed of six phases: training analysis, design, development, conduct, evaluation and validation. The quantity-control process exists to ensure intake as well as military-occupational-structure requirements are sufficient and that resources are identified early to ensure the RCAF's throughput requirements are met. The process includes the identification of personnel-training requirements, nomination, scheduling, matching, commissioning and funding. These quality- and quantity-control processes intersect in that both feed into the conduct of training. Many RCAF and departmental stakeholders are involved in these processes, and together they ensure the right training is being delivered to the right people at the right time. These processes inform the design and development of training, and they feed into as well as regulate the progression of individuals along the training continuum. Combined, they form the operating model of the FAFTS.
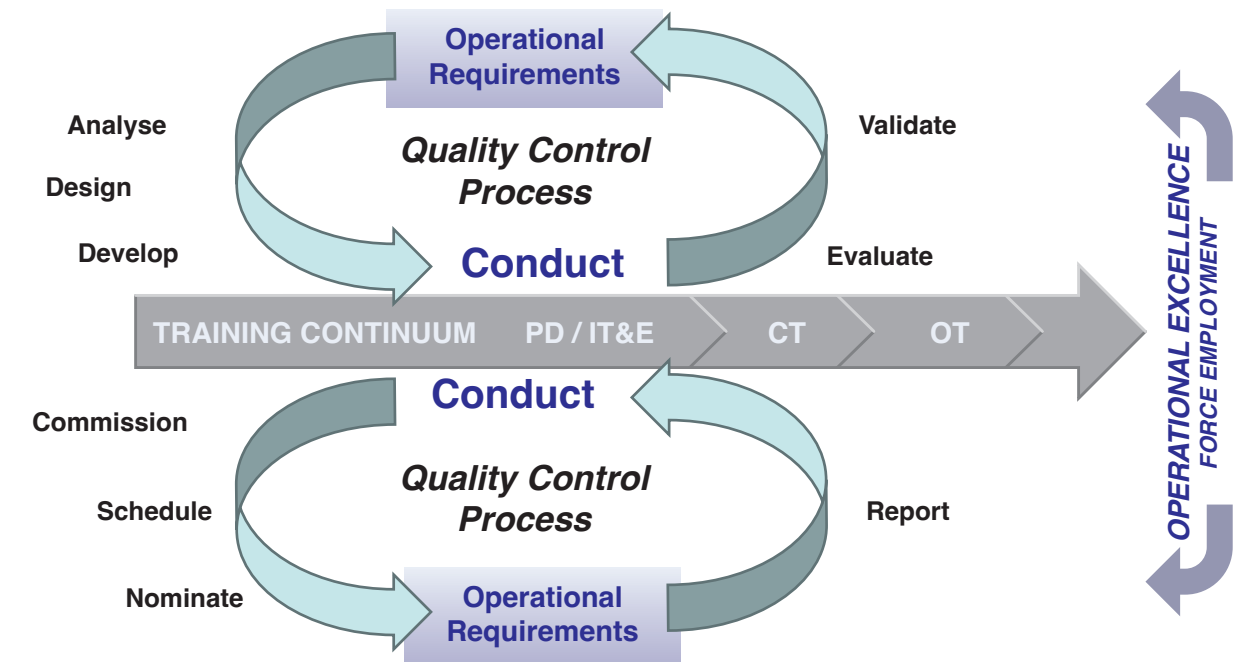

Figure 2. The RCAF approach to training[3]

CHAPTER 5: TECHNOLOGY-ENABLED LEARNING STRATEGY

In the modern training environment, training can be achieved via several means. Characteristics such as the complexity and importance of information, the time available for delivery and the location of the training audience all impact the choice of the strategy used to deliver training. Until recently, technological limitations forced a large portion of military training and education to be delivered in a linear, residential fashion—usually in a training establishment. Today, advances in training technology offer opportunities to train in new and novel ways.

The ultimate output of the FAFTS comprises effective force elements and force packages that have been developed in a cost-effective and timely manner. This is achieved through the training continuum of the training FG model. To effectively execute the training continuum in the future training environment, a mature TEL strategy is required. This enabling strategy must look at training delivery, development and management.

