



Defence Research and
Development Canada

Recherche et développement
pour la défense Canada



DRDC: YOUR VALUED PARTNER IN DEFENCE AND SECURITY

ANNUAL REPORT FOR THE YEAR ENDING 31 MARCH 2010

Canada 

TABLE OF CONTENTS

Message from the Chief Executive Officer	1
Overview of Defence R&D Canada.	2
Our Mission	3
Our Vision.	3
Our Values	3
The Structure of the Report.	4
Canada Places First in Defence and Security S&T	6
Supporting Canada's Mission in Afghanistan	12
Strengthening Canadian Sovereignty and Public Security	18
Scientific Advice and Strategic Analysis	24
Technology Development and Evaluation	29
Innovative Solutions and Future Capabilities	37
Internal Operations and Achievements.	43
Moving Forward as an Organization	44
Recognizing Our Achievements.	45
Financial Statement	51
Appendices and Tables	52
Contact Information	64

MESSAGE FROM THE CHIEF EXECUTIVE OFFICER

The 2009-2010 fiscal year was an exciting, challenging, and fruitful year for Defence Research and Development Canada (DRDC) and its partners. Through economic turbulence and an ever-changing Defence Science and Technology (S&T) environment, DRDC was able to rise to the challenges of our day-to-day mandate of ensuring that our Canadian Forces (CF) are the most technologically prepared and operationally relevant forces possible.

During this year in particular, we provided an unprecedented contribution to CF operations in Afghanistan. Furthermore, we successfully enabled the Department of National Defence's (DND) Strategic Review, were integral to preparations for the G8 and G20 summits, and brought years of public security preparation work to its culmination with Canada's hosting of the Winter Olympic and Paralympic Games in Vancouver. All of this was accomplished while we maintained a high-level of engagement with industry.

April 2010 marked the 10th anniversary of our special operating agency. The many accomplishments of the last 10 years, and the achievements outlined in this annual report, are a testament to the innovative spirit and devotion of the civilian and military personnel who work for our organization. DRDC is well positioned to continue building on its reputation as a world class full-service defence S&T provider which delivers essential contributions to DND/CF through all the changes and challenges the future brings.



René LaRose
Acting Chief Executive Officer,
Defence R&D Canada





OVERVIEW OF DEFENCE R&D CANADA

DRDC is Canada's leader in S&T for national defence and public security. With approximately 1800 employees and a budget of over 300 million dollars, the agency has a corporate office and nine research centres across Canada, each with a unique combination of expertise and facilities that enable it to deliver world-class S&T programs. In doing so, DRDC actively collaborates with industry, international allies, academia, other government departments and the national security community to ensure maximum benefit to and from the Global Innovation System.

OUR MISSION

To ensure that the Canadian Forces are technologically prepared and operationally relevant by:

- Providing expert S&T advice to the DND / CF;
- Conducting research, development and analysis to contribute to new and improved defence capabilities;
- Anticipating and advising on future S&T trends, threats and opportunities;
- Engaging industrial, academic and international partners in the generation and commercialization of technology; and
- Providing S&T for external customers to enhance defence S&T capacity.

OUR VISION

To be known worldwide as the best in S&T for defence and security.

OUR VALUES

DRDC's values guide how we accomplish our mission and maintain excellence in science:

- **Commitment:** We demonstrate dedication and pride in working towards our vision.
- **Client Focus:** We bring excellence to clients, both internal and external, by focusing efforts on discovering and meeting their needs.
- **Creativity and Innovation:** We foster a working environment of open innovation and generate innovative solutions, approaches, products and services that improve the status quo.
- **Leadership:** We actively and enthusiastically seek to exert influence and originate action to achieve our goals.
- **Professionalism and Integrity:** We focus our effort on achieving quality results and we behave in an honest, ethical manner, dealing with others respectfully and fairly.
- **Trust and Respect:** We are open, honest and responsible in our relationships and we recognize and value the contributions of others.
- **Teamwork:** We demonstrate effective interpersonal skills, and work cooperatively and productively within and across DRDC to achieve common goals.



THE STRUCTURE OF THE REPORT

The Annual Report presents some of our recent accomplishments to demonstrate ways in which DRDC strives to shape the capabilities of the DND / CF through S&T for defence and public security.

The chapter entitled “Canada Places First in Defence and Security S&T” provides an overview of some of the many contributions that DRDC made to the security preparation and support of the Vancouver 2010 Olympic and Paralympic Games.

“Supporting Canada’s Mission in Afghanistan” has been central to DRDC’s work since the operations began. This chapter features some of the most recent contributions to our soldiers’ activities overseas.

The success stories of “Strengthening Canadian Sovereignty and Public Security” provide a sample of DRDC achievements, through partnerships with other departments and organizations, in support of these important national interests.

The section, “Scientific Expertise and Strategic Analysis”, highlights examples of how the expert advice of DRDC Scientists is becoming increasingly integral to decision-making in the ever more complex defence environment.

“Technology Development and Evaluation” demonstrates how DRDC helps to incorporate the most advanced capabilities into Canadian defence and public security, ensuring that ours are the best prepared and equipped Forces possible.

The chapter, “Providing Innovative Solutions and Future Capabilities,” groups together some of the accomplishments whereby DRDC is earning the reputation for being a valued partner and a world leader in state-of-the-art research and development (R&D).

“Internal Operations and Achievements” showcases best practices in internal operations through the examples of individual employees who have excelled in their work performance, earning recognition from the defence community at home and abroad by their significant contributions to the missions of DRDC.

This report concludes with our “Financial Statement,” detailing our revenues and expenditures for the fiscal year 2009-2010, and the “Appendices and Tables,” which provide additional information about our operations, research centres and programs.



CANADA PLACES FIRST IN DEFENCE AND SECURITY S&T

The federal S&T community's contribution to the security at the Vancouver 2010 Winter Olympic and Paralympic Games was the culmination of more than two years of collaborative work, by over 20 departments and agencies, led by DRDC. Each of the DRDC research centres contributed in one way or another, according to their unique sets of expertise, to its success. This chapter provides an overview of this major undertaking, followed by several individually featured accomplishments in closer detail.

DRDC Support to the Vancouver 2010 Winter Olympic and Paralympic Games: Overview

In February and March 2010 the world set its sights on Vancouver for the 2010 Winter Olympic and Paralympic Games (V2010). While sports fans from countries around the world cheered for their favourite athletes, federal, provincial, municipal and non-governmental security partners were hard at work behind the scenes to ensure safe and secure Games. The federal S&T community's contribution to these efforts was led by DRDC through the Public Security Technical Program's Major Events Coordinated Security Solutions (MECSS) project. MECSS played a discrete but important role in mobilizing federal government efforts, especially those of DRDC centres across Canada, to provide valuable scientific and technical support to security authorities, both before and during the Games.

More than 100 DRDC employees were involved in dozens of V2010-related activities and exercises leading up to the event, working with the Royal Canadian Mounted Police (RCMP), the Province of British Columbia and the CF to ensure that responders had access to the scientific and technical knowledge, equipment and training they needed to enhance the safety and security of the Games. Throughout the Games 30 of these employees were deployed to Vancouver and Whistler to provide direct support to the RCMP.

During the Games, MECSS' reach-back mechanism enabled officials responsible for V2010 security to have timely, coordinated access to experts in the S&T community, whether they resided in the federal departments and agencies, academia or industry through one centralized body. In addition to enabling detailed tracking and monitoring of requests, the mechanism also allowed for the gathering and storing of important data on the nature of the S&T support required for major events, which could later be analyzed and turned into lessons learned.

As Canada's leader in Defence and Security S&T, DRDC had been engaged early with our security partners to share our knowledge and help with public safety and security. DRDC support leading up to and during V2010 took many forms, including on-site expertise and advice, access to knowledge and advice through a centralized reach-back mechanism and analytical and exercise support. This work attracted attention from not only national partners but also from the international security community. It has helped to build on a growing reputation for being a valued partner not only in defence but also in public security S&T. The following accomplishments describe individual achievements in closer detail.



Ergonomic Analysis and Human Science Support

The hosting of the 2010 Winter Olympic and Paralympic Games prompted one of Canada's largest ever domestic security operations. The RCMP led the effort by developing three integrated command centres that supported the Olympic venues. Among the many specialized DRDC contributions to the security environment were the Human Sciences advice, tools and capabilities in the areas of distributed collaboration, ergonomic analysis and layout design as well as expertise in data

collection and analysis in an operational environment. This expertise was used to develop initial command centre layouts for the V2010 Integrated Security Unit (ISU) as well as the CF and Olympic Marine Operations Centres, that were later validated and improved during Exercise Bronze, Silver and Gold.

Marine Security Support

DRDC personnel played a significant role in the marine domain defence for the Olympics. The DRDC Automated Ship Image Acquisition (ASIA) system, which is an Automated Identification System (AIS)-cued high-resolution camera, was deployed at a Canadian Coast Guard facility for broad area surveillance of the Vancouver outer zone during the Games. Other maritime support to the marine security planners and operational staff included a technical trial of a Diver Detection capability, a demonstration of a Long Range Acoustic Device (LRAD), an analysis of the RCMP Maritime Operations Centre and various studies including a waterside security study of the Olympic Village.



DRDC personnel played a significant role in the marine domain defence for the Olympics.

Critical Infrastructure Security Support

In preparation for the V2010 Olympic and Paralympic Games, the V2010 ISU identified several areas of concern related to critical infrastructure for which DRDC was able to provide analytical support. One area concerned the vulnerability of the Olympic venues to explosive blasts, which is a challenging problem given the complex urban topography surrounding several of the venues. DRDC was able to mobilize analytical expertise from the Canadian Explosives Research Lab and industry to provide the RCMP with information on the vulnerability to explosive blasts, which they used to negotiate security zones with municipal authorities. Another area of concern was the dependency of the ISU's security operations on the services provided by critical infrastructure. DRDC conducted a risk-based assessment of these dependencies that allowed the ISU to allocate planning and liaison resources to work with those owners of critical infrastructure, for whom the loss of service would have the greatest effect on security operations, to ensure that adequate precautions were being taken by the owners and to coordinate activities during the Games.

Command and Control Support

Under the MECSS project, DRDC scientists from all centres provided a variety of support services to the V2010 security planners to help develop and test the Command and Control (C2) structures for the Games' security operations. Robust, science-based assessment and analysis methods were applied to the Games' C2 architecture designs that were tested during the full range of V2010 preparatory exercises. In addition, the C2 CONOPS work was leveraged to provide the ISU with its only method for systematically confirming the readiness of the functional components of its C2 architecture.



Exercise Support

During the course of V2010 preparedness activities, MECSS provided support to more than 10 exercises, including Pegasus Guardian 3, the final Command Post exercise for the RCMP-led Integrated Security Unit, and Exercise Gold, the final confirmation exercise for safety, security and Games operations. During these exercises, DRDC provided essential analytical support by embedding experts into the different Command Centres activated during V2010. These experts were responsible for collecting evidence and providing analysis and assessments of Command and Control arrangements, information collection and sharing, inter-agency interactions and relationships, and processes and procedures. The results of these observations were delivered in letter reports to the exercise organizers to support decision-making related to operating procedures and guidelines.



CF members reconnoiter a mountain top as part of a V2010 security exercise.

In addition, DRDC was instrumental in planning, designing and executing two live-play chemical, biological, radiological, nuclear and explosives (CBRNE) exercises, one in Richmond and one in Vancouver, which were integrated into Exercise Gold. The purpose of the CBRNE scenarios was to practice how the response community would react to an incident involving hazardous materials, and how different agencies at the municipal, provincial and federal levels would work together in responding to and recovering from such an event. The scenario in Richmond involved a simulated chemical agent released through a snow machine during a pep rally in support of the men's hockey team. In Vancouver, responders had to simulate a response to an incident involving radiological materials on a passenger train. DRDC's contributions were integral to the success of the V2010 security exercises.

Network Information Operations Cyber Security

In response to a MECSS reach-back request for network and software expertise, Network Information Operations supported a cyber security review of key cyber stakeholders for V2010, providing a summary and recommendations to the ISU and Canadian Cyber Incident Response Centre, and creating a contact chart of key stakeholders for information sharing. As a result of this work, organizations were able to rapidly share information, access cyber expertise across private and public sectors, and respond to events collectively.

Collateral Damage Assessment of Air Incidents

One of the North American Aerospace Defence Command (NORAD) missions is the enforcement and defence of North American aerospace sovereignty. Given the increased security concerns surrounding V2010, NORAD requested amplifying information on the potential for collateral damage due to a NORAD engagement of a hostile commercial aircraft in North America. DRDC's NORAD Operational Research Team helped develop an a priori assessment method to

estimate the potential for collateral damage on the ground based on population densities, debris field modelling and NORAD tactics. The results of the work were used in NORAD command centres to increase situational awareness.

Multi Agent Tactical Sentry used to carry Olympic Torch

As V2010 was fast approaching and the country was patriotically following the Olympic Torch Relay, the community of Medicine Hat, Alberta, gathered on 16 January 2010 to see the flame cross their town. At 6:15 p.m., Sgt Jim Smallbones from IT / Communication Centre at CFB Suffield had the honour to carry the Olympic torch onboard a Multi Agent Tactical Sentry (MATS) vehicle. He was able to ride 1 km at a nominal speed of 10 km / h on the TransCanada Highway while the vehicle was tele-operated from a side street adjacent to the highway by scientists from DRDC's Autonomous Intelligent Systems Section, responsible for the MATS' development.



Sgt Jim Smallbones proudly carrying the Olympic Torch while riding the tele-operated MATS vehicle.

Security Screening in Vancouver

As part of the MECSS project, DRDC personnel participated in the analysis of vehicle and pedestrian screening areas (VSA/PSA) at both indoor and outdoor Olympic venues. The objective of this activity was to ensure an effective security screening process while minimizing delays to arriving athletes, spectators and officials. DRDC provided analysts and team leadership expertise during the planning and implementation of field trials, data analysis and reporting. DRDC also provided a human factors analysis of the VSA/PSA physical and operational environment, resulting in recommendations for maintaining security screener performance and public/screener safety and comfort. Recommendations from both activities were well received by the Physical Security Team and elements were utilized during the 2010 Olympic Games.

DRDC deployed a defence scientist to the operational theatre of V2010 specifically for expertise and leadership in troubleshooting vehicle and pedestrian screening operations. The operational context was essential for translating many modeling, exercise, and analytical results previously produced by DRDC into timely, practical advice tailored to the real-world situation at each venue, allowing observation and the provision of advice to the RCMP-led ISUs on security measures throughout the Vancouver and Whistler areas.



Spectators arriving at BC Place are screened within some of the Olympic Stadium's dozens of Pedestrian Screening Area tents prior to an Opening Ceremony dress rehearsal held on 10 February 2010.

Science Town

The security community no longer needs to lose precious hours or even days to identify suspected CBRN agents in the field. A collection of federally-funded and operated mobile laboratories is now available to provide real-time, on-site CBRN detection and identification of potentially hazardous materials to assist the National CBRNE Response team during security operations for major planned events. These mobile laboratories avoid the need to transport samples, losing critical time for incident management. They also improve the safety and security of response team operations by allowing in depth analysis to be performed on-site, in order to inform responders of what they are dealing with much sooner.

This new capability, which has been coined Science Town, was deployed to both Vancouver and Whistler during the Vancouver 2010 Olympic Games. Science Town in its entirety is comprised of individual mobile chemical, biological, radiological-nuclear and forensics laboratories, respectively, along with specialized equipment and CBRN experts from DRDC, Environment Canada, Public Health Agency of Canada, Health Canada, Natural Resources Canada, RCMP, Canadian Nuclear Safety Commission and DND. In addition to the on-site labs and teams, the Science Town concept provided a reach-back capability by which the CBRNE National Response Team could access remote scientific expertise and support via email, telephone and internet. This concept is the culmination of years of collaboration between the National CBRNE Response Team and the federal S&T community through the CBRNE Research and Technology Initiative (CRTI), which was supported by the MECSS project during its final stages of operational deployment.

