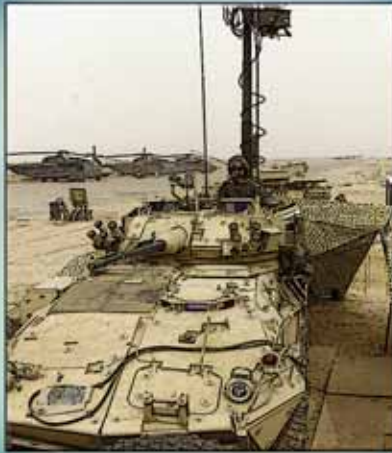


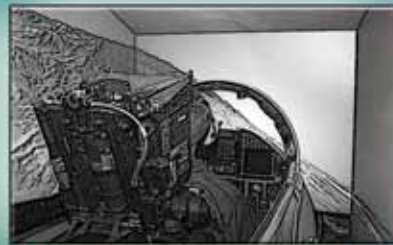


Defence Research and
Development Canada

Recherche et développement
pour la défense Canada



IMPACT *MAKING A DIFFERENCE*



ANNUAL REPORT
for the year ending **March 31, 2005**

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COVER IMAGES

The work of DRDC over the past five years is represented by the front-cover images taken from some recent Annual Reports. Top row, from left: the Remote Minehunting System; the Coyote light armoured reconnaissance vehicle. Bottom row, from left: CTTC training exercises; The CF-18 Multi-Task Trainer; a mini uninhabited aerial vehicle.

MESSAGE FROM THE CHIEF EXECUTIVE OFFICER



This is a special time for Defence R&D Canada (DRDC), as we celebrate our fifth anniversary as a special operating agency of the Department of National Defence. We have built on our legacy of more than 60 years of research and development for the Canadian Forces to deliver world-class science and technology products and services through innovative planning, analysis, research, development and experimentation. At the same time, we have expanded our contributions to, and impact on, the broader security posture of the nation.

Early in 2005, the Government of Canada introduced a new International Policy Statement that included defence as one of its pillars. The Defence Policy Statement, the first in over a decade, is driven by the significant change in the Canadian and global security environment and calls for a significant transformation of the Canadian Forces. DRDC's mission is to ensure that the Canadian Forces remain technologically prepared and operationally relevant, and we strive to engage the right partners and collaborators, both domestic and international, to deliver the broadest and most relevant science and technology program to the Department of National Defence and the Forces to help meet the objectives of the new policy statement.

DRDC makes concerted efforts to remain close to the Canadian Forces as they engage in military planning and operations. Our Centre for Operational Research and Analysis is co-located with the Forces in both the National Defence

Headquarters and across Canada. Staff from our research centres located across the country, and from our Corporate Office, are embedded in the exercises that the Canadian Forces conduct to evaluate new concepts. DRDC participates in many activities undertaken under the auspices of formal international programs, such as those conducted by the North Atlantic Treaty Organization (NATO). These, along with the national efforts, help us translate the products of our research into concepts, equipment and services needed by the Canadian Forces for today and for tomorrow.

Militaries around the world have been going through a period of transformation that addresses the need to maintain effectiveness in a changing security environment. Technological change and proliferation are major elements of this environment. DRDC is contributing to insights and priorities for transformational initiatives through our

Message from the Chief Executive Officer

long-standing relationships with the Canadian Forces and through close collaboration with both Canadian science and technology performers and the defence science agencies of our major allies. DRDC accesses investment and know-how through a number of national, multinational and bilateral relationships.

The theme of this year's report is "Impact." Through research, development and analysis and the broad array of scientific services that we bring to the Canadian Forces and the Department of National Defence, DRDC is leading the way in providing science, technology and conceptual insights to policy, strategy, equipment and capability for the future, as well as for current operations. Increasingly, our capabilities and services are seeing dual-use application to public security priorities. This report highlights but a few of the many contributions that DRDC has made to ensuring the Canadian Forces of today and the future are among the most progressive and pre-eminent militaries of the world.

DRDC continues to look to the future of science, technology and global defence and security. Our programs are on target and adapting continuously to the dynamic and ever-changing environment of the 21st century.