The TEL strategy will guide the selection and employment of training methods and media that optimize and enhance learning. This enabling strategy provides a framework with which new aircraft programmes can assess TEL procurement options. Above all, it will ensure optimal benefits for investment over the long term. The TEL strategy, therefore, describes how the RCAF will use technology in training. It is based on four design principles:

- **Distributed learning**. A wider student body can be reached when and where training is needed, and often in a student's place of employment, through the use of distance- and distributed-learning technology.

- **Multi-purpose reconfigurable training**. TEL has advanced to the point where the most effective and efficient simulator/emulator system is reconfigurable and serves more than one purpose. Reducing reliance on single-purpose training tools will reduce maintenance, operating and application-development costs for models, simulations, infrastructure and associated materiel. TEL permits direct and rapid training adaptation using operational lessons learned as the operating environment changes.

- **Ubiquitous learning**. Ubiquitous learning refers to the ability to learn or refresh skills and knowledge through persistent access to learning and training devices (i.e., on-demand learning).

- **Networked training**. Modern network technology allows for the training of individuals, crews/teams and units using distributed mission training and distributed synthetic training. This will further enable the RCAF to work with the CAF and allied players in a persistent manner, significantly advancing interoperability and readiness.

The future training environment features more efficient and timely training through enabling training delivery at the point and time of need using modern technologies that are agile in responding to evolving training techniques and methods. This approach to design not only increases the effectiveness and flexibility of the FAFTS, but also reduces the demand for infrastructure. The design principles allow the FAFTS to reduce its physical footprint by decreasing the demand for large, purpose-built facilities to house trainers or single-role classrooms, labs and workshops. The FAFTS will provide efficiencies to the RCAF through the use of reconfigurable and mobile equipment.

> **The FAFTS will be supported by an underlying learning ecosystem known as the Total Learning Architecture (TLA). The TLA is an open architecture that supports the integration of diverse learning technologies as well as platforms and is designed to help organizations create and deliver effective learning experiences. Overall, the TLA's importance is underscored by its ability to enable organizations to create and deliver effective, personalized and data-driven learning experiences that are adaptable and future-proof. By promoting interoperability, reusability, personalization and data-driven learning, the TLA helps organizations achieve better learning outcomes and maximize the value of their learning resources and technologies.**
>
> (*RCAF Strategy / RCAF CP* – Modernize for tomorrow)

THE ROLE OF LEARNING ENGINEERING

Learning engineering is a field that combines principles of learning science, instructional design and educational technology to design and develop effective learning experiences. It involves the use of data, analytics and evidence-based methods to create educational materials that are engaging, adaptive and tailored to the individual learner's needs.

The importance of learning engineering lies in improving education and training effectiveness. By using a scientific approach to learning, learning engineers can create learning experiences that are more engaging, personalized and effective. This can lead to better learning outcomes, increased retention of knowledge and more efficient use of resources.

In addition, learning engineering can help address issues of access and equity in education by creating more inclusive and accessible learning experiences. This is especially important in today's digital age, wherein online and remote learning have become increasingly prevalent. By using technology and data-driven approaches, learning engineering can help to ensure that all learners have equal access to high-quality educational opportunities, regardless of their background or location.

Overall, learning engineering is an important field because it has the potential to transform the way we approach education and training, making it more effective, efficient and accessible for learners of all backgrounds and abilities. Learning engineering will play a prominent role in the FAFTS.

In support of learning engineering and integral to the TLA is the rapidly evolving area of learning analytics. Learning analytics is "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning."[4] With the increase of digital data from students' learning activities, the RCAF will use computational analytics techniques from data science and artificial intelligence (AI) to improve teaching and learning within the RCAF. Informed by the *Royal Canadian Air Force Data and Analytics Strategy*, learning analytics will support learning progress, improve student retention rates, improve qualification attainment and create efficiencies in student-support processes. Insights from learning analytics will also inform decision-making, drive continuous improvement and deliver tailored learning experiences.

Learning theory about multimodality tells us that a balance of the following is required in order to produce the optimal blend of effectiveness and efficiency in training:

- classroom and distributed learning;

- a progressive mix of partial or wholly digital representations of tools, consoles and equipment; and

- a measure of digital hands-on and real hands-on media and equipment.

Individuals may first learn about partial, functional representations of tools and the work environment, then progress to more constructive functional representations that simulate working individually and, further on, as part of a team and teams-of-teams operations. Consequently, as skills and knowledge demands increase, so too does the diversity of training methods, media and environments available to impart effective learning.