The Vancouver Olympics provided an excellent opportunity to validate the concept of Science Town while providing real support to security operations. The creation of Science Town is a great S&T success story and a legacy of the V2010 experience. Its success will have a lasting effect on Canadian defence and security as the capabilities that have been fostered during this historical sporting event will be able to be applied to any future planned major events.



The Mobile Laboratories of Science Town.



SUPPORTING CANADA'S MISSION IN AFGHANISTAN

The war in Afghanistan is currently the main mission for the CF and has been its primary focus over the last several years. DRDC has been and continues to provide S&T expertise resulting in saved lives. Supporting Canada's troops is the fundamental purpose of the agency and is where our work is most valued. The following pages present an overview of some of the contributions that DRDC has made to help the CF achieve their operational objectives overseas.

Support to Operations in Afghanistan: Vehicle and Personnel Protection

Intense operations in Afghanistan and evolving threats have required vehicle improvements to increase occupant survivability. DRDC supports DND/CF in the development of protection systems for deployment in theatre. Since 2006, DRDC has performed over 60 tasks in vehicle threat characterization, support for acquisition and protection systems development.

In the past year, the LAV (Light Armoured Vehicle) Operational Retrofit Implementation Task variant of LAV III was deployed in Afghanistan in the fall of 2009. This variant includes many protection systems developed and tested by DRDC in collaboration with other DND organizations and industry partners. Systems include the Exposed Crew Protection Kit, Impact Seating System, Improvised Explosive Device (IED) and Mine Protection Kit, Enhanced Spall Liner, Ballistic Blankets and the Interim Belly Armour Kit.

Vehicle protection support activities are being pursued in terms of experimental testing as well as advice and technical documents for acquisition projects. New vehicle fleet acquisition program activities are increasing as implementation steps are being taken by Medium Support Vehicle System, Tactical Armoured Patrol Vehicle, Close Combat Vehicle, Force Mobility Enhancement, LAV III Upgrade and Logistic Vehicle Modernization Programs. On the experimental side, a study on mine and underbelly IED loadings was performed for several vehicles in active service. The results are used for the selection of testing conditions for the acquisition programs. DRDC participated in the LAV II Belly Armour Kit program by providing the test procedure and scoring criteria, as well as by performing the bid evaluation tests.

These protective systems have already proven to save lives in incidents in Afghanistan.



Closeup of CF Armoured Vehicle Belly Armour Kit.

Operation ATHENA

Operation ATHENA is Canada's participation in the International Security Assistance Force (ISAF) in Afghanistan. Focused on Kandahar Province in southern Afghanistan since fall 2005, Op ATHENA has one over-arching objective: to leave Afghanistan to Afghans, in a country that is better governed, more peaceful and more secure.

This year saw an increasing demand for DRDC support in the theatre of operations. A total of 13 DRDC employees were deployed, including 10 civilians and 3 CF members, from 8 different DRDC Centres.

Since fall 2006 DRDC has maintained a cadre of two Defence Scientists deployed in the Task Force Kandahar (TFK) staff headquarters in direct support of the Joint Task Force Commander. One individual provides operational analysis support and advises the Commander in areas such as campaign assessment, polling survey analysis and Significant Actions trend analysis. The second individual serves as the Commander's Scientific Advisor and provides input on battle damage assessment, participates in field trials and coordinates reach back into DRDC on technical and scientific matters.

During 2009-2010, DRDC deployed three teams of technical and scientific personnel into Afghanistan on short term visits to train CF troops in technical issues, to investigate the impact of blast injuries on our soldiers and provide other operational support.



The first two DRDC Scientific Advisors in Afghanistan.

Red Teaming Technical Advisory Visit

In response to an invitation received by Canadian Expeditionary Force Command (CEFCOM) from the US-led Combined Joint Task Force – 82 (CJTF-82) Decision Support Red Team (DSRT) Operation Enduring Freedom 10 to have a member of the DND/CF join the DSRT for approximately 45 days at Bagram Air Field (BAF), Afghanistan, a DRDC scientist conducted a Technical Advisory Visit (TAV) to Afghanistan beginning 15 February 2010.

The purpose of the TAV, which involved embedding into and serving as a full-member of the Commanding General's special staff, CJTF-82 in Regional Command East, was two-fold:

- (a) to participate in Red Teaming activities and to interview and observe key personnel to solicit insights and guidance while identifying key issues and challenges regarding the Red Teaming and Human Terrain Systems concept integration into Canadian and ISAF training, tactics, and procedures; and
- (b) to help the DSRT gain a 'Coalition Force perspective' and provide assistance in the examination of the problem-space from a holistic, systems-based perspective, and to 'Red Team the Red Team', helping to prevent potential stagnation and guard against complacency in critical thinking.

In working with and interviewing several units and persons occupying key positions, several issues, challenges and benefits were identified. Consequently, a course of action was recommended to CEFCOM, specifically the development of an organic and dynamic Human Domain Analysis (HDA) capability. In essence, the purpose of the HDA would be to assist the Commander and the staff to gain a deeper appreciation and understanding of the socio-cultural and psychological context (i.e. the Human Domain) of the operational environment. The HDA concept is seen primarily as an intelligence preparation of the battle space support capability and one of the key enablers of the full range of influence activities.



Deployed DRDC Scientist in Afghanistan.



Medical Technical Advisory Visit in Afghanistan

Improvised explosive devices and suicide bombers have become the weapons of choice by insurgents around the world. DRDC, together with an extensive network of partners, is aiming to develop an integrated blast injury research program that will utilize expertise in blast physics and models of injury. The program will target brain injury, hemorrhage, and crush injury and promises to deliver operationally relevant medical information with the intent to deepen DND and the Department of Veterans Affairs' understanding for developing diagnostics and medical treatments and to support informed-decision making.

A two-person DRDC TAV was carried out in Afghanistan to support this program for three different reasons. Foremost, to gather first-hand information from medical CF personnel in-theatre to inform both the direction and content of the program as well as ensuring its practical relevance to the CF. Second, to create broader awareness of this research program with both the CF and our allies. Finally, to assist in the development of an ongoing relationship between DRDC and CF medical personnel with operational experience.

The two DRDC staff, over a 12 day period, visited a wide range of medical treatment facilities at Kandahar Airfield, with the last two days spent visiting the Landstuhl Regional Medical Center (LRMC) in Germany. The LRMC is a facility that provides the full spectrum of medical care that is not deployable in theatre.

Interviews were conducted with both medical staff and patients in order to collect information viewed as critical to the blast injury program's definition and direction. The information gathered from both visits will be utilized to further develop the program as well as improve the tactical medical course. The TAV provided critical insight into the operational issues facing the medical community in theatre, and also created an opportunity to begin the exchange of information specifically between the blast injury team members and the medical personnel who deal with blast injured casualties. The information gathered from the TAV will be incorporated into the overall planning of this program, while maintaining contact with CF medical personnel to ensure that the research is relevant to their operational needs.

Robotic Prototype in Afghanistan

DRDC has been involved in the development of Explosive Ordnance Disposal (EOD) robots for the CF for several years. One of these promising projects is the creation of a Miniature Unmanned Ground Vehicle (MUGV) prototype. The project's main focus is to develop remotely operated and relatively inexpensive unmanned vehicles, to allow for potential dangers to be assessed from afar. After receiving extraordinary support, it was decided that the project would continue by developing a more advanced prototype. Initial testing of the robot took place on pre-deployment exercises with the CF. Favourable reception of the prototype encouraged further R&D.

Since IEDs are increasingly being used in warfare, a prototype of this kind has become a priority for assisting the troops. Keeping soldiers away from the threat will reduce the risk of injury and death. Field trials have involved sending a prototype to Afghanistan to assess

the capabilities of the robot and its real usefulness in the field. So far, the comments received have been positive overall. The need for certain improvements has been identified and changes will be made to better reflect the current situation of the troops. Three other vehicles are expected to be sent by the end of 2010. What is special about this prototype is its ability to be modified on-site in real time so as to be able to respond to the specific needs of a given situation. This allows for a more effective reaction to the dangers associated with IEDs in various operational contexts.

Operational Work/Rest Tables

Work, rest and fluid replacement guidelines are necessary to reduce the risk of heat injury for CF members conducting operations in hot environments. New guidelines were necessary to accommodate the new CF coverall, the inclusion of the use of the tactical assault vest worn alone or in combination with the fragmentation vest, an extension of the operating environment to 50°C, and the addition of wind and solar load.

Previous NATO guidelines provided estimates for continuous work times and suggested work and rest schedules for approximately 200 combinations of environmental conditions, metabolic rates and clothing. The new CF guidelines provide information that was not previously available, resulting in over 5200 combinations of operational environments and clothing combinations.

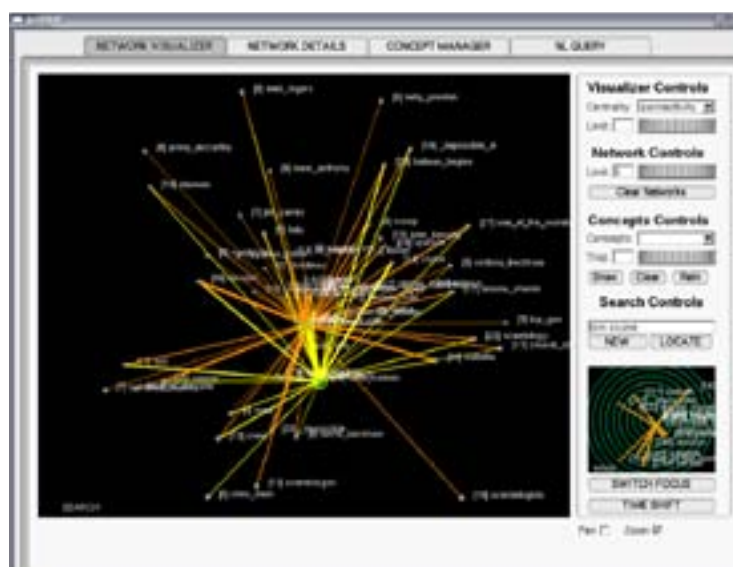
The efforts to formulate new guidelines involved human laboratory testing, thermal manikin testing and the validation of a US Army heat strain model that predicted thermal strain for environmental conditions ranging from 15°C to 50°C. These modeling efforts, software development and coordination of access to CF and NATO allies involved months of commitment from DRDC's research technologists.



The new work/rest tables developed by DRDC will reduce risk of heat injury to soldiers.

GOSSIP in Kandahar

GOSSIP (Graphical Overview of the Social and Semantic Interactions of People) is a tool that extracts the names of people, places and groups from text, allowing the user to see connections among them as well as the nature of those connections. The prototype system was developed and then enhanced to become a fully functional program. Eleven years worth of Afghanistan-based news was then integrated into the system's knowledge base. Four computers equipped with this software were then shipped to Kandahar Air Field in February 2010. Training on how to use the software was delivered at the Petawawa, Montreal, and Wainwright CF bases. DRDC's ongoing role will be to provide reach-back support to the users by sending regular news updates that will be loaded into the knowledge base.



This software will allow the PsyOps analysts to develop a rapid understanding of the human terrain in which they are working. In particular, they will be able to stay abreast of who the important and influential people are in the area, using GOSSIP to track who their associates are, as well as how they are portrayed in the media. Typically, to get such information would require hours to examine the incoming reports or news items. With GOSSIP, some of this can be done in minutes.



STRENGTHENING CANADIAN SOVEREIGNTY AND PUBLIC SECURITY

Ensuring the security and well-being of Canadians is a role to which DRDC is proud to contribute. DRDC's wealth of S&T expertise allows partnerships with various departments and organizations in order to support a wide spectrum of Canada's national and international interests. Helping to define and protect our borders and adapting military capacities to public security uses are increasingly important as the natures of global threats change. The following samples illustrate DRDC's achievements in promoting our Sovereignty and Public Security.

The Official Launch of Project Cornerstone

The United Nations Convention on the Law of the Sea establishes the rights of a coastal State to a 200 nautical mile wide Exclusive Economic Zone (EEZ) as well as a mechanism to define the outer limits of their continental shelf where it extends beyond the EEZ. To define an extended continental shelf, coastal states must submit seismic and bathymetric information on the proposed outer limits to the Commission on the Limits of the Continental Shelf. Canada has committed to the submission of this scientific information in 2013.

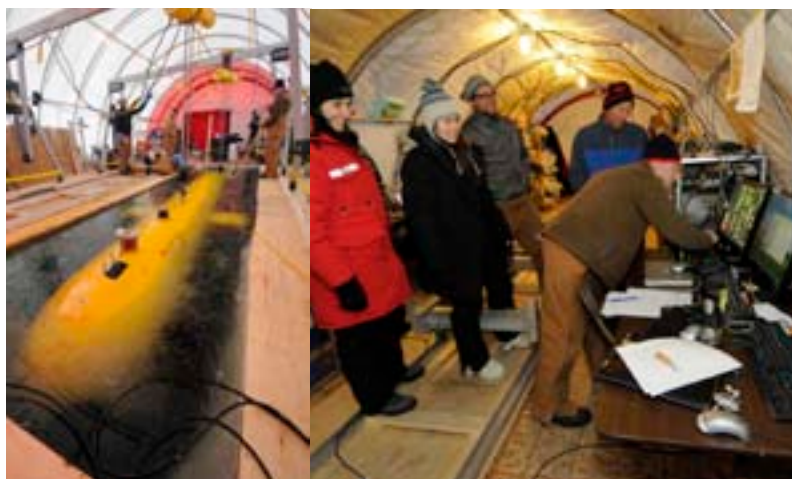
The collection of seismic and bathymetric data in the Arctic takes place under very difficult circumstances. Traditional methods, including icebreaker and helicopter-based spot soundings, have been highly dependant on weather and ice conditions. The use of Autonomous Underwater Vehicles (AUV) had been identified as a more effective and reliable way to collect the requisite bathymetric data.

DRDC has significant experience in the use of AUVs. For that reason, Natural Resources Canada and the Department of Fisheries and Oceans have collaborated with DRDC to assist in Project Cornerstone; the mapping of the continental shelf in the Arctic Ocean using AUVs. The significance of this work lies in that establishing an extended continental shelf would give Canada exclusive rights to the resources on and below the seabed in those areas.

The AUVs were procured in November 2008 and delivered less than one year later. Necessary modifications to past designs included extended endurance, under-ice capture and charging system, long range homing system, short range positioning system, variable ballast system and modified control software. The AUVs underwent engineering trials between November 2009 and February 2010 to test the Arctic modifications and to prepare the AUVs for the first Arctic operation, which was officially launched in March 2010 in the Canadian high Arctic.

The AUV operation was staged out of Resolute, Nunavut, and the field work was based out of two ice camps: a main camp located south of Borden Island and a remote camp, located on mobile ice approximately 300 km North West of Borden Island. At the main camp, the AUV was assembled, tested, launched on a transit mission to the remote camp and recovered from a return transit mission from the remote camp.

At the end of the 2010 Arctic operation the AUV had successfully completed three survey missions, reaching water depths of approximately 3,300 m and covering approximately 1,000 km distance. The operation is believed to have broken new ground for AUV under-ice operations with respect to continuous under-ice operations, underwater battery charging and repeated homing to a moving ice camp. The team is currently planning for the next Arctic operation in 2011, during which the AUVs will be deployed under-ice in the Arctic for a second year of bathymetric data collection.



AUV in the ice hole at the Main Camp, south of Borden Island.
AUV control consoles at the Main Camp.

