



National
Defence

Défense
nationale

CANADIAN
ARMED FORCES



FORCES ARMÉES
CANADIENNES

ASSISTANT DEPUTY MINISTER (DEFENCE RESEARCH AND DEVELOPMENT CANADA)



IMPACT REPORT 2025

DRDC | RDDC



Canada



FOREWORD

From the Assistant Deputy Minister

In a world where challenges are accelerating and threats are becoming more complex, innovation is Canada's frontline defence. In 2025, DRDC delivered scientific excellence that strengthened our sovereignty, supported CAF, and advanced the Government of Canada's commitment to keep Canadians safe.

This year included major milestones. DRDC played a key role in the first phase of NMST. From the launch of the Gray Jay satellites to new Arctic shelter technologies, protective gear innovations, and advances in adaptive camouflage, these achievements are the foundation for the next phase of modernization.

Through the IDEaS program, we continued to unlock Canadian innovation. Promising ideas are moving from early concept to field ready solutions, as national talent connects with CAF capability needs.

Following the Prime Minister's announcement of the BOREALIS initiative, DRDC established the JPO to help shape this next generation innovation ecosystem, including early deliverable of the maritime Defence Innovation Secure Hub (DISH). BOREALIS represents a bold step toward a more agile and future-ready Canada.

We also advanced reconciliation by strengthening guidance for respectful engagement with Indigenous communities and improving procurement processes to support Indigenous businesses. These actions reflect our responsibility to build enduring, mutually beneficial relationships.

This year, we also invested in our own future, opening a new research pavilion at the Valcartier research centre and have begun broader efforts to modernize DRDC's facilities and capabilities.

R&D is essential to Canada's security and our people make it possible. Their creativity, expertise, and dedication give CAF the advantage it needs and help Canada prepare for the future with confidence.

Together, we are shaping a safer, stronger, and more resilient Canada.

Dr. Jaspinder Komal
Assistant Deputy Minister (DRDC)

Acronyms

- AI**
artificial intelligence

- BOREALIS**
Bureau of Research, Engineering and Advance Leadership in Innovation and Science

- CAF**
Canadian Armed Forces

- CANSOF**
Canadian special operations forces

- CANSOFCOM**
Canadian Special Operations Forces Command

- DND**
Department of National Defence

- DRDC**
Defence Research and Development Canada

- HMCS**
His Majesty's Canadian ship

- IDEaS**
Innovation for Defence Excellence and Security

- ISR**
intelligence, surveillance and reconnaissance

- JPO**
joint program office

- NATO**
North Atlantic Treaty Organization

- NMST**
North Atlantic Aerospace Defence Command modernization science and technology

- NORAD**
North Atlantic Aerospace Defence Command

- NRCan**
Natural Resources Canada

- R&D**
research and development

- RCAF**
Royal Canadian Air Force

- RF**
radio frequency

- SAR**
synthetic aperture radar

- SFA AC2I**
strategic focus area accelerate command, control and intelligence

- SFA APW**
strategic focus area advance platform and weapons

- SFA Cbt**
strategic focus area combat in the virtual and physical environment

- SFA EVO**
strategic focus area evolution of science and technology

- SFA Inst**
strategic focus area the institution

- SFA Ppl**
strategic focus area people

- SFA SDC**
strategic focus area strategic defence capabilities

- UAS**
uncrewed aircraft system



Optimizing and growing CAF platforms



Over the past year, the geopolitical state of the world has changed more rapidly than any time in recent history. At the same time, the climate is changing at a similarly fast rate. The arctic is warming 3 times faster than the rest of the planet and dissolving the geographical and climatic protections in our North. Canada is investing in sustaining and growing its military platforms: land, sea, air, and space. DRDC provided scientific and technological support to ensure CAF is equipped and informed to respond in these unprecedented times. We supported optimizing the life span for our ships, tested performance in the unforgiving Arctic, and increased environmental awareness in remote regions with satellite support. It is through this holistic and collaborative approach that DRDC has contributed the science that validates and enables CAF readiness.