KEY TEL COMPONENTS

With the design principles and knowledge of modern learning theory previously articulated, the key TEL components of this enabling strategy are as follows:

Component 1 – Conventional Classroom Training

While there will be a continued requirement for the use of traditional classrooms, this requirement will decrease with the application of the four design principles. Future training facilities will feature a multi-purpose structure that is better adapted to modern learning methodologies, such as standardized distributed-learning content delivery. The learning space will have the ability to plug and play with various networked devices and peripherals at one time. It will also be rapidly reconfigurable to deliver different types of training activities at any time. Through its reconfigurable nature, a modern classroom infrastructure will ensure a lower life-cycle cost and affordable learning that is more effective. Notwithstanding, the conventional classroom will always have its place, with an experienced instructor providing instruction and mentorship as well as the leadership and example that are so important in inculcating new personnel into the RCAF culture, or in developing the student to assume new responsibilities at new rank levels often achieved upon the completion of formal training.

Component 2 – Multi-Purpose Reconfigurable Trainers

The use of simulators in the RCAF has long been a tried-and-true training mechanism. The future application of multi-purpose reconfigurable trainers (MRTs), supported by reconfigurable training spaces at training campuses, is expected to reduce the overall costs of trainers, simulators and training tools by enabling the reuse of hardware, software and infrastructure for different training applications. Additionally, the use of deployable simulation devices and virtual/augmented-reality applications will allow enhanced learning in a variety of training and operational settings. MRTs will have hardware and software components configured for use by individual students in classrooms, as individual part-task trainers and by crews/teams as full mission simulators. MRTs will support individual, operational/collective team and networked applications. MRTs will also support technical and maintenance applications in different configurations. Maintenance and technical MRTs will feature application modules that enable interactive part-task and whole-functional virtual representations. They will have a flexible open architecture with modular components to facilitate cost-effective expansion, modification and technology insertion.

Abundant in situ access to MRTs will enable ubiquitous learning, allowing individuals to practise, master and refresh skills, drills, procedures and simulations anywhere, anytime, using real or emulated equipment. The future RCAF training capability will feature accessible simulation and synthetic environments that allow training to achieve a realism and faithfulness to real operations that could not otherwise be possible through conventional technologies and with far less reliance on expensive and repeated use of live operational assets.

Component 3 – Distributed Learning

Distributed learning, or the ability to offer training and education through various means in various locations, offers the RCAF an ability to reduce classroom footprints, standardize curricula and increase learning at the point and time of need. Traditional computer-based learning (students learning at their own pace, either in school labs or via distance learning, while monitored/mentored by an instructor) and the Universal Classroom are two examples of distributed learning in today's training system. The RCAF will expand upon the use of distributed learning within a robust digitalized training environment—i.e., the TLA.

As discussed previously, upholding cultural traditions and enabling indoctrination into the RCAF, particularly at junior levels of training, is critical to a well-enabled fighting force. Therefore, more junior-level courses may employ classroom-based, synchronous and instructor-led training using distributed learning as a standardized presentation platform. As training progresses, more asynchronous, non-cohort-based approaches may be applied. Where training is focused on higher-level skill, knowledge and procedure learning that is more suited to a distance-learning environment, the RCAF will achieve resource and time savings by employing that method of instruction. Furthermore, the RCAF will leverage technology to extend the reach of the traditional classroom to deliver real-time lectures, coaching and tutoring at a distance. Microlearning opportunities using readily available devices (smartphones, tablets, etc.) will also become more prevalent.

Using distributed-learning technologies, the RCAF will be able to increase accessibility to training, reduce reliance on physical infrastructure, become geographically independent and increase flexibility and scalability in delivery.

Component 4 – Platform-Based Training

Live exercises will continue to play a critical role in building, maintaining and validating operational effectiveness. Technology allows the blending of aircraft, simulators, other MRTs and command nodes into live, virtual and constructive (LVC) concepts to enhance training. LVC training serves as a force multiplier, complementing traditional training regimes while delivering measurable improvements in mission readiness. One of the key benefits of LVC training is its ability to integrate seamlessly into the existing TEL framework. This seamless integration allows for the creation of realistic, high-fidelity scenarios that can be tailored to meet specific training requirements. By utilizing LVC training, the RCAF can also overcome the limitations of geography and time, enabling continuous ubiquitous-learning experiences that can be accessed from multiple locations. The reconfigurable nature of LVC environments aligns well with the TEL design principle of MRTs, allowing for rapid adaptation to various training needs. The cost effectiveness of LVC training cannot be overstated. The integration of LVC training offers a data-rich environment that allows for real-time feedback, robust after-action reviews, performance analytics and adaptability in training scenarios. This provides commanders and training facilitators with invaluable insights into areas for improvement, thereby driving an upward spiral in training effectiveness and mission readiness.