Great Lakes Surveillance Study

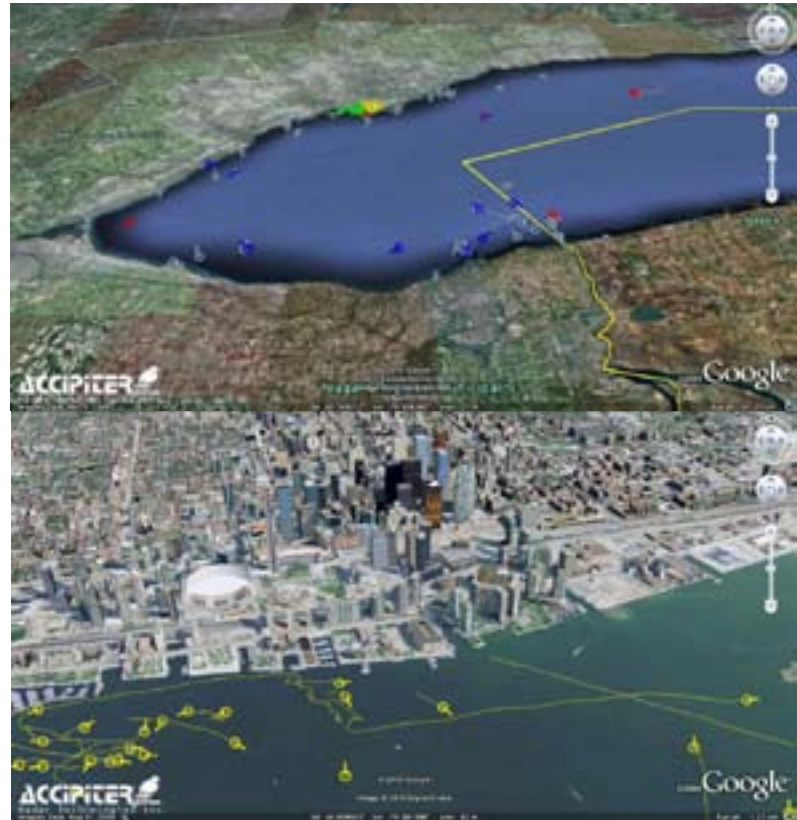
Securing the borders between Canada and the US is a critical security operation for both countries. One of the greatest border challenges involves monitoring the 3700 km Great Lakes/Seaway system which is made up of waterways with a surface area of nearly a quarter of a million km². Innovative S&T solutions are needed to support authorities in addressing this challenge; however, technology alone cannot solve the issue. It is important that S&T experts, like radar engineers, work in collaboration with border enforcement and intelligence practitioners to develop solutions that truly respond to the needs of border authorities.

In 2009, the Public Security Technical Program funded a study which brought experts from the RCMP, along with international and private industry partners together to examine the feasibility and operational effectiveness of radar surveillance networks to support border enforcement and interdiction on the Great Lakes and St. Lawrence River. This was achieved through existing fixed and mobile radar assets, which were used to deploy radar surveillance capabilities in the designated areas.

The intent of the study was to gather data for analysis and development of recommendations, and to see whether this capability would improve and enhance Canada's ability to monitor the Great Lakes and St. Lawrence River. The study reached beyond this original purpose and demonstrated real impact in an operational setting. The system allows for the monitoring of vessel traffic across Lake Ontario and the documentation of points of departure and arrival. This enabled early detection and increased awareness of maritime traffic, as well as enhanced port and harbour security in preparation for the G20 summit.

The data collected throughout the study and the feedback from operational users will be analyzed in order to validate and document the results. For the first time in Canadian history, Canada has had a persistent surveillance capability on part of the Great Lakes

border. Although the current system is in place temporarily as part of the study, authorities have seen how this type of capability can help them to better protect Canada's borders and are looking at how to make it permanent.



Monitoring of vessel traffic across Lake Ontario.
Toronto harbour monitoring of vessel traffic.

Inter-Agency Harbour Security Coordination Project

The Interdepartmental Marine Security Working Group (IMSWG) Inter-agency Harbour Security Coordination Project was created in response to the Government of Canada's commitment to improve marine security in Canada's territorial waters and shore facilities as stated in the National Security Policy. Marine security, and specifically harbour security, has been identified as one of the Government of Canada's top priorities. Harbour security is a complex problem because of the multiplicity of threats and because of the overlaps in jurisdictions within the port environment. Recent multi-stakeholder and multi-level emergency

management exercises have shown that improved coordination and knowledge management are needed among the large number of regulators and stakeholders involved in the port setting.

The focus of the IMSWG project was on mapping inter-departmental processes, information sharing, and assessment of stakeholder interoperability. DRDC and Public Safety Canada (PS) agreed to collaborate in the development and application of S&T to enhance harbour security. In this instance, PS agreed to lead a harbour security exercise called Harbour Siren 09 (HS09). Highlighting the complexity of marine security, HS09 involved over 30 partners from all three levels of government as well as industry. DRDC, in collaboration with PS, used this live exercise to support the data collection required for the IMSWG project.

This project was executed in four distinct phases over three years: scenario development, process mapping, a public security live exercise and recommendations. Performance metrics were produced to assess performance during live exercise and by spring 2010, the final exercise scenario was completed. The results shed light on many aspects of marine safety and security that have the potential to lead to better coordinated multi-jurisdictional decision-making and response to marine security incidents in the Port of Halifax and to other major ports of Canada, improving port safety and security, increasing awareness of national initiatives, and improving linkages between national and regional stakeholders.



CFAV QUEST was used to simulate a container ship with dangerous cargo.



CFAV FIREBIRD acted as a fire response vessel.

Working with Responders to Improve Decontamination Capabilities

When a CBRN agent is released, responders are concerned with reducing casualties, minimizing damage to property and the environment and restoring the area affected as quickly as possible so that normal life can resume. DRDC's CBRNE Research and Technology Initiative (CRTI) and Canadian Police Research Centre (CPRC) have joined forces with industry and the Canadian Association of Fire Chiefs in a project that aims to improve Canada's ability to respond rapidly to incidents involving CBRN hazards.

The project facilitated the accelerated development of a prototype hardware that is mounted on a truck to provide fire services with an extremely versatile, compact and highly maneuverable tool to rapidly decontaminate large areas. Known as the LPODS (Large Portable Decontamination System), this hardware propagates the Canadian Aqueous System for Chemical/Biological Agent Decontamination Surface Decontamination Foam, which was originally developed by DRDC for use by the military and later adapted for civilian applications.

As part of an innovative pilot initiative, LPODS have been delivered to four fire services located in New Westminster, Calgary, Regina and Montreal for on-going testing and evaluation in an operational setting. These partners also contributed to the development of procedures and training packages for using the LPODS and will be providing regular feedback to CPRC on recommended changes to improve these documents, as well as the hardware itself.

This new capability will enable responders to rapidly, safely and effectively render harmless known and unknown agents that could be released as a result of a terrorist attack or an accident. By working so closely with fire services to evaluate how this technology performs in the real-world, DRDC is ensuring that the tools and knowledge developed through this project truly address the needs of responders.



Mobile LPODS System.

LPODS decontamination demonstration.

H1N1 support: Monitoring Public Health across Canada

In 2009, the H1N1 virus swept the globe, affecting almost every nation, including Canada. When the World Health Organization declared a pandemic in June 2009, it was clear that the effective monitoring of the virus' progress would be instrumental to response efforts. For years, CRTI has been fostering the development of S&T solutions to address this type of situation, and a number of these technologies were deployed to assist Canadian authorities in responding to the outbreak.

One of these technologies, the Canadian Network for Public Health Intelligence (CNPHI), was developed in March 2003 through a CRTI project led by the Public Health Agency of Canada. CNPHI was designed as a web-based suite of applications and resources to integrate public health information resources and expertise, and share this information with local, regional and national health officials. This national infectious disease surveillance system is now used by many regional health authorities in Canada, providing a pro-active approach to combating these types of incidents by enabling early detection and response.

Similar to CNPHI, the Advanced Syndromic Surveillance and Emergency Triage tool, which was also developed through CRTI funding, was quickly re-configured to detect Influenza-like illnesses and was deployed during the outbreak to several Ottawa area hospitals. It continues to exchange information on occurrences with Ottawa Public Health.

Although the WHO announced that the H1N1 influenza virus has moved into the post-pandemic period, these systems continue to monitor public health across Canada, looking for patterns or trends that could be indicative of a new outbreak in order to help authorities to initiate a response as soon as possible and help protect the health of Canadians.

Experimental Proving Ground Overview

DRDC's Experimental Proving Ground (EPG) is a national asset responding to the needs of a growing number of public and private sector partners and is one of DRDC's significant contributions to Canada's defence and security innovation system. Occupying 470 km², the EPG plays an important role in defence and security priorities by facilitating multi-faceted work in operational support, force generation, public safety, and national security. The EPG's realty assets of specialized laboratories, trial sites and facilities, coupled with DRDC's expertise in CBRNE and robotics provide a strong basis to support industry and S&T endeavors, as well as leveraging resources through international collaboration.

This past year was another robust year on the EPG. The activities ranged from training of special forces, CF medics, and NATO forces to scientific and trial support to partners such as industry, other government departments, and DRDC centres. A key contribution realized through the EPG this year revolved around critical support to security partners preoccupied with preparing for major events, prosecuting terrorists, and securing structures and borders.

Explosives Expertise Supporting the Conviction of Terrorists

In support of the RCMP and the Ontario Crown Prosecutors Office, DRDC was called upon to provide supporting evidence that led to the conviction of a member of the infamous "Toronto 18" terror cell during the fall of 2009. The RCMP again turned to DRDC for their specific expertise working with home made explosives (HME) and its facilities to stage large scale explosives trials. DRDC explosives experts used their knowledge in this specific threat area to demonstrate the relative ease with which large improvised explosive device could be constructed with readily-available materials. The blast trial, video recording of this process, and blast overpressure data generated from the detonation



Large scale HME explosives trial with cargo container as a point of reference.

of the device, were provided to the RCMP for use in the subsequent prosecution of the alleged terrorists. This blast trial video footage was released to the national media who used it as part of their trial coverage.

Baseline Data for Improved Aviation Security

DRDC's specific HME expertise and unique facilities were put to use to provide Transport Canada with numerous HME bulk samples for evaluation of airport screening equipment detection capability and for the development of HME stimulants for training of airport security staff. This work supports Transport Canada's ongoing efforts, in conjunction with the US Department of Homeland Security and the US Transportation Security Laboratory, to develop better equipment and methodologies for the detection of HME-based aviation threats.



SCIENTIFIC ADVICE AND STRATEGIC ANALYSIS

Canadian civilian and military decision makers are often faced with complex challenges. Sound scientific advice and innovative solutions are becoming ever more integral to inform decision making. To this end, DRDC scientists are recognized as invaluable assets, providing rigorous evidence-based analysis and subject-matter expertise, which is readily integrated into the decision options and solutions for Canadian defence and security. The stories that follow provide a few selected examples of DRDC acting in this information support role.

DSRI Workshop on Environmental Science, Technology and Society

Created in June 2008, as a strategic alliance between the Royal Military College of Canada (RMCC) and DRDC, the Defence and Security Research Institute (DSRI) is the newest of the DRDC centres. Located on the RMCC campus in Kingston, DSRI facilitates collaborative research, technology, and analysis between DRDC and RMCC to better tackle the challenges facing defence and security communities. Globally, DSRI establishes and maintains world-class S&T capabilities that reflect long-term defence and security needs.

With its mandate firmly in place and a full complement of staff, DSRI hosted its first official workshop in January 2010 focusing on the theme “Environmental Science, Technology and Society.” Over 40 participants from a broad cross section of government, academia and industry explored this timely and relevant topic through 27 different presentations, which highlighted innovations and projects in this field from DRDC, RMC Kingston, RMC St-Jean, Queen’s University, Health Canada, National Research Council and DSRI.

The workshop was a success both in terms of kicking off the knowledge generation activities that DSRI is intended to foster and in bringing together leading scientific minds from particular fields of interest.



Conference participants pose for a photo at the RMC Kingston campus.

Managed Readiness Simulator

The DRDC-developed Managed Readiness Simulator (MARS) is a versatile program that allows the user to quickly simulate a wide range of CF readiness scenarios to determine if the resources of an establishment are able to satisfy the requirements of a set of operational tasks. The flexibility of MARS allows diverse activities and events such as attrition, recruitment, deployments, and training to be defined as tasks that can place specific resource demands and can affect the availability of the resources within the establishment. MARS provides a graphical user interface that facilitates the creation and execution of simulation scenarios and the analysis of simulation output. The user can view aggregated simulation results and drill down to view the status of specific tasks and units over time. This provides the user with a powerful tool to anticipate problems that may arise and to identify their causes.

Ultimately, MARS is intended to be used as a decision support tool for senior commanders of the CF. It provides them with forecasts of the impact of proposed changes to lines of operation, the establishment, the readiness plan, CF policy, and other factors that may affect the CF's ability to satisfy operational demands and to maintain the health of the establishment. It has been used to analyze the sustainability of Task Force Afghanistan and the Army's Reorientation Plan. It is currently being used to analyze the proposed amalgamation of four military occupations into one and the Navy's Halifax Class Modernization Project.

E-Learning in the CF

The CF Air Technical Training evaluation has highlighted the need for R&D for effective learning and training tools in response to not only Air Force but all CF environments' training goals and priorities laid out in Defence Strategy 2020.

During the past two years, a stakeholder analysis and a gap analysis have been conducted to collect the CF's requirements for personnel training and available technologies. A literature review has also been performed to investigate relevant intelligent tutoring technologies, including the cognitive learning style-based adaptation, eye-tracking-based adaptation, psychophysiological-based adaptation, and performance-based adaptation techniques. Based on these research findings, a project roadmap has been developed to guide the coming design, implementation, and evaluation of the intelligent tutoring system. A baseline study on the Counter-IED Disposal (CIEDD) operator training course has been conducted in the CF School of Military Engineering at CFB Gagetown, and another study on questioning techniques has also been performed. Currently a CIEDD operator training scenario and the intelligent tutoring system architecture and functional modules are being developed, with the first system prototype expected by the end of 2010 for review and evaluation. The result of this work should be a more customized learning environment using intelligent tutoring technology to increase learning effectiveness and efficiency while reducing costs.

The First Annual Report on Regular Force Attrition

Knowledge about attrition is crucial to CF personnel management. Attrition projections are necessary for accurate planning of recruitment and training of Regular Force (RegF) members as well as for budget preparation. Historical attrition behaviour and knowledge of key factors associated with retention also inform the development of personnel policies and retention strategies. In recent years, attrition has become an increasingly important issue of concern to the CF. With an increasing number of requests for attrition statistics, attrition forecasts and other attrition or retention-related research and analyses, along with the limited resources with which to conduct the research, the need for an authoritative document with frequently required attrition information became evident. It was decided that DRDC would prepare a report, similar to the Annual Report on RegF Personnel, but one that focused exclusively on attrition; a report where attrition data and related information can easily be accessed by all stakeholders.

Prepared on behalf of Chief of Military Personnel, in 2009 DRDC produced the first Annual Report on RegF Attrition. This report provides authoritative analysis of CF attrition for the past 20 years ending in the 2007-2008 Fiscal Year with projections for the future, as well as more detailed information broken down by Career Field & Occupation Authority, career field, and rank, for the past five years. In a few cases, attrition data is also shown for each Military Occupational Structure Identification. Additionally, this report presents summaries of recent research in the area of attrition and retention. It has been reported Department wide and has been very well received as it has provided departmental managers, career managers, human resource administrators and analysts with authoritative information on attrition within the CF RegF. It is a valuable source of information, supporting a variety of human resource planning activities across all levels, including the Annual Military Occupation Review process. This initiative will have a continuing benefit, as it is planned that the report will be updated annually in the years to come.



An intelligent tutoring system architecture is being developed to increase learning effectiveness and efficiency for all CF training environments.