DRDC IN ACTION:

- provided actionable recommendations, based on scientific analysis, regarding the overwintering of HMCS Toronto to minimize risk of hull damage due to ice (SFA APW, NMST)
- supported public confidence, by developing a method of providing options analysis of fleet mix composition for the next tactical aviation capability set (nTACS) modernization project, to provide defensible performance measures and significantly reduce real or perceived subjectivity (SFA Cbt)
- successfully launched 3 Gray Jay Pathfinder micro-satellites to demonstrate, strengthen, and evaluate new space-based ISR technologies and systems for Arctic surveillance and NORAD modernization (SFA SDC)
- actively monitored collision risk for Near Earth Object Surveillance Satellite (NEOSSat) with space debris; used a novel scientific approach to control the position of the satellite, reducing the risk and ultimately avoiding the collision
- delivered an advanced ship-helicopter operation tools that includes a user-friendly modeling and simulation tool, integrated reality in-flight simulation, and flight deck motion system to support planning and executing trials, and enhancing operational safety and performance (SFA Inst)
- developed a robust dataset and visualization system to support advanced hull prediction tools and rudder stall prediction, improving safety, reducing operational risk, and supporting future design codes for deep-diving and maneuvering performance (SFA Inst)
- developed and tested a prototype ship signature management system on HMCS Charlottetown to allow a ship to measure its own signature organically and recommend actions to improve operational safety in combat zones (SFA APW)
- provided urgent support across multiple ship classes, including Halifax, Kingston, joint support ship, and Arctic and off-shore patrol vessels (AOPV), to address structural cracks, corrosion protection, material evaluations, coating performance, cavitation risks, and operational challenges; informing decision-making and ensuring timely intervention reducing lifecycle costs and operational risks (SFA Inst)

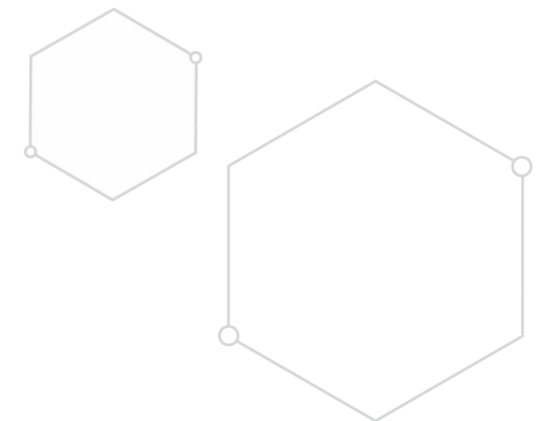


Protecting those
who protect

Canadian military members dedicate their lives to serving for the defence of Canada and our allies. DRDC dedicates our research to ensuring that we protect their lives with the most advanced science available. Whether it is developing shelters for extreme climates, reducing cold weather injury, developing field ready treatments, or testing and innovating new protective equipment, we are responding to the needs of CAF and protecting our most valuable assets.

DRDC IN ACTION:

- compiled decades of data, with the Strategic Medical Countermeasures Program and Regulatory Affairs, meeting Health Canada requirements for a phase I clinical trial of the nerve agent oxime, HI-6; giving Canada the regulatory foundation to advance a world-class nerve agent treatment capability (SFA Ppl)
- conducted assessment of CANSOF personnel exposed to low-level blast overpressure, providing a scientifically validated, operationally relevant capability for early detection and monitoring of blast-related brain changes, supporting precision health surveillance and long-term care strategies for high-risk operators (SFA Ppl, Cbt)
- validated, with Canadian Forces Health Services Group and Canadian Blood Services, dried plasma effectiveness for trauma resuscitation in austere environments and providing CAF access to a resilient, field-ready blood product that extends the “golden hour” of trauma care, improving survival in combat and remote settings while enhancing health system resilience for civilian applications (SFA Ppl)
- designed and operationalized, in partnership with NRCan CanmetENERGY, a groundbreaking, transportable energy-generating shelter for harsh environments; a prototype was leveraged by RCAF for the Crossbow major capital project under NORAD modernization (SFA SDC)
- developed scientifically validated ballistic plate sizing schemes that increase accommodation from about 3% to as much as 96% of CAF personnel, enabling a mobility-focused, NATO-recognized approach that will enhance soldier protection and inform future procurement (SFA Combat)
- hosted a demonstration for promising Canadian innovators developing technology to advance mine detection and defeat, connecting them with CAF experts, as well as providing them direct insight from sappers in Ukraine (IDEaS)



Expanding our awareness



The world is wide, and Canada is a vast territory. Building the capacity to know what is happening across our country, and in the areas in which we operate, is a growing challenge. Areas historically protected by inaccessible geography are opening up. DRDC is investing in developing advanced sensing technologies, including leveraging the emerging field of quantum computing. We are developing cross-domain shared awareness, advanced autonomous surveillance, and improved satellite imagery interpretation. In the past year we opened 2 new quantum sensing laboratories, with plans to continue and grow these capabilities.