> **Networked training systems can deliver increasingly realistic, complex IT&E and CT in simulated operating environments. Moreover, modern technology allows for real-time training with joint and allied force elements. Distributed mission training is a critical component of the RCAF's training capability. The capabilities offered by modern training technologies coupled with platforms are force multipliers in the truest sense, offering real-life situated training opportunities. Force elements with embedded and networked training capabilities will be considered as part of the training continuum and are a critical component of the RCAF TEL strategy.**
>
> *(RCAF Strategy / RCAF CP –*
> *Ready to conduct operations)*

SUMMARY

The four components of TEL each play a role in the training continuum. The preferred method of training delivery largely depends on the assessment of needs and is subject to the availability of cost-effective and reliable training solutions. However, the general trend will go towards the increased use of synthetic components as one moves from IT&E towards operational CT. This represents the TEL strategy and the change in the training technology centre of gravity from a school-based solution to one more broadly leveraging the variety of capabilities necessary to meet the challenges of tomorrow's operating environment.

CHAPTER 6: TRAINING-MANAGEMENT STRATEGY

The delegation of TA responsibilities to Comd 2 Cdn Air Div for the IT&E and personnel-management elements of FG allows 1 Cdn Air Div and 3 CSD to focus on their operational CT responsibilities, supported by the RCAF AWC. From this broad division of responsibilities, key organizations will be involved in the management of the FAFTS—namely, the division commanders and, at the strategic level, Director General Air and Space Readiness (DG Air & Space Rdns) and Director General Air Strategic Resources and Air Reserve (DGASRAR). To ensure a focus on operational readiness and the seamless management of training responsibility across the RCAF, clear and effective training governance is required. To enable this, an agile and scalable training-management system is needed as the enterprise solution.

The execution of the training FG model is complex not only due to the nature of the training quality- and quantity-control processes used to design and deliver training, but also because of the number of stakeholders involved. DG Air & Space Rdns is charged with strategic-level readiness and providing guidance for RCAF exercises, supporting joint readiness and support to Strategic Joint Staff force posture and readiness direction. Director Air Personnel Strategy is responsible for the identification of strategic occupational specifications and strategic occupation production requirements. At the operational level, Comd 2 Cdn Air Div is responsible for the development and delivery of IT&E and the management of RCAF personnel before they reach their occupational functional point. Comds 1 Cdn Air Div and 3 CSD ensure op trg requirements are met, although 2 Cdn Air Div (TA) still provides oversight of quality-control processes. CT and exercises are planned and controlled by 1 Cdn Air Div, with the support of the RCAF AWC. Almost all of the RCAF's training requirements are managed, analysed, identified, designed, developed and delivered with multiple stakeholders' involvement. To ensure the smooth management of training at the seams of responsibility between these organizations, clear and effective training governance will be required. This modernization will not just be operational; it will entail a cultural shift across the RCAF. The transition will be guided by a concrete policy strategy focused on governance and aligned with aerospace force mission-essential task lists.

The RCAF must manage the quantity of trainees and the quality of training while using its resources efficiently. An agile and scalable enterprise training-management solution will enable this. The enterprise training-management system will be consistent with the integrated RCAF enterprise information-technology (IT) / information-management model yet specifically oriented to the execution of RCAF FG (currently the Air Force Training Resource Information Management System [ATRIMS]).