Analytical Support to Strategic Review

Strategic Review (SR) is a Treasury Board Secretariat (TBS) expenditure management requirement to increase alignment of Federal Government departments to the needs of Canada. It requires Departments to conduct a 100% review of their programs every four years and to recommend measures to reduce programs of low relevance to government or low performance while enhancing important programs. For DND this required the identification of approximately \$1B of potential savings and to do so within a tight time frame set by TBS.

DRDC analysts contributed by developing an analytical methodology and supporting software tools that permitted the DND SR team to assess approximately 400 programs against TBS criteria and to present their relevance and performance. This required working as part of the DND SR team and frequent briefings to stakeholders at all levels, including briefings to the Deputy Minister.

The SR effort demonstrated the ability of DRDC scientists to directly support management at the most senior levels. It has strengthened the reputation and visibility of Operations Research and provided a basis for future work to support strategic planning in the department.

Canadian NORAD Region Fighter Basing Study

In 2009, Canadian NORAD Region (CANR) requested a comprehensive study on the subject of fighter basing locations in support of NORAD missions. In response, DRDC developed an innovative, comprehensive approach to evaluating potential basing combinations, which was then codified into three distinct models. The modeling efforts accounted for a wide range of variables such as refueling capabilities, tanker basing, fighter

capabilities, NORAD tactics and procedures, real world flight patterns and activity levels. The output of the models is an operational capability assessment that has been used to inform discussions of investment in new and existing Air Force infrastructure. The model has since been used by NORAD headquarters to evaluate the current capability of NORAD to execute air sovereignty and defence missions, which in turn will support future budget requirements and basing location considerations.

Strengthening the CF Selection Model

The CF selection model has been evolving for the past several years. The most recent selection model, put in place in 2005 by Chief Military Personnel includes three major assessment components: cognitive ability (i.e., academic background and CF Aptitude Test), personality traits, and person/environment fit, with the latter two components being assessed in an interview. In 2006, the Office of the Auditor General reviewed the CF selection process and directed that the interview component of the process be validated. A working group, including DRDC researchers, was formed in 2007, which investigated the interview protocol in use at the time with two key problems being identified. First, questions related to both personality and person/environment fit did not adequately meet the requirements of an assessment tool. They were also found to be unrelated to basic military or occupation-specific training, outcomes that they were purported to predict. Based on these findings, the working group proposed additional changes to the CF Selection Model resulting in additional research requests to complete research on and develop norms for the Trait Self Descriptive Inventory (T-SD), assess personality with a test versus assessment in an interview, revise follow-up personality structured interview questions, and develop a similar tool for assessing person/job fit.

Extending previous research on the T-SD, a measure of personality developed by the US Air Force and used for research purposes across military organizations, DRDC continued to tailor this measure to meet CF requirements and to improve efficiency in administering the test. This research resulted in significantly synthesizing the T-SD and decreasing the time required to administer it, developing and validating a French version, and integrating the test into existing electronic administration media delivered in recruiting centers to test the new measure and to collect additional data necessary for further research. In February 2010 the Armed Forces Council approved a proposal to implement the T-SD into the CF Selection Model. Current research on CF norms will facilitate the full implementation of the T-SD in spring 2011, which will coincide with the implementation of the entire new CF Selection Model.



TECHNOLOGY DEVELOPMENT AND EVALUATION

Through its technological expertise, DRDC helps to ensure that our forces are optimally equipped and prepared for current and future defence priorities and requirements. Where there are technological gaps, DRDC is there to develop and evaluate new capabilities for their incorporation into CF use. The following examples feature DRDC's technological accomplishments.

Evaluation of the HMCS CHICOUTIMI Pressure Hull

Following the introduction of the VICTORIA Class submarines to the Canadian fleet, DRDC and DND's Materiel Group signed a Submarine Scientific Support Service Level Arrangement to provide S&T support. One of the challenges was to adapt and develop technologies to provide improved non-destructive examination of the pressure hull. Like all pressure vessels, shape and shell thickness have a strong influence on strength. As a submarine operates, its pressure hull's circular shape and shell thickness is subjected to various distortions and structural degradation from service loads, corrosion and maintenance operations. Developments in pressure hull inspection technologies are critical to improve the accuracy and efficiency of monitoring hull integrity throughout the operational life of a submarine.

Using a precision laser tracker system, the HMCS CHICOUTIMI's pressure hull was gridded like an archeological site. Hull features were laser-scanned to provide a common map for all the survey measurements. Data was collected using portable hardness measurements, magnetic particle crack detection, X-ray fluorescence chemical analysis and various other technologies. Teams conducted the primary objectives of residual stress measurements with the adapted DRDC Miniature X-ray Diffractometer to delineate weld boundaries, surface topology and hull thickness mapping. Careful choreography was necessary to prevent interferences between the various measurements, equipment, personnel and different hazard control zones in the confined 56 m² area.

This survey has provided an unprecedented comprehensive dataset for pressure hull analysis now and into the future and represents the most comprehensive assessment known of a submarine pressure hull ever conducted in Canada or abroad. Accurate maps are now available on areas with under-design thickness, out of tolerance circularity excursions, all weld boundaries, surface cracks and residual stress. In addition, there is detailed

characterization of the metallurgical parameters over the base metal and each of the welded regions. Using this data, numerical analysis is underway to support the determination of accurate deep dive depth limitations which will help to ensure crew safety and optimize the platform's operational envelope. The data will be used to guide restorative repair planning for this area of the hull as well as new weld repair procedures for all of the VICTORIA Class fleet. The information and capabilities fostered through this project will support life extension analysis for the fleet, optimizing the long-term availability of the asset and return-on-investment for Canadians.



HMCS CHICOUTIMI with the pressure hull survey underway inside the aft enclosure.

Survey characterization activities on the hull survey area on HMCS CHICOUTIMI.

PCL Radar Sensing Evaluation

Passive Coherent Location (PCL) is a radar sensing technology that uses transmitters of opportunity, such as FM radio stations, with one or more receivers, to monitor airspace. PCL came to the attention of the Air Force who requested that DRDC evaluate this technology as a gap filler alternative for domestic surveillance.

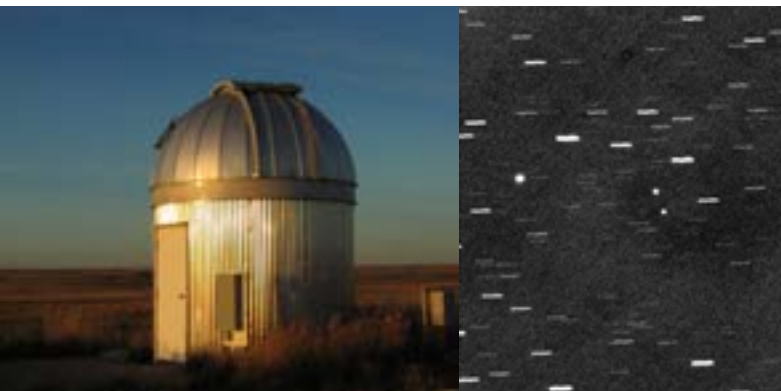
The original scope of the project was performance evaluation for basic domestic surveillance. However, it was recognized that the technology being evaluated had potential applications to a wide range of security and surveillance issues. A broad group of military and government agencies was assembled including the Norwegian Defence Research Institute, RCMP, and the Canadian Air Force.

The evaluation, which took place in 2009, required the tasking and coordination of air and maritime targets, from 3 different organizations. In total, ten cooperative targets, all requiring truthing and flight planning, were deployed as part of the PCL radar evaluation. Flight and scenario planning took into account the operational requirements of the stakeholders including such diverse applications as domestic hijacking, low altitude drug smuggling and cross-border speedboat monitoring. These efforts gave the DRDC team members considerable insights into military and police surveillance problems. This multi-year effort has produced considerable and highly positive visibility of DRDC to a broad range of government groups and external parties and has highlighted DRDC's radar expertise both internal and external to DND.

GBO Space Surveillance System Trial Period with US Space Surveillance Network

The DRDC designed and built Ground Based Optical (GBO) Space Surveillance system recently entered into a trial period with the US Space Surveillance Network, a major milestone toward accreditation of the system and the positioning of Canada as a strong contributor to NORAD's mission to maintain space assurance. Designed to act as risk reduction to the upcoming Sapphire project, an orbiting space surveillance sensor, the GBO consists of two robotic telescopes designed to track earth orbiting objects in deep space. The robotic telescopes, which can detect space debris as small as 2 meters, 40,000 km into space, are located at DRDC Suffield and DRDC Valcartier and are controlled from the Processing and Scheduling facility at DRDC Ottawa. The system's goal is to become a contributing sensor to the US Space Surveillance network and allow CF operators, located at CFB North Bay, to gain operational experience in space surveillance ahead of the launch of Sapphire.

DRDC's Space Systems Group, sponsored by the Surveillance of Space project office, is the systems integrator for the GBO. The Space Systems group is also involved with the Canadian Space Agency in the Near Earth Orbit Surveillance Satellite (NEOSSat) microsatellite project where the High Earth Orbit Space surveillance Technology Demonstration Project (TDP) will use NEOSSat to perform R&D around the detection and tracking of Earth orbiting objects including artificial satellites and near-Earth orbit asteroids in support of DND's goals. The technologies developed include automated scheduling and operations, an efficient image processing approach to detect objects, and automatic association of the detection with the most likely satellite, all with an eye to increasing the effectiveness and efficiency of future CF sensor systems.



A GBO sensor waits for sunset at DRDC Suffield.

GBO image of Galaxy 11, DBS-3 and Canada's NImiq-1 (closest to center). Stars are streaked in the background while the telescope tracks the satellites (which appear as points).

LRAD Evaluation

The Long Range Acoustic Device (LRAD) is a long-range, directed acoustic device designed both to communicate acoustically, using live or recorded voice messages, or to attract attention, by producing a modulated tone. DRDC purchased two LRAD systems in August 2008 under the auspices of the Maritime Force Protection TDP and performed baseline operational testing in collaboration with the CF Maritime Warfare Centre (CFMWC) in October 2008, concluding that the system was an effective communication and warning device for maritime operations. The systems were deployed on HMCS Winnipeg for operational evaluation from March through June 2009.

In August 2009 DRDC and CFMWC were tasked by the Commander of Joint Task Force Atlantic to conduct testing of the LRAD as part of a larger process to determine whether or not it should be considered a weapon system for its intended use in maritime operations. This evaluation consisted in the requisite scientific analysis so as to be conclusive in the LRAD's potential to cause superfluous injury or unnecessary suffering. This was required before the system could be fielded in operations.

The conclusion of the legal review of the study was that it would be lawful to use LRAD for its intended and expected use as a communications and warning device when employed in strict accordance with the

appropriate operational and tactical instructions.

Following the completion of the legal review, the LRAD systems were deployed on HMCS Fredericton for counter piracy operations. This was a successful example of contributing DND and CF partners navigating through a complex process to facilitate the introduction of new technology into naval operations.



The team reviews data during testing at CFB Shearwater. LRAD deployed at sea.

Deployment of the GeOLAP and GeoMIS Applications

DRDC has been highly involved over the last four years in modernizing the Mapping and Charting Establishment (MCE) geospatial infrastructure. The MCE has the responsibility to provide timely and accurate geospatial information and geomatics support to the DND/CF and other government departments in accordance with Canada's national objectives. It has several data centres, each having the responsibility to deliver either nautical charts to the Canadian naval fleet, flight maps to the aeronautical fleet or topographic maps and imagery to soldiers on the ground. Together, these maps represent more than three quarters of a million documents which previously existed in silos with heterogeneous description formats, thus complicating the task to find and assemble data for a given mission in a timely fashion. To overcome this problem, MCE has been putting together the Gateway Services (GWS), aimed at modernizing and centralizing the geospatial data management and dissemination functions.

DRDC, jointly with MCE, has designed and developed two key components of GWS, namely Geospatial Online Analytical Processing (GeOLAP) and Geospatial Metadata and Inventory System (GeoMIS). GeOLAP provides a web-based infrastructure to facilitate the online discovery, ordering and exploitation of geospatial data. GeoMIS aims at managing centrally, through the use of metadata standards, the distributed inventories of geospatial products within MCE while providing advanced ordering and client management functionalities. These applications have greatly simplified the management of such large geospatial inventories and have reduced from days to hours and minutes the time required to assemble and to prepare geospatial data in support to CF missions. These two components of the GWS are now fully deployed and in operation on DND's intranet.



GeOLAP is a tool that offers simple answers to complex questions.

Binaural CEP – HGU-56P Helmet

Aircrews are continuously exposed to the dangers of working in the high noise environment inherent to rotary wing operations. This poses difficulties in communication as well as potential hearing damage. In response to this problem, DRDC was approached by DND's Materiel Group to incorporate binaural CEP (Communications & Ear Protection) into the current helmets used by the CH-124 Sea King community. From the outset, the objective was to modify the existing helmet to include the binaural CEP interface. The modifications were to be embodied with little or no alteration to the shell of the helmet; no effect to the ease of donning and doffing of the helmet; and no negative effect to the comfort of the wearer.

By February, 2010, 11 Prototype HGU-56P helmets and one SPH-5CF were modified. Ten of the HGU-56P prototypes were shipped to the Helicopter Operational Technical Evaluation Facility in Shearwater for test and evaluation. The addition of CEP to the CH-124 aircrew helmet should improve the operational effectiveness of the aircrew, as well as improve hearing protection.



The new communications and ear protection device will improve hearing protection and operational effectiveness of aircrew.

TRIMIX Decompression Table Validation

The Canadian Underwater Mine-countermeasure Apparatus (CUMA), commercially known as SIVA+, is a re-circulating semi-closed breathing apparatus that provides a breathing mixture with a nominal constant partial pressure of oxygen using a helium-oxygen mix (Heliox). For many years the scientific and technical recreational diving community has used Trimix, which

uses a nitrogen and helium mixture to dilute the oxygen vice helium only, in large part to reduce the high cost of helium. An additional benefit of Trimix is that it requires less decompression time than Heliox and hence longer working bottom times can be realized. While there is significant anecdotal data, there has been no scientific validation of any Trimix decompression schedules used.

DRDC began a scientific approach to testing and validating Trimix in 2008. The testing to date has involved 45 volunteer military divers from 6 different countries, which highlights the wide interest in the potential operational safety and cost benefits that these tables will provide. In the initial stages a few minor cases of decompression sickness were experienced resulting in some modifications to the algorithm. Throughout the remainder of the trials, 304 man-dives have been completed without further incident. The resulting schedules for in-water oxygen decompression will be completed by fall 2010 with plans to conduct two additional phases for repetitive diving and no-decompression tables to be completed by fall 2014. This project will produce validated Trimix tables for CF general and operational use, which will increase the tempo of mine counter-measures diving while providing additional safety and reducing overall costs for the Navy and CF.



Divers in DRDC's Diving Research Facility have undergone dive testing to scientifically validate the Trimix breathing gas, which will improve efficiency, safety and will reduce costs.

CABA Trials and Development

CF divers are required to dive in some of the most diverse conditions imaginable. From extremes within Canada, to deployed operations, the needs of the diving community are continually expanding and transforming. DRDC and the Canadian Forces Environmental Medicine Establishment (CFEME) contribute to the efficiency and safety within the CF diving community. Over the past year, DRDC and CFEME have conducted trials and development on the Compressed Air Breathing Apparatus (CABA) configuration, resulting in new first and second stage regulators, dry suits, power inflators and the inclusion of ambient air breathing valves into full face masks.

Taking place at DRDC's Diving Research Facility, as well as various other labs within the establishment, equipment trials were conducted to ensure compliance with existing standards. Field trials were then conducted to ensure that the actual needs of the client diving groups were met. During the field trials, divers and bioscience officers conducted tests in a variety of areas and conditions to ensure that all items met the needs and requirements of the various CF diving elements. All components are now fully integrated into operational dive teams on both the East and West coasts, which include operational Search and Rescue Technician groups, Combat Engineer, Special Forces and Reserve dive teams from across the country. Furthermore, advice requested from Director of Diving Safety has led to recommendations on Standard Operating Procedures for CABA systems and the reconfiguration of Light Weight Surface Supplied Diving System emergency breathing backup systems.