Robert S. Walker
Chief Executive Officer (CEO), Defence R&D Canada

EVOLUTION OF DEFENCE R&D CANADA

Defence R&D Canada (DRDC) is Canada's leader in science and technology for national defence and public security. DRDC is responsible for conducting research, development and analysis to ensure that the Canadian Forces are technologically prepared and operationally relevant, possessing the knowledge, equipment and technology they need to carry out their mission both at home and abroad.

DRDC operates six research centres across Canada, each with a unique combination of expertise and facilities to carry out world-class research and development (R&D). With a broad scientific program, DRDC actively collaborates with industry, international allies, academia, other government departments and the national security community. (See Table 1 at the end of this report for more information about our centres.)

In early 2005, DRDC celebrated its fifth anniversary as a special operating agency within the Department of National Defence. Canadian defence research can be traced back to World War I, when Canadian scientists provided support to the Allied powers. By the end of World War II, Canada had a strong competence in defence research and development.

In 1947, the Defence Research Board (DRB) was established by an amendment to the *National Defence Act*. The DRB provided scientific advice to the Minister of National Defence, met the

research requirements of the Canadian Armed Forces, and contributed to the collective defence research efforts of Canada's allies. It also supported research of defence interest in Canadian universities and industries. These functions were incorporated into a single departmental program following the integration of the service branches of the Canadian Forces in the 1960s.

Under the control of the Chief of Research and Development, the Research and Development Branch was formed in 1974, with the responsibility for the overall conduct of the R&D program in the Department.

DRDC was created as a special operating agency within the Department of National Defence in 2000. Agency status has provided new flexibilities that serve us well in continuing to provide scientific excellence to meet the needs of the Canadian Forces and make R&D contributions to the growth of Canada's economy.

Our Mission

DRDC's mission is to ensure that the Canadian Forces are technologically prepared and operationally relevant by:

- Providing expert science and technology advice to the Canadian Forces and the Department of National Defence;
- Conducting research, development and analysis to contribute to new and improved defence capabilities;
- Anticipating and advising on future science and technology trends, threats and opportunities;
- Engaging industrial, academic and international partners in the generation and commercialization of technology; and
- Providing science and technology for external customers to enhance defence science and technology capacity.

Our Vision

DRDC's vision is to be known worldwide as the best in science and technology for defence and security.

Our Values

DRDC's values define 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 focussing efforts on discovering and meeting their needs.
- **Creativity and Innovation:** We 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

This Annual Report presents a number of our recent accomplishments which support the Canadian Forces and the Department of National Defence, and features some of our activities that enable the realization of that goal.

- The chapter entitled “Contributing to National Defence and Security” highlights our contributions to defence capabilities and our support to the public security needs of Canada and our allies.
- The next chapter, “Making the Best Use of Our Resources,” describes the augmentation of our scientific and technological capacity through international and national collaboration and through the work we do for external clients.
- The following chapter, “Promoting Operational Excellence,” shows that we are an organization that promotes excellence, that engages our customers, and that partners with the world’s best organizations.
- The last chapter, “People and Infrastructure,” focusses on enhancing the productivity and innovative spirit of our people and on renewing our infrastructure.
- This report concludes with our “Financial Statement,” in which we present our revenues and expenditures for fiscal year 2004–2005, and the “Tables,” which provide additional information about our centres and our program.



CONTRIBUTING TO NATIONAL DEFENCE AND SECURITY

Since becoming an agency within the Department of National Defence five years ago, DRDC has made many strides forward in defining and advancing science and technology issues in the areas of defence and security. As an essential element of the Defence team and through the broad engagement of the Department of National Defence and the Canadian Forces, we are recognized as a key contributor to defence capability. We are also developing the capacity to provide the science and technology foundation for Canada's national security needs.

Over the years, DRDC's research and development activities have resulted in scientific and technological products and services that have had significant impact on the Canadian Forces and the Department of National Defence. Our work has helped train and equip the Forces with innovative tools that contribute to their effectiveness in operations conducted all over the world. We have developed measures to improve their safety. We have also contributed to shaping policy and direction in the areas of defence and security through the provision of expert advice to decision makers.

This chapter highlights some of our most recent activities, which contribute to enhancing the capabilities of the Canadian Forces in the areas of command and control, information and intelligence, conducting operations, sustaining and generating forces, corporate policy and strategy, and public security.

Command and Control / Information and Intelligence

During the last year, DRDC made significant contributions to improving the capability of the Canadian Forces to collect, analyze and communicate information; plan and coordinate operations; and provide the capabilities necessary to direct forces to achieve assigned missions. The examples that follow serve to demonstrate the impact of the agency over the past year.