> The training-management system will facilitate decision-making by providing commanders with the levers and reporting mechanisms necessary to properly plan, develop and manage the FAFTS. The solution will be an integrated system that combines business as well as training data and leverages recognized CAF systems of record into the TLA. Furthermore, the system will consist of shared training-management applications. It shall be seamlessly integrated with CAF-wide strategic business-management applications. The agile and scalable enterprise training-management system will incorporate data-analytics capabilities to drive decision-making. It will not just enable more effective planning and resource allocation, but also provide a robust feedback mechanism that informs ongoing policy development and governance.
>
> *(RCAF Strategy / RCAF CP – Modernize for tomorrow)*

The FAFTS will be consistent with the CAF Campus concept. The *CAF Campus Operational Framework* defines the CAF Campus as "a strategically driven modern learning architecture that is performance-oriented, agile, integrated and continually evolves in response to the [contemporary operating environments] and CAF institutional requirements. Integrated with CT and joint training, CAF Campus provides the mechanisms to optimize IT&E investments."[5]

CHAPTER 7: OPERATIONAL TRAINING–INFRASTRUCTURE STRATEGY

The RCAF's existing training infrastructure largely consists of an eclectic mix of buildings, many of which are ageing or at the end of their useful service lives, with high upkeep costs even before necessary retrofits are factored in. Given that the RCAF conducts daily operations from multiple locations across Canada, training establishments are often co-located with related aircraft fleets and operational facilities, thus providing some level of shared resources, flexibility and potential efficiencies. In other cases, the dispersed nature of training infrastructure creates a system that is difficult to manage and inherently inefficient. Several hundred classroom spaces are spread among training facilities, and a significant portion of them are often empty, resulting in a substantial and unsustainable waste of both space and resources. Repurposing ageing infrastructure is also very costly; more often than not, the resulting installation is barely adequate for the end user. With the increasingly specific environmental demands for modernized training tools and simulators, as well as new security requirements for networked and advanced training technology, new infrastructure will be needed. Current infrastructure is limiting the RCAF's ability to meet present-day training needs, let alone what the future will demand.[6]

There is a need to renew the RCAF training infrastructure and, to the maximum extent possible, follow a campus model. This concept builds upon what is already being done by Canadian universities and colleges and consolidates training into one environment with shared infrastructure and support services. The adoption of a campus-style infrastructure will create opportunities for shared collaborative and distributed learning, partnerships with industry, and effective TEL environments through an optimized footprint, taking advantage of the spatial and management efficiencies that it affords.

(RCAF Strategy / RCAF CP – Modernize for tomorrow; engage and partner for success)

A critical element of the FAFTS is the need for flexible, multiconfigurable space to accommodate the training necessary to meet the ever-evolving demands of advanced systems and weapon-systems technology and capabilities. Trying to find space to retrofit and repurpose to accommodate training technology is time consuming, ineffective and costly. Therefore, the new RCAF training-establishment infrastructure will need to be equipped with robust power supply systems, industrial-grade cooling and ventilation systems, and enhanced security measures suitable for next-generation platforms. Additionally, this infrastructure will be designed for flexibility and multiconfigurability to adapt seamlessly to the evolving training demands of the RCAF.

The Defence Learning Network (DLN) and its coming enhancements also dramatically increase the demand for networked learning spaces within existing infrastructure, and as a key enabler of the TEL's distributed-learning component, this requirement will increase in the future. Current infrastructure hosts very few networked classrooms and has inadequate power and communication-support infrastructure to further expand upon. New campus facilities will include robust network-support infrastructure to ensure adequate communication capabilities for both simulator and e-classroom spaces. The renewed training infrastructure will enable the implementation of TEL environments, creating valuable opportunities for shared classes between training establishments and partnership with other CAF training systems, allies, academia and industry for enhanced learning possibilities.

This OTI strategy decreases costs for DND because the training-asset footprint will be reduced, and vacated buildings can be restored, repurposed or demolished in accordance with master real-property development plans. The total life-cycle operation and maintenance costs for a new consolidated training campus built upon green-building design principles will cost less than numerous old and inefficient buildings spread over DND property. Green, energy-efficient buildings are proven to reduce energy costs by at least 25% and operating costs by 20%.[7] Building a new RCAF Campus infrastructure will also result in greatly reduced operation and maintenance costs which, over a 20-year span, can be nearly half the cost of sustaining the current facilities.

The direct cost savings from modern OTI are substantial, but more importantly, learning effectiveness and the quality of life of our people (through increased training where people live) will also improve. In effect, this OTI strategy moves the RCAF training system from the Cold War–era industrialized model to the modern learning environment that is familiar to, and expected by, today's recruits, thereby creating a new, progressive and stimulating RCAF learning environment as well as infusing a desire to learn and pride to be in the RCAF.