DRDC IN ACTION:

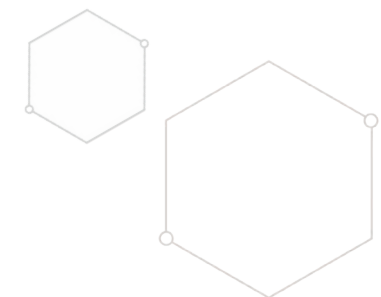
- provided science-supported guidance for creating a real-time indications and integrated cross-domain warning ecosystem, setting conditions for complex cloud capabilities; giving CANSOFCOM the ability to tackle problems beyond the scope of existing industry tools, and enabling advanced operational awareness and decision making (SFA AC2I)
- opened a state-of-the-art quantum RF sensing laboratory focused on applications including quantum-enhanced radar, positioning, navigation, and timing (PNT), and secure low probability of intercept and detection (LPI and LPD) communications; the cutting-edge facility supports advanced quantum sensing research and experimentation, fostering collaboration across military and government partners for future operational capabilities (SFA EVO)
- opened a secure, state-of-the-art quantum optics laboratory for advanced electro-optical and infrared sensing research, certified up to Level II/Secret, enabling advanced sensing work of direct interest to partners, and allowing progress on classified projects in a trusted environment (SFA EVO)
- developed new proximity operations sensors for RF situational awareness and influenced the development of new cyber operations capabilities by providing hands-on assistance in porting software, obtained via a partnership with US Secretariat for Special Operations (SSO), to sensor hardware (SFA Cbt)
- created custom data acquisition modes to address the specific challenges of detecting low radar cross-section (RCS) uncrewed surface vehicles, as well as low, slow, small UAS, providing a database of truthed and tagged datasets to support AI activities, baseline radar performance predictions, advanced algorithm development, and validation (SFA AC2I)
- developed and integrated a new radar model 3MD, along with software updates into the RADARSAT Constellation Mission (RCM) 30 meters and 50 meters modes, enhancing the vessel detection system used by CAF's Polar Epsilon 2 (PE2) and other government departments and reducing reported excessive false alarms in SAR imagery (SFA SDC)
- delivered an updated tool for extracting intelligence information from space-based ISR sensors, to support improved harbour monitoring, tracking high value targets, and identifying dark targets (SFA SDC)
- hosted a test environment for 19 innovator-developed counter UAS technologies, advancing 3 promising solutions to further development to provide Canadian drone detection technologies for use in complex city environments (IDEaS)

Forward planning

Those who fail to plan, plan to fail. In the uncertain and unpredictable state of the world, as long held norms fall apart, it is more important than ever to plan for every possibility. DRDC applies its long history of analytics to building the tools and scenarios that engage the collaboration and critical thinking that will give CAF the edge. We have participated in joint trials with allies to support interoperability, developed wargaming and tabletop exercises to support critical thinking, and responded with science backed analysis to support operations in Latvia.

DRDC IN ACTION:

- trialed 4 unique technologies during BOLD QUEST 25, demonstrating to CAF and international partners, AI-enabled Responsive Airborne Motion Imagery Screener (ARAMIS), Joint Terminal Attack Controller (JTAC), beyond line of sight (BLOS) communications, and a training scenario for tactical data link (TDL) 400. Together these contributions support future force training and development
- in response to an urgent requirement from operations in Latvia, DRDC applied extensive knowledge of masking materials, electro-optical signatures, and active protection to provide science-backed recommendations for the purchase of smoke grenades based on performance and compatibility with Canadian systems
- as part of exercise OMEN, DRDC deployed the Cluster Analysis and Data Exploration Toolset (CADET), analyzing over 24 000 fictitious social media messages and successfully detecting disinformation narratives; demonstrating application in supporting informed decision making (SFA Cbt)
- developed and tested a war simulation capability using a one-day tabletop exercise with a whole-of-government audience to address multidimensional challenges and providing a proven mechanism for scenario-based learning, relationship-building, and strategic planning on geopolitical priorities (SFA SDC)
- organized working groups on war gaming, Human System Integration, and battlespace management, supported by the pan-domain command and control X (PDC2X) community, to define processes, narratives, and scenarios for the Modernized Command and Control Information System (MC2IS) project approval process; Assistant Deputy Minister (Digital Services) leveraged these outputs to build Defence Capability Board briefs and enable an accelerated and de-risked MC2IS project scope and schedule (SFA AC2I)
- evaluated the performance of radar-aimed automatic weapons including M2 and M240 systems, multiple remote weapon-station variants, and several radar types against Class 1 mini-UAS, generating key insights into a vehicle-mounted counter-drone and multipurpose weapon solution capable of providing point-defence against threats (NMST)



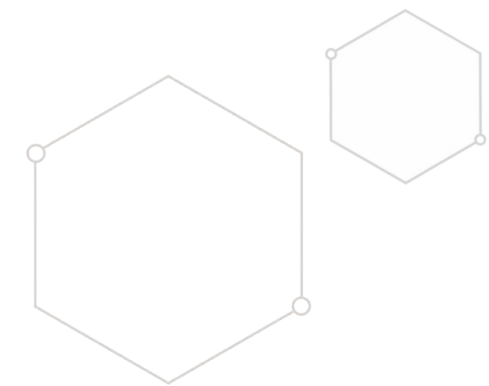
Working across government to advance change



Over the past year, changes in the government have brought a marked increase in the pace of delivery. Whole-of-government priorities rely on cooperation and collaboration across departments to influence real change. DRDC leverages its strong network of relationships to support these efforts. We have worked within DND to support the growth of CAF, supported greening initiatives by looking at opportunities across CAF, and developed strong guidance for engagement with Indigenous communities as we conduct our work.

DRDC IN ACTION:

- built and delivered a Canadian defence critical mineral list, considering global supply and current equipment needs, to identify high-value critical minerals using a defensible framework and methodology, highlighting critical minerals of relevance to defence and informing supply chain risks for CAF and DND, distinct from NRCan and NATO lists (SFA Inst)
- established a set of level 0 future force strategic planning documents based on principles of military effectiveness and capability portfolio optimization that will guide the development of new processes for force development and design and will improve CAF credibility and relevance out to 2040; supporting CAF leadership in making investment choices based on a coherent and defensible expression of military value that satisfies Government of Canada objectives while addressing ally and partner expectations
- developed a complete suite of cost-effective, non-invasive diagnostic tools covering all major heating, ventilation, air conditioning (HVAC) system types that will improve building performance, enhance energy efficiency, reduce operating costs, to support DND's progress toward its net-zero goals (SFA Inst)
- advanced future net-zero aircraft acquisitions and informed decision-making for sustainable aviation strategies by providing innovations aimed at reducing emissions from existing platforms and adopting of low-emission platforms, with a particular focus on Arctic operations, batteries, fuel cells, hydrogen storage, energy-efficient propulsion systems, aerodynamic improvements, sustainable aviation fuels, and simulation technologies (SFA Inst)
- created data and tools to support risk-based decision-making for munition residue management, assessing cold climate impacts on munition residue behavior and developing and testing eco-friendly smoke compositions, and providing access to sustainable pyrotechnic compositions and range designs that minimize ecological footprints (SFA Inst)





Looking ahead

As we look to the year ahead, DRDC is entering a period of tremendous momentum and opportunity. Historic national investments will shape our path forward and redefine how Canada prepares for an increasingly complex security environment.

Building on the success of phase 1, DRDC has begun scoping priority R&D areas for NMST phase 2. This ensures that Canada continues to advance the technologies that protect our sovereignty, strengthen continental defence and equip CAF with the capabilities they need to meet tomorrow's threats.

At the same time, our close integration with CAF operators, and our deep partnerships across government, and with industry, academia and allies, will position the BOREALIS JPO to move quickly. By creating coherence across Canada's fragmented innovation ecosystem, BOREALIS will accelerate development and delivery of modern, mission-critical capabilities for CAF and the Communications Security Establishment.