Diving trials across Canada ensured that the Compressed Air Breathing Apparatus complied with existing standards and met CF divers' needs.

Stand Up and Expansion of DRDC Geographic Information Systems Capacity

Most human information has a geographic component. This geographic aspect of the CF personnel environment is very important due to the diverse nature of the regions that make up Canada. Given the vast amount of geographic information available on CF personnel, DRDC established a Geographic Information Systems (GIS) capability to exploit this information to inform human resources decisions.

Initially, establishing a GIS capability required a complete program design and development, as there was nothing to build upon. Key experts representing the various aspects of a complete GIS operation were consulted to provide expert advice and guidance in developing this capability. Partnering within and outside of DND, DRDC was able to stand up a functioning GIS capability in less than 1 year from concept to operation. The stand up of this capability required acquiring a secure location from which to operate, purchasing specialized computers, networks, data storage, GIS software, baseline data, topical data, partnering with external agencies and developing a client base.

The stand up of this capability positions DND/CF as world leaders in the analysis and use of information for military personnel strategy, mandate and operations. Impacts include identifying the area of influence of CF bases on recruiting, demographic attributes of relevance to the DND/CF across Canada, ways to streamline personnel databases, and much more. The outcome of this capability is timely and efficient analysis of personnel information to support strategic decision-making in direct support of the CF military personnel mandate.

Maritime Helicopter Project Sea Trials

As part of the Maritime Helicopter Project (MHP), namely, the acquisition project for obtaining new CH-148 Cyclone maritime helicopters for the CF, DRDC was asked to assist in the facilitation of the test and evaluation phase. This entailed the performance of two series of sea trials: the Dead Load Test Vehicle (DLTV) trials and the Ship Helicopter Operating Limits (SHOL) trials.

The DLTV trials were performed from 2008-2009 to assess on-deck handling characteristics of the new CH-148 Cyclone helicopter, which proved to be very different from the CH-124 Sea King. The DLTV trials established operational and training procedures for handling the CH-148 Cyclone on the flight decks of CF Halifax Class frigates. These trials were performed using a mechanical surrogate in place of a real Cyclone helicopter. This DLTV surrogate was an open framework with correct mass and mass distribution properties to represent the CH-148 Cyclone, as well as having correct geometry, landing gear, and other important features.

The SHOL sea trials, which began in early 2010, are required to determine the operating envelope for CH-148 Cyclone helicopters operating from CF Halifax Class frigates. The operating envelope is determined by qualified test pilots and flight test engineers who take off, land, and perform a variety of airborne and on-deck activities at different “relative wind” conditions, and in

various sea states, from calm to quite rough. This information also enables comparison of the CH-148 Cyclone’s actual capabilities with performance requirements specified in the acquisition contract.

Ship borne maritime helicopters are only permitted to fly in conditions of relative wind and ship motions that have been tested and declared to be within the cleared operational envelope. This work will contribute toward establishing the SHOL and operational envelopes for CH-148 Cyclone helicopters operating from CF Halifax Class frigates, which will be the foundation for CF naval helicopter activities for decades to come.



DLTV sea trial.

CH-148 Cyclone tests in Halifax.

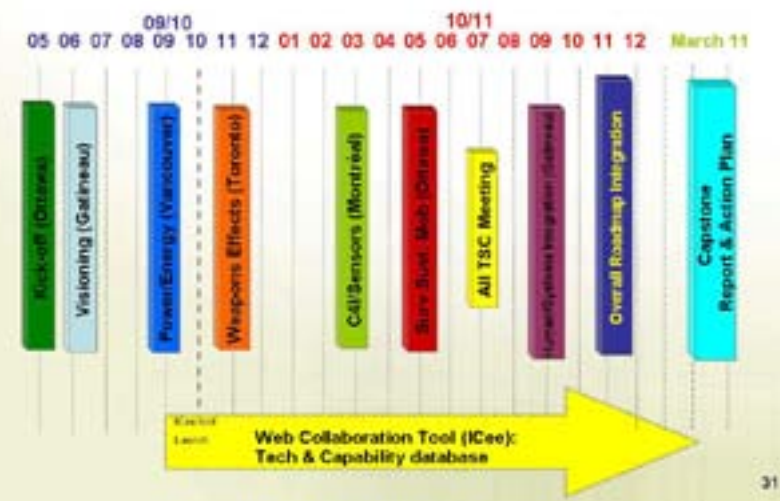


INNOVATIVE SOLUTIONS AND FUTURE CAPABILITIES

Innovation is everywhere, with multiple players each with partial solutions. By connecting defence and security needs to industry capabilities, DRDC provides maximum S&T value-for-money to DND/CF while positioning Canadian industry for success. As a leader in S&T innovation, DRDC is a valued partner and contributor to the global innovation system. This section demonstrates some of the most important innovations in which DRDC was a major contributor.



Development Phase Activities



Roadmapping process: Engaging industry and academia to brainstorming on technology options to address future soldier systems capability requirements.

SSTRM development phase activities: workshops and ICee tool.

SSTRM and the Launch of the ICee Tool

The Soldier Systems Technology Roadmap (SSTRM) project is a pilot interdepartmental initiative between the DND/CF and Industry Canada that engages industry, academia and government in the joint development of a comprehensive technology roadmap that supports the CF soldier modernization effort. The stakeholders in this innovative project are: DND, Industry Canada, Public Works and Government Services Canada, the

Canadian Association of Defence and Security Industries (CADSI), and Technopôle Defence and Security (TDS), industry (large and small companies), academia and research organizations.

The SSTRM development kick-off took place in Ottawa in May 2009, and has been followed by several technical workshops throughout Canada, addressing each of the soldier capability areas. Participation has far exceeded initial expectations for each of the two or three-day workshops attracting an average of 230 representatives from national and international organizations. At the facilitated workshops, participants were engaged to explore future soldier systems capability needs, identify capability deficiencies and brainstorm on related technology options to solve these. All the findings from the workshops are captured in reports.

In addition to the workshops, another project enabler is the Innovation, Collaboration and Exchange Environment (ICee) tool which was launched in October 2009. The SSTRM project team has leveraged the power of this innovative wiki-type knowledge base to enable and enhance online collaboration. This first Government of Canada public-facing wiki is positioned as a Technology Knowledge database, in which over 450 registered users both internal and external to Government of Canada share knowledge and discuss topics relevant to soldier systems. The ICee knowledge base is expanding both in terms of users, and in terms of content, which includes future capability requirements, potential solutions, technologies and R&D projects.

The SSTRM development will be completed in March 2011 and will deliver a capstone report/action plan containing the overall Soldier Systems roadmap. The capstone report will also feature a roadmap for each soldier capability area which will present structured and prioritized information on future capabilities, capability gaps, enabling technologies, S&T focus areas and related R&D efforts.

A follow-up project planned for 2011 is under definition to implement and exploit the SSTRM capstone report and action plan. The intent will be to foster the innovation system to develop unique and required capabilities for the soldier.

Maritime Automated Information System Radar Fusion

Ships of a certain class are required by international laws to carry Automatic Identification System (AIS) transponders that broadcast their identity, location and heading. AIS signals are broadcast from the world's major marine vessels for navigation and identification purposes, but currently they are only collected by other ships and land-based receivers within a 50 nautical mile range. The system was originally conceived as a collision avoidance system and was never intended for space applications.

Private industry specialists have demonstrated the effective collection of these signals from space using patented Nanosatellite Tracking of Ships (NTS) AIS technology, which exceeds the performance of any other known system. Recognizing the potential impact of this capability, DND has partnered with private industry to enable an unprecedented global view of the world's shipping traffic. DND interest in AIS has led to a number of innovative investigations with links to the Maritime Monitoring and Messaging Satellite (M3MSat) TDP and Applied Research program (ARP). Additional leverage via an international agreement with Norway, as well as the Canadian Space Agency's (CSA) AIS Constellation Mission, has been applied to maximize the benefits to DND partners. The current partnership is to fuse this existing technology with the additional capabilities of the DRDC/CSA jointly funded and managed M3MSat mission. In particular it will allow enhanced data collection and handling capabilities as well as allow the fusion of NTS data with Synthetic Aperture Radar imagery. Demonstrating these enhanced capabilities on M3MSat will be the next logical step to providing global AIS data services.

Combat Fluid Resuscitation Interoperable Capability TDP

Severe bleeding and traumatic brain injury (TBI) are leading causes of preventable death in both civilian and military trauma settings. The standard of care for resuscitation includes infusion of large volumes of dilute isotonic salt solutions to replace blood loss, typically using normal saline (0.9% sodium chloride) in quantities 2-3 times the estimated blood loss. While such aggressive resuscitation is effective in restoring blood pressure and initially life-saving, it frequently results in an overload of fluids in the body tissues causing edema and a wide spectrum of adverse complications which can worsen long-term patient outcome.

The primary objective of the Combat Fluid Resuscitation Interoperable Capability (CFRIC) Technology Demonstration Project was to validate the clinical effectiveness of small-volume hypertonic fluids for the initial pre-hospital resuscitation of patients suffering from severe traumatic injury in a large multi-centre randomized controlled trial.

Recognizing the enormous potential benefit of this life-saving measure, DRDC, in association with the US Army Medical Research & Materiel Command, assumed a leading role within TTCP to coordinate the pursuit of a possibly better resuscitation fluid for battlefield care. This helped facilitate the formation of the Resuscitation Outcomes Consortium (ROC), which is a massive \$50M collaborative network of 10 Regional Clinical Centers throughout North America (8 US, 2 Cdn).

The ROC clinical trial was designed to determine if hypertonic saline resuscitation is superior to normal saline in terms of patient survival after hemorrhagic shock and also neurological outcome after TBI. Blood samples were also collected from patients for the analysis of selected injury biomarkers to monitor the post-traumatic inflammatory response. During this 3-year period (May 2006 – May 2009), the trial enrolled more than 2,000 patients (853 shock and 1,331 TBI) making

it the largest randomized controlled trial ever to evaluate hypertonic saline for resuscitation of traumatic injury. The trial demonstrated that there is no clinically significant difference in resuscitating patients with either normal or hypertonic saline. However, from a military operational medical care perspective, the less than 10% hypertonic fluid volume required to generate the same clinical outcome confers a substantial logistical advantage in the field.

As a key partner in the ROC, DRDC demonstrated its capacity to act as an open innovator, knowledge integrator and integral advisor by successfully partnering with major international S&T organizations in addressing CF Health Services (CFHS) operational requirements for casualty care. Led by the CF Health Services Regulatory Affairs group, DND and the US Department of Defense are working cooperatively to seek regulatory approval of hypertonic saline for military use from Health Canada and the US Food and Drug Administration. Validation and adoption of hypertonic resuscitation in the practice of military operational medicine could result in improved field logistics and enhanced medical operational capabilities in austere combat environments.



DRDC's trials of hypertonic saline solution will lead to improved field logistics and enhanced operational capabilities in dealing with battlefield injuries.

Delivery of the CATSI EDM to D CBRN D

The end of the 2010 fiscal year marked an important event for DRDC and for Canadian defence and security capability as DRDC delivered two Compact Atmospheric Sounding Interferometer (CATSI) Engineering Development Model (EDM) chemical standoff detectors to the CF Development's Director CBRN Defence (D CBRN D). This important event is the result of more than 15 years of research by DRDC's team of experts from the Spectral and Geospatial Exploitation Section.

CATSI EDM is a sensing system developed specifically for the CF for the passive standoff detection of gaseous Chemical Warfare Agents (CWA) and Toxic Industrial Chemicals (TIC). Two prototypes were built. One system will be employed by the CF for operational use. The second system will remain within DRDC to complete further tests and to extend its detection and identification capabilities to additional products.

Work began on the CATSI EDM technology in 1995. In the early 2000s a laboratory prototype CATSI was developed, which demonstrated detection at 5.7 km.



In 2003, based on this great potential, Director Combat Support Equipment Management (DCSEM) and D CBRN D decided to allocate funds for the development of an EDM. DRDC awarded a contract to industry specialists in March 2005 for the hardware and software development, while DRDC retained responsibilities for the algorithm development and performance testing. Close collaboration between DRDC, private industry and CF have resulted in a state-of-the-art prototype which satisfies the technical specifications of the CF. Performance tests conducted on the CATSI EDM have demonstrated outstanding performances that exceed the detection and identification

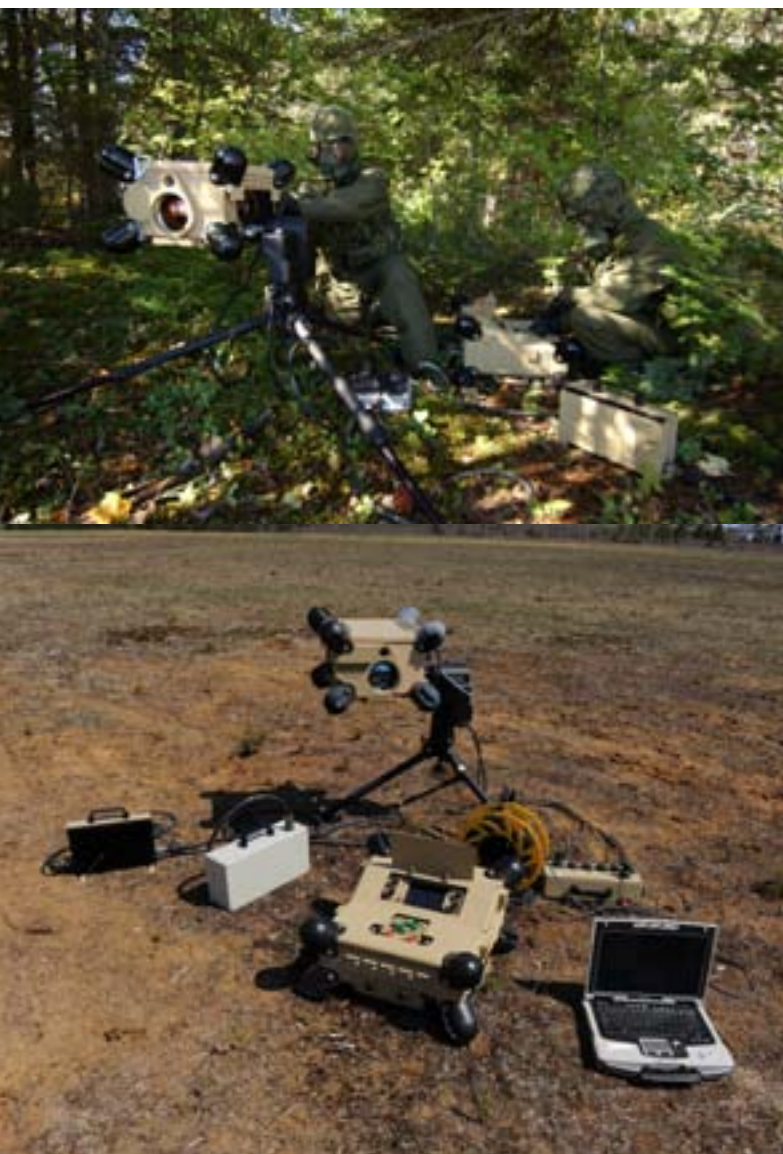
requirement of 80% with a confidence level of 95% at up to 5 km distances. In 2010, CATSI EDM was also effectively deployed in support of V2010.

While there have been a number of effective technologies and methodologies for close proximity screening of CWA and TIC, among other dangerous substances, the problem of detecting these substances at significant standoff distances remains one of the most difficult and most important challenges confronting defence and security specialists. This latest capability is a huge leap forward in addressing this challenge.