CHAPTER 8: CAPABILITY DEVELOPMENT, SUPPORT AND SUSTAINMENT STRATEGY

A good capability development, support and sustainment strategy leads to lower through-life system costs as well as increased system availability and ensures the system remains relevant over time. In the RCAF, capability development, support and sustainability processes are clearly established, flowing from CAF FD policy. Attention is required, however, in capturing training development, support and sustainment in an integrated fashion. New training requirements have generally been captured through the training component of PRICIE in major and minor projects. Given recent advances in TEL and the FAFTS vision of embracing training technology, the RCAF must move beyond the traditional method of developing training capability as strictly an element of capital projects, to a strategy that views the entire FAFTS as a distinct capability stream in its own right. This will require good governance and an understanding of stakeholder roles. This chapter outlines the FAFTS strategy to develop, support and sustain the future training system.

TRAINING CAPABILITY AND INTEGRATION

The RCAF continuously procures and updates a wide range of equipment to sustain platforms and meet operational requirements. Major training systems introduced by capital acquisition projects within the materiel-acquisition system are subject to systematic life-cycle-support processes that are well planned and sustained throughout their useful lives. Other training assets acquired by the FAFTS during and in support of training must have a well-defined support and sustainment strategy. All training and training support systems, regardless of the means of procurement, need to be guided by a training-system capability support and sustainment strategy. As such, appropriate development, support and sustainment processes must be established.

The establishment of a separate training capability-development process that includes the right RCAF and CAF stakeholders will ensure the alignment of training capabilities between the development of organic learning support systems and capital procurement projects. Through integrated options analysis, definition, implementation and continuous feedback mechanisms, training capability gaps and sustainment requirements can be identified and resolved to ensure the training system remains relevant. Capability development must be approached holistically by establishing the right governance mechanisms to ensure 1 Cdn Air Div, 2 Cdn Air Div (TA), 3 CSD, the RCAF AWC, DG Air & Space Rdns, DGASRAR, Director General Air and Space Force Development, and Assistant Deputy Minister (Materiel) training capability elements are developed consistently with the goals of the FAFTS strategy. This means ensuring the right hardware and software are procured, regardless of the procurement mechanism or authority. This also means ensuring the right governance exists to integrate infrastructure planning.

> **Support and sustainment must be considered as part of the training capability-development process. Existing or new in-service support contracts must be leveraged to provide efficient support through the life cycles of new equipment, including those developed and purchased through L2s. This will require 2 Cdn Air Div to assume a larger leadership role in the integration of development, support and sustainment for the RCAF and to move the organization to a more coherent system of systems. This will also require careful attention to the integration process, as the FAFTS is envisioned to be developed over a period of years. Indeed, the end state becomes a moving target, as the increased availability of new technology will need to be considered on an ongoing basis. Understanding and leveraging new technology and integrating chosen capabilities into new and existing curricula on an ongoing basis, while ensuring support and sustainment is well managed, will become a critical role in the future—one that requires openness and understanding between stakeholders through good governance and a common vision.**
>
> (*RCAF Strategy / RCAF CP* – Modernize for tomorrow)

STRATEGIC PARTNERSHIPS

The support and sustainment of the FAFTS will increasingly rely on relationships with external partners. As mentioned in the *CAF Campus Operational Framework*, training delivery can be optimized by harnessing private and other public training and education programmes. When the FAFTS chooses to deliver training in this manner, appropriate in-service support must be established for the maintenance of key elements of the training systems. Additionally, the FAFTS will similarly work with CAF allies and expand upon areas of training collaboration wherein mutual benefit results.

> Ultimately, the RCAF will not go it alone when sustaining, managing and delivering training. The creation of long-term, agile, flexible, cost-effective and efficient relationships with non-RCAF actors will afford the system economies of scale and effort. This will increase the FAFTS's ability to generate effective forces while eliminating redundancy through coherence and compatibility in which rapid, agile FG is obtained for optimal cost and maximum through-life sustainment.
>
> (*RCAF Strategy / RCAF CP –*
> **Engage and partner for success**)

RESOURCES

The modernization of the legacy RCAF training system will require resources. However, modernization will ultimately enable the achievement of long-term defence resource savings. Numerous resource streams can be synchronized and leveraged to modernize the AFTS. As discussed, the challenge is ensuring synchronization of the available strategic resources to meet the desired strategic end state. Enabling this effort will require pan-RCAF/CAF approaches, closely linked to allied training initiatives and managed through good governance. Given the scope of this modernization effort of RCAF FG tools, challenges in communication, governance and synchronization should be expected. However, these challenges must be overcome to ensure that required strategic resources are provided in a timely manner.