Together, these initiatives reflect the broader truth that Canada's security and resilience depend on sustained investment in science, technology, and innovation. DRDC's people, expertise, and partnerships will continue to turn investment into impact. We are committed to strengthening our defence, advancing national priorities, and ensuring Canada remains ready for whatever comes next.



PHOTO CREDITS

PAGES 1 & 2

Private Brendan Gamache, CAF Combat Camera

A multirole rescue boat travels on calm water near a massive iceberg under a cloudy sky. The picture is taken from the HMCS Harry Dewolf during operation NANOOK in Baffin Bay, Nunavut.

PAGES 3 & 4

Master Seaman Zach Barr, CAF Combat Camera

A drone with 4 rotating propellers is airborne, viewed from below, silhouetted against an overcast grey sky, at a training held at the Engineer Training Element, during operation UNIFIER, in Poland.

Bevan Goldswain, Getty Images

A person in a lab coat is using a microscope at a laboratory workstation.

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Corporal Antoine Brochu, CAF Combat Camera

A flight engineer from the air task force observes the ground while flying a CH-146 Griffon helicopter, viewed from the front, during operation NANOOK-NUN-ALIVUT in Rankin Inlet, Nunavut.

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Corporal Brendan Gamache, Formation Imaging Services

Corporal Dakota Lacroix simulates injecting medicine into a casualty for a massive transfusion protocol exercise, on-board HMCS Ville de Québec.

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Janice Lang, DRDC/DND VisDoc

DRDC Defence Scientist Vijin Venu collects data and adjusts the quantum sensor at the DRDC Ottawa Research Centre.

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Corporal Morgan LeBlanc, CAF Combat Camera

A member of HMCS Montréal wearing a headset stands outdoors overlooking a snowy mountain range and a large body of water, during the transit towards Bodø, Norway.

PAGE 13

Corporal Nicolas Tremblay, Valcartier imaging section

Members from 5e Regiment d'artillerie légère du Canada take cover as a CH-147 Chinook helicopter takes off with a M777 Howitzer artillery piece, in the training areas of Canadian Forces base Valcartier, during exercise RAFALE BLANCHE.

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Corporal Braden Trudeau, CAF Combat Camera

A sailor aboard HMCS Montréal stands on the deck and raises the Canadian flag for colours at sunrise, during operation RE-ASSURANCE, in Rota, Spain.

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Stephen Bickram, DRDC/DND VisDoc

Drone hovers above a rooftop crew with tripods and equipment, with Canada's Parliament building in the background.

Canada en arrière-plan. Un drone plane au-dessus d'une équipe sur un toit avec des trépieds et de l'équiperment, avec l'édifice du Parlement du Québec.

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Un matelot à bord du NCSM Montréal se tient sur le pont et hisse le drapeau canadien lors de la cérémonie des couleurs au lever du soleil, pendant l'opération RE-ASSURANCE, à Rota, en Espagne.

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pendant l'exercice RAFALE BLANCHE. base des Forces canadiennes Valcartier, dans le secteur d'entraînement de la décollé en transportant un obusier M777, alors que l'hélicoptère CH-147 Chinook léger du Canada se met à couvrir Des membres du 5e Régiment d'artillerie d'imagerie de Valcartier

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Une membre de l'équipage du NCSM Montréal portant un casque d'écoute se tient à l'extérieur en regardant une chaîne de montagnes enneigées et un vaste plan d'eau, pendant le transit vers Bodø, en Norvège.

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La scientifique de la Défense de RDDC Vijin Venu recueille des données et ajuste le capteur quantique au Centre de recherche Ottawa de RDDC.

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Un bateau de sauvetage multirôle navigue sur une eau calme près d'un gros iceberg sous un ciel nuageux. La photo est prise depuis le NCSM Harry Dewolf pendant l'opération NANOOK, dans la baie de Baffin, au Nunavut.

Caporal Brendan Gamache, Services d'imagerie de la formation

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Caporal Antoine Brochu, Camera de combat des FAC

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Bevan Goldswain, Getty Images

Matelot-chef Zach Barr, Camera de combat des FAC

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Soldat Brendan Gamache, Camera de combat des FAC

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RÉFÉRENCES PHOTOGRAPHIQUES