Deployment of SR-BioSpectra during V2010

The SR-BioSpectra is the latest biological detector developed by DRDC and its partners. This detector is a short-range (SR) compact light detection and ranging device (LIDAR) that enables the detection of bio-threats in aerosol form over critical indoor, semi-enclosed and outdoor venues like stadiums, subways and airports. The SR-BioSpectra is the result of over a decade of R&D on an innovative bioaerosol sensor prototype known as SINBAHD (Standoff Integrated Bioaerosol Active Hyperspectral Detection). SINBAHD is still used today by DRDC to develop capabilities for detecting, classifying and tracking biological agents.

Similar to radar technology, LIDAR is an optical remote sensing technology that measures properties of scattered light to find range and other information of a distant target. This latest capability was developed to fill security gaps resulting from other capabilities that were produced for military uses with very different requirements than civilian first responders and security agencies. Designed to be part of a network of sensors, the SR-BioSpectra is tailored to the needs of the first responders, which include short range over long range detection, small size, lower cost, easy to use with a low false alarm rate. It requires no cost per test, contrary to mobile lab requiring consumables, with an effective



CF military reservists performing tests on CATSI EDM.
Optical head and modular components of CATSI EDM.

range of 100 m over 360°. Of all the trigger detectors, SR-BioSpectra is the only one that can cover a large area with a single unit. This capability will enable rapid detection of a bioaerosol release and allow for timely implementation of measures to protect occupants and minimize the extent of contamination.

It was deployed in a backup role during the Vancouver 2010 Olympics. While SR-BioSpectra was not officially part of the security force contract effort through Public Health Agency Canada (PHAC) at the Winter Olympics, successful beta-testing of the detector in numerous climatic conditions took place during the Games. Unofficial responses obtained from security force personnel during the Olympic deployment and feedback from the first responders associated with this TDP were favourable. As a result, DRDC and its partners are investigating ways to further the development and exploitation of SR-BioSpectra for enhanced force protection.



The SR-BioSpectra is the latest biological detector developed by DRDC and its partners.



INTERNAL OPERATIONS AND ACHIEVEMENTS

DRDC's success arises from a combination of several factors working together, including the quality and relevance of our research, the excellence of our operations, the skills of our workforce and the effectiveness of our work environment. These factors create a strong foundation on which to build and strengthen our capacity. We celebrate our success by recognizing and rewarding our achievements.

MOVING FORWARD AS AN ORGANIZATION

DRDC Level 1 and Level 2 Business Continuity Plans.

In accordance with the Policy on Government Security, all departments are required to develop and maintain business continuity plans (BCPs) to provide for the continued availability of services and associated assets that are critical to the health, safety, security or economic well-being of Canadians and the effective functioning of government in crisis. As a result, an Agency Level 1 BCP and, subsequently, Level 2 BCPs were created for all DRDC centres to ensure that DRDC has the strategies, processes and procedures in place to respond and deal with emergency situations and to ensure that critical services are maintained during them. DRDC is proactively positioned to respond to emergency situations and to maintain critical services in order to provide S&T advice to DND/CF, other government departments and partners.

Strategic Communications Plan

Senior management recently approved a three year Strategic Communications Plan for the Agency. It provides DRDC with a framework to foster public understanding and awareness of the Agency, DND and the CF. The overarching goal of this communications plan is to support DRDC in achieving its vision to be known worldwide as the best in S&T for defence and security. This Plan will guide DRDC leadership and employees to engage in effective and coherent communication with a focus on the following three key objectives:

- i) to raise awareness of DRDC as an organization positioned to act upon current and future defence and security S&T needs in the context of its core roles; (Integral Advisor, Risk Mitigator, Knowledge Integrator and Open Innovator);

- ii) to promote the impact of S&T on Canada's defence, security and the economy, within the broader whole of government agenda; and
- iii) to create a culture of communications excellence.

Creation of the CSM Corporate Office

As part of the EXPEDITION 09 corporate renewal exercise, the Corporate Services Manager Corporate Office was created to provide operational capacity in the Corporate Office to support the ADM Office, Chief of Staff, Director General S&T Operations, and Director General R&D Corporate Services in the areas of human resource, information management, information technology, finance, administration (accommodation, security, records management, etc.), and procurement, thereby allowing greater strategic functional direction. The outcome is that there is increased capacity to provide a greater focus on strategic issues in these areas to the Agency.

Infrastructure Renewal Program

A major milestone toward the implementation of the DRDC Infrastructure renewal program was passed on 8 December 2009 when the Minister of National Defence, on behalf of the government, gave approval in principle to a \$163 million project for the renewal of the infrastructure at DRDC Valcartier. While doing so, he also provided authority for the expenditure of \$13 million for design and consulting services to prepare for the implementation of the project.

RECOGNIZING OUR ACHIEVEMENTS

Recognizing the achievements and successes of employees is an integral part of DRDC's organizational culture. We are committed to recognizing employees for the excellence of their work and will continue to demonstrate our appreciation of them. Exemplary qualities such as initiative, integrity, leadership, teamwork, dedication and perseverance are vital to our continuing success, and we proudly acknowledge these attributes when they are displayed by our personnel.

TTCP Awards

The Technical Cooperation Program (TTCP) is the most important defence collaboration program in which Canada participates. Each year, TTCP recognizes individuals who have made significant contributions to cooperative research activities as well as to enhancing the technological strength of military forces.

Bruce Liao, Andrew Mudry, Michelle Wang (DRDC Ottawa) and **Robin Addison** (Communications Research Centre) were awarded the TTCP Team Achievement Award for excellence in the category Command, Control, Communications and Intelligence/Early Warning Systems.

Les Nagata (DRDC Suffield) received the TTCP Team Achievement Award for CBD TP4 for his contributions to the project "Generation of Lead Vaccine Candidates Against Aerosolized Biological Warfare Agents."

Dennis Nandlall (DRDC Valcartier) was awarded the TTCP Team Achievement Award for Land Action Group 2 for the "Integrated IED Protection."

Francine Desharnais, Vance Crowe and Anna Crawford (DRDC Atlantic) were awarded the TTCP Team Achievement Award MAR AG-9 for their work on "Underwater Force Protection: Underwater Harbour Security Trial."

David Frost (McGill University), **Stephen Murray** (DRDC Suffield, ret'd), **Robert Ripley** (Martec Ltd.), **Akio Yoshinaka** and **Fan Zhang** (DRDC Suffield) were awarded the TTCP Team Achievement Award WPN KTA 4-35-06 for their work on "Fundamentals and Performance Assessment of Enhanced Blast Explosives."

NATO Awards

David DiFilippo, Greg Barrie (DRDC Ottawa), **Maj Linda Bossi** (ret'd), **LCol Mike Bodner, Maj Bruce Gilchrist, CWO Roger Cuffe** (ret'd), **David Compton** (Colt Canada), **Gary Crocker** (Colt Canada), **Maj Stephen Boyne** (ret'd), **Ed Andrukaitis** (DRDC Atlantic), **David Tack** (Humansystems Inc.), and **Harry Angel** (Humansystems Inc.) were awarded the NATO Team RTO Scientific Award.

Robert Dickson (DRDC CORA) was awarded the Non-Article 5 NATO Medal for ISAF for the time that he worked as an Operational Analyst with ISAF HQ in Kabul.

International and National Awards

Pang Shek (DRDC Toronto) was the recipient of the 2010 Undergraduate Teaching Award, Department of Laboratory Medicine and Pathobiology, Faculty of Medicine, University of Toronto for sustained excellence as an educator in teaching Immunopathology and other courses. The selection was based on input from student evaluations and peer recognition.

Gerry Rude, Julian Lee (DRDC Suffield), **Mark Riley** and **Malcolm Smith** (DRDC Atlantic) received an award for their work on the Canada-Netherlands-Sweden MOU on Cooperative S&T.

Denton Froese, Douglas Pierce, Huaizhi Liu, James Hancock, Jasmina Rakic, Michael Lukacs, Pierre Lecavalier, Sara Bohnert, Stephaine Huelin, Angela Saunders, Carmela Jackson Lepage and Claude Chenier (DRDC Suffield) were recognized by RCMP Assistant Commissioner Doug Lang “for their dedication and expertise provided to the Vancouver 2010 Winter Olympics Integrated Security Unit and for their good work providing scientific expertise to the CBRNE response capability.”

Helen Tang (DRDC Ottawa) received the 2009 IEEE/IFIP International Symposium on Trusted Computing and Communications Best Paper Award for her paper entitled “Distributed Node Selection for Threshold Key Management with Intrusion Detection in Mobile Ad Hoc Network.”

The Soldier Systems Technology Roadmap project team – **Gilles Pageau, LCol Mike Bodner and Mariane Huard** (DRDC), was recognized as a 2010 Distinction Awards Honoree – Category: Pilot Projects – at the Government Technology Event Canada (GTEC) for the Innovation, Collaboration and Exchange Environment (ICee) tool.

Michel Paul (DRDC Toronto) and co authors, **John Caldwell, Melissa Mallis, Lynn Caldwell, James Miller, and David Neri** were awarded the 2010 William E. Collins Award for the Outstanding Human Factors Publication of the Year from the journal Aviation, Space and Environmental Medicine.

Anthony Ashley (DRDC CSS) was awarded the Security Network Chairman’s Award, which honors individuals from security and defense communities that are exemplary in their on-going effort and ability to promote technology innovation and multilateral collaboration.

Bill Martell (DRDC Toronto) was awarded the SAFE Canada Chapter 2010 R.G. “Bob” Sutherland Lifetime Achievement Award for his 50 years of dedication to Aerospace Life Support Equipment.

Bill Kournikakis (DRDC Suffield) received a certificate of appreciation from the Office of the Director of National Intelligence (US) for his participation in the production of the seminal paper: “Drug-Resistant Plague: A Scientific and Technical Assessment” in response to a National Intelligence Council request on behalf of the Department of Homeland Security to a team of medical and biotechnical experts from the US and Canada to develop the first comprehensive assessment of potential threat posed should a drug-resistant micro-organism be developed.

As part of the 50th anniversary of the invention of the laser, the Québec photonic network awarded DRDC Valcartier a commemorative plaque in recognition of the centre’s contributions to the economic growth of Québec through the development of optic and photonic S&T.

Kevin Williams (DRDC Valcartier) received the TDP Gold Award for his contribution to the Soldier Integration Headwear System TDP.

Chad Stratilo, Bill Kournikakis, Jonathan Wong, Josh Wu, and Les Nagata (DRDC Suffield) were awarded Certificates of Appreciation from the National Intelligence Council (US) for outstanding contributions to the National Intelligence Council and exceptional service to the Intelligence Community.

The DRDC Ottawa Space Systems Group was one of the recipients of this year’s “Alouette Award” from CASI (The Canadian Aeronautics and Space Institute) awarded at this year’s “ASTRO 2010” conference. The Alouette award was presented for the “Canadian Advanced Nanosatellite eXperiment 2” to acknowledge “An outstanding contribution to advancement in space technology, applications, science or engineering”. The CanX-2 satellite was built by the UTIAS (the University of Toronto Institute for Aerospace Studies), and the DRDC Ottawa Space Systems Group was instrumental in defining and helping fund the mission.

Departmental Awards

Pierre Meunier (DRDC Toronto) received a Regimental Medal of Excellence from the CO and Sgt Maj of CTC Gagetown as a token of appreciation for his work on the new anti-mine Leopard (known as 2A6M). As a result of his work, proposed seat adjustment procedures (critical to protect the drivers against a mine explosion) have been implemented in theatre.

Paul Bender (Deputy Director General of DGMPRA) was awarded the prestigious Deputy Minister Commendation, which recognizes employees who have made an outstanding contribution to meeting the objectives of the Department.

Pierre Meunier (DRDC Toronto) received a Deputy Minister / Chief of the Defence Staff Innovation Award, for devising new anthropometric criteria for screening and selecting CF pilots.

Greg Barrie (DRDC Ottawa) received the General Service Medal (GSM) for his Afghanistan deployment. The GSM acknowledges civilian and military service in direct support of operations in the presence of an armed enemy.

Carol Lacoste Asmis (DRDC Ottawa) received DND's first prize in fire prevention during Fire Prevention Week 2009. Ms Lacoste Asmis showed great leadership which resulted in major improvements to the Life / Fire Safety Program. In addition to her regular duties, she delivered the Fire Prevention Program with all the units from DND's Shirleys Bay campus. This helped streamline the Fire Prevention Program, allowing fire prevention personnel to focus on other components of the program.

The Ground-Based Optical Project Team – **Robert Scott, Bradley Wallace** (DRDC Ottawa), **Sgt. Timothy Passley** (ADM (IM)), **Martin Levesque** (DRDC Valcartier) and **Stephen Bogner** (DRDC Suffield) were awarded the S&T Excellence Award for their significant achievement realizing the Ground-Based Optical (GBO) telescope network as a contributing sensor to the U.S. Space Surveillance Network.

Paul Chouinard (DRDC CSS) was awarded the S&T Excellence Award for his commitment as a scientist and as a passionate innovator whose scientific contribution made a profound impact on the security posture for the Vancouver 2010 Winter Olympics and Paralympics.

The Land Capability Development Operational Research Team – **Frederick Cameron, Roger Roy, Peter Gizewski, Bruce Chapman, François Cazzolato, Jérôme Lévesque, Ian Chapman, and Geoff Pond** (DRDC CORA) were awarded the S&T Excellence Award for their outstanding contributions to concept development, analysis and experimentation supporting the continued relevance of Canada's Army in responding to the complexities of the future.

LCol Luc Angiolini (DGSTO) was awarded the Corporate Services Excellence Award for his focused vision, exceptional leadership, and ability to incite the best from S&T partners and resources to effectively respond to the CF' operational needs, in a creative and highly responsive manner.

The Procurement and Payment Team – **Ginette Villeneuve, Louise Déry, Nicole Péloquin, Nathalie Genest, Pauline Cloutier, Céline Vaillancourt, Stéphanie Lacroix, and Loraine Légaré** (DRDC Valcartier) received the Corporate Services Excellence Award for their remarkable efforts managing contracts over the course of FY2009 and for their exceptional performance resulting in meeting the Agency's objectives.

Greg Barrie (DRDC Ottawa) received a Certificate of Appreciation and a commander's coin from the All-Source Intelligence Center (ASIC) commanding officer for his professionalism and unwavering dedication to duty, which had a direct effect on the ASIC's success in its mission.

Diana Wilkinson (DRDC Ottawa), **Slavica Vlahovich** (Health Force Protection) and **Roger Hugron** (Nuclear Safety) received the Nuclear Achievement Team Award from ADM(IE) in recognition of their enhancement of effective and innovative practices in nuclear safety. The award recipients developed and delivered across

Canada the Medical Emergency Treatment for Exposure to Radiation (METER) training. This was recognized as a critical component for improving medical casualty preparedness for National and Olympics-2010 security.

Marc Grondin (DRDC Valcartier) was presented with the People Management Excellence Award for his outstanding leadership abilities, high standard of ethics and his skill motivating teams and engaging partners to tackle the strategic challenges facing the CF which culminated in the successful development of the S2DEE.

Gary Christopher, Debbie Blakeney, Andrew Beard, Van Fong, Mark Ball, Emile Pelletier, Charles Morrissey, Shaye Friesen, Rachel Heide, Neil Chuka, Leonard Kerzner, Roman Petryk and Ben Taylor (DRDC CORA) receive an ADM Commendation in appreciation for excellence in operational research support to the Strategic Capability Roadmap.

Adrienne Turnbull, Peter Dobias and David Shaw (DRDC CORA) received the Support to Operations Certificate and Medal for their “tireless and dedicated support to the CF and for increasing the profile of Defence Research and Development Canada within the Operational community, while deployed in an expeditionary theatre under arduous, stressful and demanding working conditions.”