As new FAFTS capabilities are introduced, they must be supported and sustained using the right resources. FD processes are designed to ensure new systems are procured with capital and/or Vote 5 funding, operated and maintained with operation and maintenance funding, and periodically updated with non-public funding until the end of their life cycles. Too often, training assets were procured using inappropriate opportunity funding sources, often based solely on live training and real weapon systems being central to the training construct. Whereas this had relatively little impact in the past due to the relatively minor costs associated with these assets, the evolution of training technologies' complexity and interdependency raises acquisition/development, support and sustainment costs. A focus on striking the correct balance between live and synthetic training devices will be a key part of future acquisition and resourcing strategies.

CHAPTER 9: CONCLUSION

This document sets forth the vision upon which the RCAF will sustain its FG mission through the establishment of its FAFTS. It lays out the foundation for a streamlined governance and management model within a system of systems that continues to evolve to provide the RCAF with sustainable, well-supported and agile means of generating aerospace forces. Through a capitalization on TEL, renewed management and governance, new OTI, and a focus on sustainability, the FAFTS will provide the degree of flexibility and scalability that will enhance readiness to meet the challenges of a complex and uncertain global threat environment and the consequent, rapidly evolving operating environment. In treating the FAFTS as a distinct capability of its own, the five enabling strategies outlined herein, from Chapters 4 to 8, will ensure the continued success of the RCAF's future operations while bringing about necessary increased training efficiencies and better stewardship of the resources assigned to the Department.

With the concerted effort of the air and space divisions, other FD capability initiatives, aviation stakeholders and support organizations as well as centralized oversight by the RCAF TA, the RCAF will achieve its vision of a FAFTS. It will be an integrated system of training aligned with the FD, FG and FE systems that is based on sustainable, scalable and flexible system-design principles; rooted in our RCAF heritage, ethos and leadership philosophy; and enabled by technology for world-class excellence in operations.

ABBREVIATIONS

1 Cdn Air Div	1 Canadian Air Division
2 Cdn Air Div	2 Canadian Air Division
3 CSD	3 Canadian Space Division
AFTS	Air Force training system
Comd	Commander
CT	collective training
DG Air & Space Rdns	Director General Air and Space Readiness
DGASRAR	Director General Air Strategic Resources and Air Reserve
DND	Department of National Defence
FAFTS	future Air Force training system
FD	force development
FE	force employment
FG	force generation
IT&E	individual training and education
L2	Level 2
LoO	line of operation
MRT	multi-purpose reconfigurable trainer
op trg	operational training
OTI	operational-training infrastructure
PD	professional development
PRICIE	Personnel, Research and Development, Infrastructure and Organization, Concepts, Doctrine and Collective Training, Information Management, and Equipment Supplies and Services
RCAF AWC	Royal Canadian Air Force Aerospace Warfare Centre
RCAF CP	*RCAF Campaign Plan*
TA	training authority
TEL	technology-enabled learning
TLA	Total Learning Architecture
TM	training modernization

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NOTES

1. Image adapted from Canada, DND, A-PD-050-000/AG-003, *Royal Canadian Navy Future Naval Training System Strategy* (Ottawa: DND, June 2015), 2.

2. A systems approach to training (SAT) is a comprehensive method that considers the entire training process as an integrated system, designed to produce specific outcomes. This approach emphasizes the interconnectivity and interdependence of all components of the training process, from the initial analysis of training needs to the design, development, conduct, evaluation and validation of training programmes. The goal of the SAT is to ensure that training is efficiently and effectively aligned with the objectives of an organization or specific roles within the organization.

3. Image adapted from Canada, DND, A-PD-050-000/AG-003, *Royal Canadian Navy Future Naval Training System Strategy*, 15.

4. Society for Learning Analytics Research, "What is Learning Analytics," accessed April 23, 2024.

5. Canada, DND, *CAF Campus Operational Framework* (Ottawa: DND, June 19, 2013), 14.

6. Note that contracted training facilities, either on DND property or within existing academic/commercial institutions, are viable solutions to this strategy and are not specifically addressed here. Each option will be assessed during new capability acquisition and consolidation considerations explained further on in this publication.

7. Canada, Defence Construction Canada, *Naval Training Infrastructure Strategic Study* (Ottawa: Defence Construction Canada, May 2015).