John Donohue, Andrew Billyard and Chad Young (DRDC CORA) received the CDS “Medal for Excellence” for their work on Strategic Review.

DRDC Centre Awards

Sgt Dorothy Wojtarowicz was awarded the DRDC Toronto Leadership Award for her exceptional performance as Project Coordinator for the Improvised Explosive Device (IED) Awareness Training project.

Maj Pierre Plante received the DRDC Valcartier Award for Exceptional Service in recognition of Innovation and his contribution to the promotion of the centre’s values.

Nabil Rafei received the DRDC Ottawa Performance and Recognition Award for taking on many roles and tasks to ensure that everyone’s project requirements are fulfilled professionally and expeditiously. His support extended to other sections in DRDC Ottawa, to other DRDC labs and to the CF at large.

Youri Rousseau received the DRDC Valcartier Award for Exceptional Service in recognition of his Leadership and his contribution to the promotion of the centre’s values.

Kathleen Sutton received a DRDC Toronto Commendation in recognition of her service and dedication to the success of DRDC Toronto. Her leadership of the Corporate Services Governance initiative, establishment of the communications program for the agency, development of publication standards, among many other contributions to the ongoing transformation of DRDC Toronto have exemplified the excellence of Corporate Services.

Josée Leclerc was presented the DGMPRA Corporate Services Excellence Award in recognition of her outstanding efforts in establishing, implementing and evolving the DGMPRA comptrollership function within the CMP and ADM S&T domains.

Maj Gary Ivey received the DGMPRA Individual Achievement Award for significantly advancing knowledge, expertise and credibility in the domain of Human Dimensions of Operations through his innovation, dedication and leadership.

J.F. Levesque, Shanzeng Guo and Robert Lauchie Scott received the DRDC Ottawa Performance and Recognition Award for professionalism and perseverance in the face of adversity. In particular, for carrying out 3 ARPs and 2 TDPs at a reduced staff level that was unforeseen.

Debra Spring was awarded the DRDC Corporate Outstanding Performance Award for her outstanding performance in administering the sole responsibilities as both ATIP Coordinator and Knowledge Resources Librarian concurrently without hesitation, which has resulted in the successful execution of both positions.

Cdr Sarah McMillan, June Bowser, Karen Daley, LCol Scholtz and Louise Soucy of The Strategic Review Team received the DGMPRA Team Achievement Award for their exceptional contributions to the success of the Strategic Review. The Strategic Review was complex, with a tremendous amount of work to be done over a relatively short period of time.

François Bouffard, Denis Dubé, Hugo Lavoie, Eldon Puckrin, Jean-Marc Thériault and Caroline Turcotte of the CATSI-EDM Project Group received the DRDC Valcartier recognition prize for their scientific and technical excellence in the completion of the CATSI-EDM project. The project achieved and surpassed many of its objectives and resulted in the delivery of 2 prototype chemical standoff detectors to the CF.

WO (Ret'd) Kim Morey and Allan Keefe received the DRDC Toronto Col Carl Walker Commendation for demonstrating a spirit of cooperation and team-building in keeping with the legacy left by the efforts of Col Walker (1959-2010).

Luc Lefebvre was awarded the DRDC Corporate Outstanding Performance Award for his outstanding performance in the conception and development of technology demonstration for the Air Force.

Sonia Latchman received the DGMPRA Leadership Award in recognition of a remarkable level of leadership, dedication and professionalism in her concern for her team members, her mentoring and consistence in the delivery of quality outputs.

Louise Prud'homme-Lalonde received the DRDC Ottawa Outstanding Contribution Award for demonstrating skills, dedication, and values that facilitate a working environment exemplary of DRDC values.

Karen Eaton received a DRDC Toronto CO Commendation for her outstanding work as training development officer in the School of Operational Medicine (SOM) in the re-establishment of proper training standards, training plans and confirmation of learning in all of SOM's courses as well as the introduction of e-learning to SOM's program.

Alain Joyal received the DRDC Ottawa Outstanding Contribution Award for working tirelessly to successfully establish the Technical Analysis Laboratory (TAL) for DRDC. In cooperation with two other government departments, the TAL serves as a major element of DRDC's support to military operations.

Joe Templin, Karim Dahel, Ed Pitula and Daniel Salisbury received the DRDC Corporate Outstanding Performance Award as a team (DSTEa) for their leadership and outstanding contribution in managing the S&T Enterprise and related high-priority initiatives, which have reinforced ADM(S&T)'s reputation as an organization marked by innovation, quality, coherence and leadership.

Walter Baziuk received the DRDC Ottawa Outstanding Contribution Award in recognition of leadership to the Virtual Lab (VL) community and dedicated efforts implementing leading edge technology to improve international scientific collaboration.

The DRDC Toronto Seasonal Open House Team was awarded the organizational achievement of the year award in recognition of their outstanding contribution to the success of the DRDC Toronto Seasonal Open House. This event showcased the camaraderie and excellence of all the professional streams.

Trevor Jones, Jason Brown and Ian Watson received the DRDC Ottawa Outstanding Contribution Award for their participation in OP Podium in support of the RCMP, DND and other partners. They purchased, set-up and operated the next generation CRTI-funded Mobile Nuclear Laboratory.

David Smith received a DRDC Toronto Achievement Award in recognition of his outstanding performance in planning and conducting command and control analysis in support of the Integrated Security Unit (ISU) for the Vancouver 2010 Olympics and Paralympics.

Nathalie Rodrigue, Suzan Ballantyne, Christopher Bieniowski, Stacie Daniels and **Wendy Mertens** received the DRDC Corporate Outstanding Performance Award as a team for their outstanding contribution and professionalism in the area of Human Resources in support of the Corporate Office within DRDC.

Anthony Damini received the DRDC Ottawa Leadership and Creative Management Award for leading a high performing group at DRDC Ottawa and for demonstrating great creativity and leadership surrounding the development of a collaborative radar R&D demonstration program between DRDC Ottawa, MDA, and Selex.

Ross Pigeau received a DRDC Toronto Honorary Leadership Award for his inspired vision and dedicated leadership that has helped to transform DRDC Toronto into an organization that is strongly positioned to deliver integrated human effectiveness S&T solutions to benefit the defence and national security environments.

Mike McDonald, Chris Parry and **Tom Lukowski** received the DRDC Ottawa Performance and Recognition Award for their outstanding multiyear effort to plan, coordinate, and execute a Passive Coherent Location radar evaluation.



FINANCIAL STATEMENT

This table summarizes the funds DRDC received and expended in fiscal year 2009-2010 to carry out its program. The values shown are in thousands of dollars, with negative variances shown in parentheses.

Fund Type	Revenues (\$000)	Expenditures (\$000)	Variance (\$000)
Salary and Wages	130,486	130,177	309
Operations and Maintenance	26,420	25,728	692
R&D Contracting	91,688	90,815	873
Capital – R&D Equipment, Construction	9,751	9,455	296
Environment	11,979	11,192	787
DRDC CSS* – Operations & Maintenance, R&D Contracting	47,164	47,164	0
DRDC CSS – Capital Equipment	2,342	2,342	0
Revenue	(2,543)	(2,428)	(115)
Total	317,287	314,445	(2,842)

Source: DRDC and Assistant Deputy Minister (Finance and Corporate Services)

Notes: *DRDC CSS is the DRDC Centre for Security Science Due to rounding, figures may not add up to totals shown



APPENDICES AND TABLES

APPENDIX 1 DEFENCE R&D CENTRES

Defence R&D Canada (DRDC) is made up of nine research centres – each with a unique combination of expertise and facilities to carry out world-class S&T – in addition to a Chief of Staff organization, an operations centre and a corporate services centre.

Defence R&D Canada – Atlantic

DRDC Atlantic has world-leading expertise in anti-submarine warfare, mine and torpedo defence, air and naval platform technology, maritime information systems, emerging materials and signature management.

Defence R&D Canada – Ottawa

DRDC Ottawa is the leader in defence technology related to electromagnetic sciences. Its expertise includes radio frequency (RF) sensing, RF electronic warfare, RF communications technology, network information operations, space systems, synthetic environments and radiological defence.

Defence R&D Canada – Suffield

DRDC Suffield and its Experimental Proving Ground are among Canada's key defence S&T assets and have long been active in the development of effective defensive countermeasures against the threat of chemical and biological weapons. DRDC Suffield also has important programs of work in military engineering, casualty management and autonomous intelligent systems. The Counter Terrorism Technology Centre at DRDC Suffield is a key component of Canada's ability to respond to domestic and international CBRNE incidents and specializes in live agent training and chemical/biological testing and evaluation.

Defence R&D Canada – Toronto

DRDC Toronto is Canada's centre of excellence for human effectiveness S&T in the defence and national security environment. Using a systems-based approach, the centre covers all aspects of human performance and effectiveness, including individual and team performance, human-technology interaction, and social and psychological factors that affect the resolution of conflict. DRDC Toronto also supports the operational needs of the CF through research, advice, test and evaluation, and training in the undersea and aerospace environments.

Defence R&D Canada – Valcartier

DRDC Valcartier has world-leading expertise in optronic systems, information systems, and combat systems. The scope of activities includes spectral and geospatial exploitation, tactical surveillance and reconnaissance, command and control decision support systems, intelligence and information, systems of systems, energetic materials, precision weapons, weapons effects and protection, and electro-optical warfare. The Defence engineering Valcartier (DeV) Section brings together multidisciplinary teams to offer the CF state-of-the-art scientific expertise, world class facilities and turnkey project management.

Defence R&D Canada – Centre for Operational Research and Analysis (CORA)

DRDC CORA is our centre of excellence for operational research and analysis and the prime delivery centre for decision support to the DND/CF. Its efforts span force development, resource allocation, acquisition, force generation and readiness, improved operational effectiveness and efficiency, strategic analysis, scientific and technical intelligence, and the achievement of departmental policy goals.

Defence R&D Canada – Centre for Security Science (CSS)

DRDC CSS is a joint endeavour between DND and Public Safety Canada, which provides S&T services and support to address national public safety and security objectives. Its mission is to strengthen, through investments in S&T, Canada's ability to prevent, prepare for, respond to, and recover from accidents, natural disasters, or terrorist and criminal acts that impact the safety and security of Canadians.

Defence R&D Canada – Defence and Security Research Institute (DSRI)

DSRI is a joint venture of DRDC and RMCC, designed to help meet the S&T needs of the DND/CF. The Institute exists to create synergies between the short- to medium-term applied research conducted by DRDC and the long-term academic research conducted at RMC and associated universities. Each organization will bring to the table the benefits of their relationships with their respective partners such as the private sector and other federal S&T organizations for DRDC and the broader academic community for RMCC. DSRI is located on the campus of RMC in Kingston.

Director General Military Personnel Research and Analysis (DGMPRA)

DGMPRA is a partnership between DRDC and the CF's Chief Military Personnel. The centre is mandated to focus specifically on pan DND/CF Personnel Research coordination and delivery. Within DGMPRA there is a wide array of military and civilian research expertise in areas such as psychology, sociology, anthropology, psychometrics/statistics, operational research and computer science. Research domains focus in three key areas: Personnel Generation Research, Personnel and Family Support Research and Organizational and Operational Dynamics.

Defence R&D Canada – Chief of Staff (COS)

The COS organization is responsible for providing corporate leadership for DRDC. The Chief of Staff is a member of the DRDC executive and represents the organization on behalf of the Assistant Deputy Minister (S&T).

Defence R&D Canada – Science and Technology Operations

DRDC S&T Operations provides central coordination, strategic planning, delivery oversight of S&T programs, and support to operations through established interfaces with the DND/CF and external partners.

Defence R&D Canada – Corporate Services

DRDC Corporate Services provides functional direction and central management of our corporate services and acts as an interface between DRDC, DND and the Government of Canada.

APPENDIX 2

DEFENCE R&D CANADA'S S&T PROGRAM

DRDC focuses its S&T activities in areas of critical importance to future CF operations. Our key objective is to ensure that the Forces are technologically prepared for operating in a defence environment that will see increased emphasis on interoperability with allies, technology-driven warfare and new asymmetric threats.

Our S&T program is developed in consultation with our partner groups in the following areas: Integrated Capabilities; Maritime; Land; Air; Personnel; and Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance, and Personnel Protection.

The DRDC S&T program is delivered through thrusts – packages of scientific and technical activities. Each thrust addresses a broad spectrum of issues and involves a team of our staff working with external partners, including academia, industry and allies. In fiscal year 2009–2010, the total value of our S&T program was approximately \$475 million. This figure includes internal costs such as salaries and overhead, R&D contracts, and external and in-kind contributions. Please refer to the tables at the end of this report for additional details on our S&T program.

Integrated Capabilities

The Integrated Capabilities S&T program aims to achieve objective and timely decision support, anticipate future challenges, and foster innovation through various projects and initiatives to ensure that DND/CF have the capabilities necessary for assigned missions in line with defence policy. The program is executed through four research thrusts: Strategic and Future Environment; Operations Analysis and Integrated Solutions; Special Operations; and CBRN Hazard Protection.

Maritime

The Maritime S&T program identifies specific objectives and activities to be pursued, and outputs to be produced, for the Maritime partner group. It identifies the resources required to meet the research and development priorities established by the partners for ships, submarines and maritime aircraft and their systems. The program is arranged in six thrusts: Above-Water Warfare, Maritime Command and Control, Underwater Warfare, Naval Platform Technology, Maritime Domain Awareness and Integrated Maritime Decision Support.

Land

The Land S&T program provides leadership and expertise to the army and other stakeholders to define concepts, analyze options and develop capabilities for land operations. The program complements the forward-looking developments with support to the capabilities currently being acquired under capital equipment projects. The program is organized along six thrusts: Command, Sense, Act, Shield and Sustain, all of which parallel the army's operational functions, and Integrated Land Analysis.

Air

The Air S&T program supports the air force goals of integrated CF operations at home and abroad by the discovery, development and integration of advanced sciences and technologies. The program is delivered through six thrusts, created in accordance with the air force functions terminology from the aerospace doctrine: Command, Sense, Shape, Move, Sustain and Analyze.

Personnel

The Personnel S&T program is designed to provide scientifically valid advancements in human resources and social science knowledge in areas that substantially benefit DND / CF in the pursuit of operational tasks and missions or departmental priorities today and in the future. The program is executed through five thrusts: Plan, Recruit and Train; Prepare, Support and Recognize; Individual and Organizational Operational Effectiveness; Human Integration; and Medical Intervention.

Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR)

The C4ISR S&T program supports the joint and national-level commander and staff in work on communications, information and knowledge management; information architecture and information technology; information operations; national-level and joint command and control, surveillance, intelligence and space. The program comprises five thrusts: Command and Control, Communications and Computer Network Operations, Intelligence, Surveillance and Space, and Scientific and Technical Intelligence Support and Advice.

The DRDC S&T Program is delivered via two interconnected mechanisms: the Applied Research Program and the Technology Demonstration Program. In addition to these, two programs are designed to fund smaller projects: the Technology Investment Fund provides funding for forward-looking, high-risk, but potentially high-payoff, research projects and the Defence Industrial Research Program supports partnerships with Canadian industry. Projects in all four programs span the range of the six partner groups.

Applied Research Program

The Applied Research Program is DRDC's main research and development program and is made up of projects distributed among the six partner groups previously mentioned. Its objective is to advance the knowledge base of defence science, investigate novel and emerging technologies, and explore the military application of those technologies within the CF.

Technology Demonstration Program

The Technology Demonstration Program (TDP) demonstrates technologies fostered by DRDC and Canadian industry in the context of real and potential future CF capabilities, concepts, doctrine, operations and equipment. The TDP is aimed at concept development and evaluation for force design purposes and is therefore typically not focused on hardware development.

Technology Investment Fund

The Technology Investment Fund supports forward-looking, high risk – but potentially high-payoff – research projects to ensure a dynamic DRDC technology portfolio that is consistent with the Defence S&T Strategy, and that will lead to important new in-house competencies.

Defence Industrial Research Program

The Defence Industrial Research Program strengthens and supports the Canadian defence industrial base through the provision of financial and scientific support for eligible industry-initiated research projects relevant to the defence of Canada and/or its allies. The objective is to stimulate research and innovation to enhance Canada's ability to share in the development of technologies to meet Canadian, NATO and other allied defence requirements.

APPENDIX 3

PATENTS, LICENCES AND ROYALTIES

DRDC manages its intellectual property (IP) through patents, copyrights, trademarks and licences. Over the course of the 2009-2010 fiscal year, DRDC filed 19 applications and was granted the following 14 new patents.

- Solar Infrared Ground Clutter
- Laser Underwater Camera Image Enhancer (LUCIE)
- An Adaptive Multi-Channel Multi-Function Digital Intercept Receiver
- Insensitive Melt Cast Explosive Compositions Containing Energetic Thermoplastic Elastomers
- Super Compressed Detonation Method and Device to Effect Such Detonation – (United States Patent)
- Super Compressed Detonation Method and Device to Effect such Detonation (Sweden Patent)
- Genetic Engineering of Streptavidin-Binding Peptide Tagged Single-Chain Variable Fragment Antibody to Venezuelan Equine Encephalitis Virus
- Highly Accurate Digital to Analog Converter
- Energetic Copolyurethane Thermoplastic Elastomers
- Use of Cross-Protection to Identify Novel Vaccine Candidates for Infectious Agents
- Carbon Nanostructure Catalyst Support
- Field-Deployable Forced Air Warming System
- Fusion Protein of Human 1GG1 Heavy Chain Constant Region and SCFV Antibody Against Equine Encephalitis Virus
- Hybrid-Drive Multi-Mode Pipe Projector

DRDC has granted 11 license agreements (LA) in the 2009-2010 fiscal year and they are:

1. Omnitech Electronics Incorporated for the “Rapidly Deployable Systems Array” technology
2. MacDonald, Dettwiler and Associates End-User LA for the “OceanSuite – Automatic Identification System (AIS)” technology
3. MacDonald, Dettwiler and Associates End-User LA for the “Oceansuite – GSI Applied R&D Radarsat II Data Exploitation” technology
4. MacDonald, Dettwiler and Associates End-User LA for the “Oceansuite – Near-Real Time Ship Detection (NRTSD) Implementation” technology
5. Stedfast Inc. for the “Thermal Heat Shield Fabric” technology
6. Les Ateliers Non-Tech Inc. for the “Thermal Heat Shield Fabric Products” technology
7. Jasco Research Limited for the “System Test Bed Software” technology
8. Crawley Creatures Limited for the “CBplus Mannequin” technology
9. Plexus Defense and Security Group Inc. for the “Thermal Heat Shield Fabric Products” technology
10. Ultra Electronics Maritime Systems for the “Modelmaker Software Program” technology
11. Royal Society of Chemistry for “Bio-Inspired Materials and Sensing Systems”

Our Licensees reported \$4,833,778.39 in royalties generated for 09/10

DRDC paid \$1,260,145.76 in Public Servant Inventor Awards for 09/10

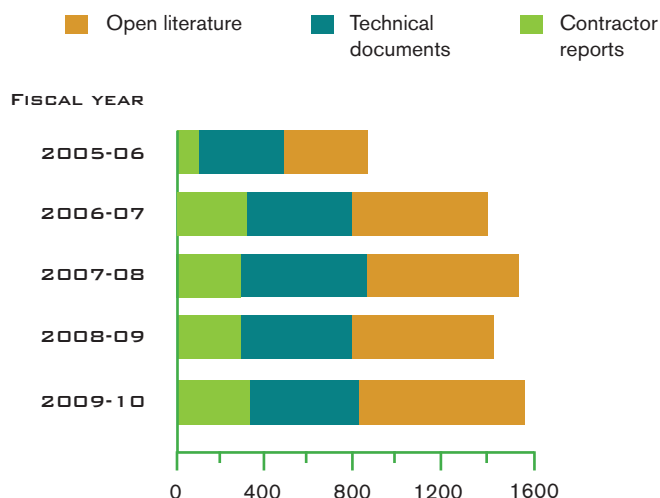
APPENDIX 4

PUBLICATIONS AND CONFERENCE PRESENTATIONS

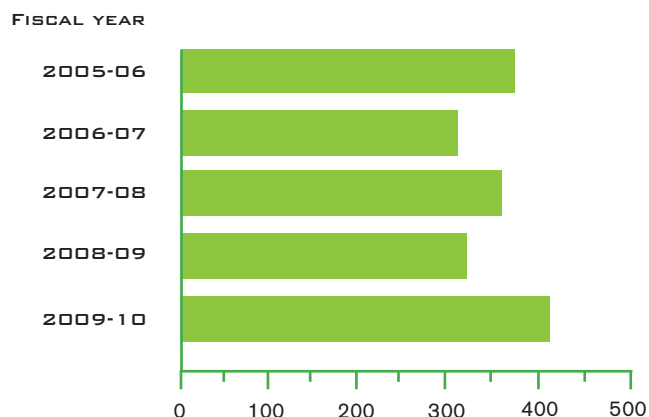
By promoting the results of our S&T activities, through either publication or conference presentation, DRDC transfers knowledge to clients in DND / CF and to colleagues in industry, academia and government.

This dissemination is a means of demonstrating our expertise and increasing awareness of our organization. The following charts show history of our publication and presentation activities over the last five years.

NUMBER OF PUBLICATIONS



NUMBER OF CONFERENCE PRESENTATIONS



APPENDIX 5

EMPLOYMENT EQUITY

WORKFORCE REPRESENTATION

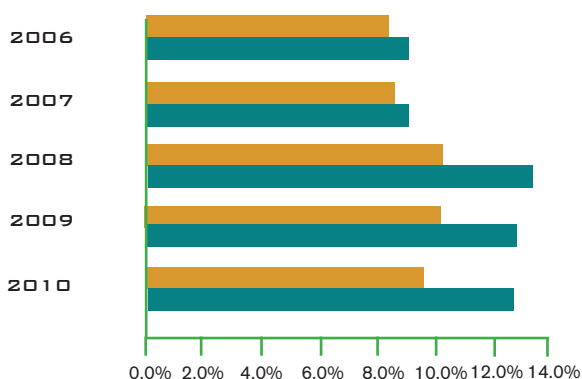
The charts below show DRDC's progress over the last five years in building a workforce that is increasingly representative of the Canadian population. Employment equity considerations were included in our human resources plan to ensure better integration and consideration for workforce management.

The data depict a significant variance ($> 2\%$) in our representation of visible minorities in comparison with external labour market availability. DRDC continues to focus on increasing the participation of visible minorities in our workforce.

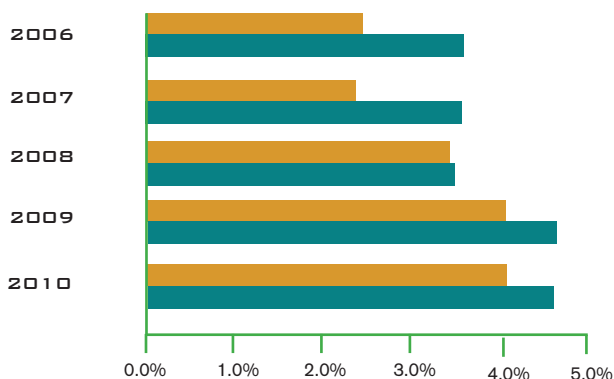
There are some minor anomalies in the employment equity reporting continuity between this year's and last year's reports, which can be attributed in part to changes in methodology. Also, last year's 2009 data was taken from the September 2008 Directorate of Diversity and Well-Being report and has been replaced this year with the March 2009 data to provide continuity with the rest of the years, each having used March data.

Employees are encouraged to self-identify to ensure an accurate representation of the workforce composition, and managers are encouraged to consider organizational needs when conducting recruitment.

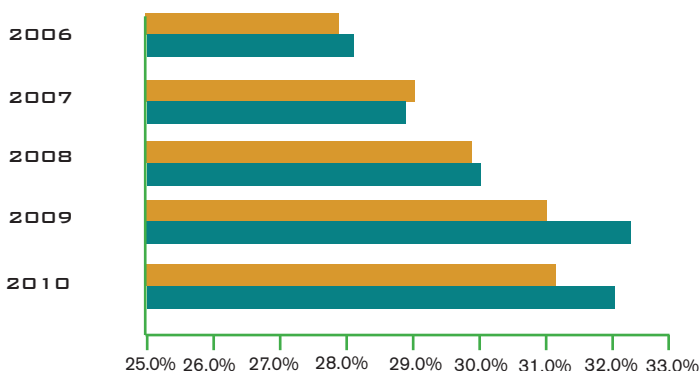
**EMPLOYMENT EQUITY REPRESENTATION
BY DESIGNATED GROUP: VISIBLE MINORITIES**



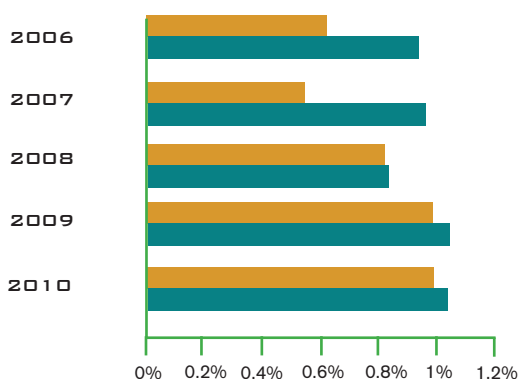
**EMPLOYMENT EQUITY REPRESENTATION BY
DESIGNATED GROUP: PERSONS WITH DISABILITIES**



**EMPLOYMENT EQUITY REPRESENTATION
BY DESIGNATED GROUP: WOMEN**



**EMPLOYMENT EQUITY REPRESENTATION BY
DESIGNATED GROUP: ABORIGINAL PEOPLES**



■ Percentage of DRDC Employees

■ Percentage of Workforce Availability

APPENDIX 6

ARRANGEMENTS FACILITATING INTERNATIONAL COLLABORATION

DRDC's collaborations are carried out with allied countries under a number of international arrangements which facilitate information exchange, collaborative projects and exchange of personnel and equipment in some cases. The most active multilateral arrangements include TTCP, NATO Research and Technology Organisation and the Multilateral Master Information Exchange Memorandum of Understanding (MOU). Trilateral cooperation has also taken place under MOUs with The Netherlands, Sweden, UK and the US respectively under the Trilateral Technology R&D Projects Agreement. Several bilateral arrangements including MOUs with each Australia, Germany, France, The Netherlands, Norway, UK and the US facilitate bilateral collaboration in defence and security S&T. In addition, DRDC has arrangements within the Public Security Technical

Program with the UK Centre for the Protection of National Infrastructure under an MOU Concerning Public Security S&T, with the US Department of Homeland Security under an Agreement on S&T for Critical Infrastructure Protection and Border Security as well as under another MOU to Combat Terrorism. These arrangements are very important tools for DRDC in that they permit joint knowledge generation, access to knowledge outside of Canada, application of allies' knowledge and S&T integration which all lead to greater interoperability with Canada's allies and ensure that DRDC can obtain the most efficient and cost-effective results through partnerships.

The table below lists the international arrangements in which DRDC participated and the approximate number of projects associated with each agreement in fiscal year 2009–2010.

Arrangements

No. of projects

Bilateral with Australia	8
Bilateral with France	18
Bilateral with The Netherlands	7
Bilateral with Norway	1
Bilateral with the United Kingdom	9
Bilateral with the United States	38
Trilateral with The Netherlands and Sweden	12
Multilateral on research, development and acquisition of chemical, biological and radiological defence	1
Multilateral Master Information Exchange MOU	12
Multilateral with other countries (MTMD & GBNL)	10
Trilateral Technology Research and Development Projects	1
NATO Research and Technology Organisation	95
Other agreements (CANUSTEP)	5
Public Security Technical Program	20
The Technical Cooperation Program	296
Total	533

TABLE 1

Value of DRDC S&T Program by Partner Group

Partner Group	Internal Costs ¹ (\$000)	R&D Contracts (\$000)	External Contributions ² (\$000)	Total Value (\$000)
Integrated Capabilities	21,916	6,861	17,427	46,205
Maritime	38,739	11,279	31,603	81,622
Land	41,733	27,390	36,128	105,251
Air	21,587	14,236	34,671	70,494
Personnel	23,206	8,203	34,392	65,801
Command, Control, Communications, Computers, Intelligence, Surveillance & Reconnaissance	34,184	19,622	52,257	106,064
Total S&T Program	181,366	87,592	206,478	475,435

1. Internal costs include salary and wages, overhead, and operations and maintenance.

2. External contributions include cash and in-kind contributions from sources external to DRDC.

TABLE 2

Value of DRDC S&T Program by Canadian Forces Capability

Capability/ Core Process	Strategic and Policy ³ (\$000)	Force Development ⁴	Capability Production ⁵	Force Generation ⁶	Force Employment ⁷ (\$000)	Total Value (\$000)
Command	-	38,541	13,403	5,207	2,254	59,405
Sense	-	59,647	50,403	2,212	4,254	116,516
Act	-	5,114	30,865	-	5,017	40,996
Shield	3,508	10,160	95,316	2,249	7,086	118,319
Sustain	1,927	46,356	29,425	5,050	13,883	96,641
Generate	1,663	14,579	2,427	12,576	882	32,126
Integrated	3,513	5,507	1,088	-	1,324	11,433
Total S&T Program	10,612	179,903	222,926	27,294	34,700	475,435

3. Strategy and policy is a process for developing a roadmap by which DND / CF, as an instrument of government, will meet the defence and security objectives of the Government of Canada.

4. Force development is longer-term planning associated with the creation and maintenance of military and departmental capabilities tailored to and aligned with the security environment and available resources.

5. Capability production is the process of developing capability implementation options; acquiring equipment, personnel and infrastructure; developing training, doctrine, capability support and supply systems; and integrating them into specific CF capabilities. Outputs are CF operational capabilities.

6. Force generation is the process by which forces are trained, equipped and assembled for potential operations. The process is completed once the Forces are declared operationally ready and their command is transferred to the field.

7. Force employment is the exercise of authority over assigned forces in the field. It includes planning, directing, coordinating and controlling these forces in the conduct of operations.

TABLE 3

Table 3 Value of DRDC S&T Program by Time Horizon

Partner Group	Time Horizon II ⁹ (\$000)	Time Horizon II ⁹ (\$000)	Time Horizon III ¹⁰ (\$000)	Value (\$000)
Integrated Capabilities	18,013	18,667	9,526	46,205
Maritime	39,451	28,121	14,050	81,622
Land	44,277	35,166	25,808	105,251
Air	34,773	24,746	10,975	70,494
Personnel	22,844	26,720	16,237	65,801
Command, Control, Communications, Computers,	39,968	31,376	34,719	106,064
Total S&T Program	199,326	164,795	111,283	475,435

8. Time Horizon I refers to the enhancement and maintenance of current capabilities and includes projects that are expected to be completed within one to five years.

9. Time Horizon II refers to the replacement of current capabilities and includes projects expected to come to fruition within five to ten years

10. Time Horizon III refers to the acquisition of new capabilities and includes projects that extend ten years and beyond.



CONTACT INFORMATION

DRDC publishes its Annual Report to describe its operations for the fiscal year covered by the report, and includes information about its performance and any other information that the Deputy Minister of National Defence may require.

Our goal is to ensure that this report can readily serve as a quick and easy reference, personal or professional, to keep readers up to date on what DRDC and, by extension, Canada is doing in the area of S&T for defence and public security.

We invite you to get in touch with us should you have any suggestions or questions.

For more information or additional copies of this report, please contact:

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