ENHANCED BATTLEFIELD SITUATIONAL AWARENESS

Accurate and precise situational awareness is crucial to the safety and effectiveness of Canadian soldiers on the battlefield. DRDC delivered enhanced electronic warfare (EW) sensors and a significantly improved EW analysis capability to the Canadian Forces. The Integrated Communications Electronic Warfare Analysis and RF (Radio Frequency) Sensors (ICEWARS) project, an integral component within the Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) architecture, will pave the way for the future operational capabilities needed to improve situational awareness on the battlefield.



The Integrated Communications Electronic Warfare Analysis and RF (Radio Frequency) Sensors (ICEWARS)

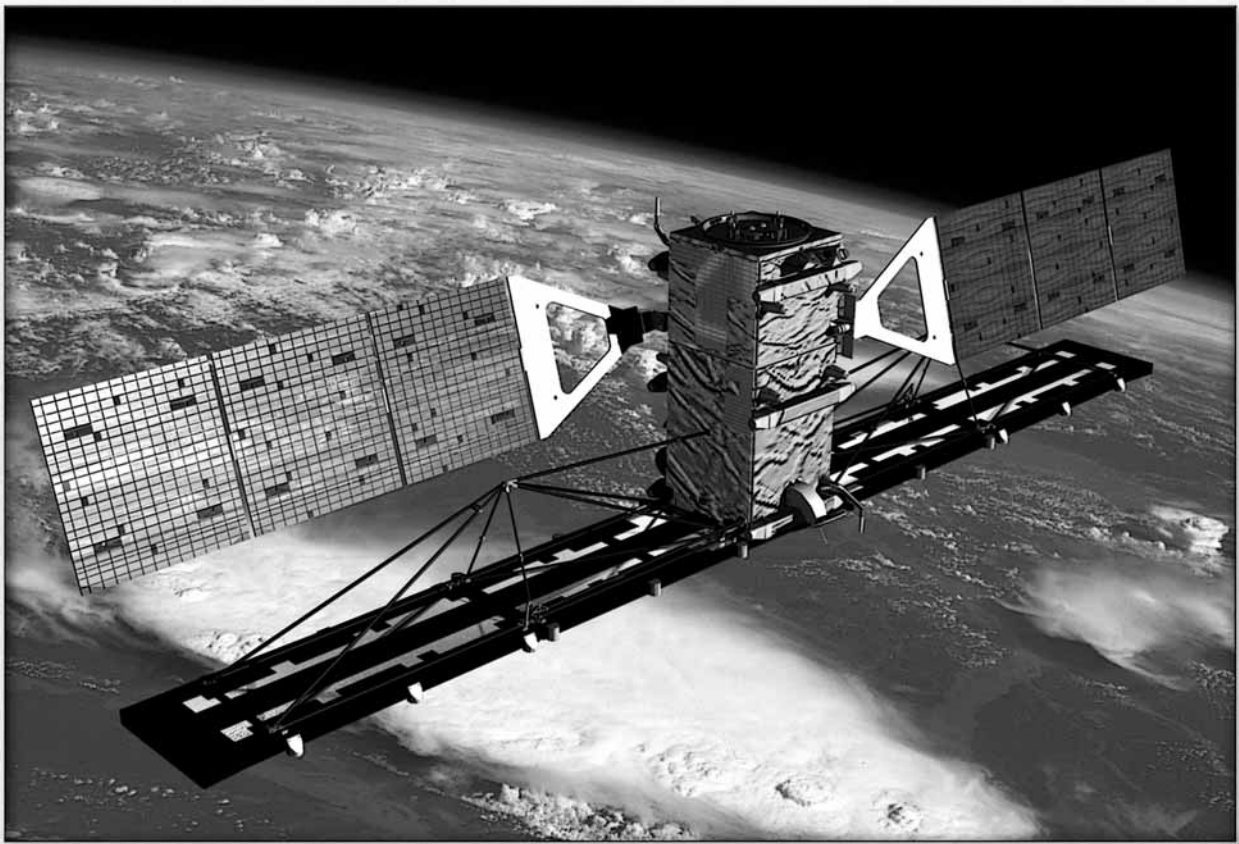
ICEWARS includes two major components, the Military Digital Analysis System (MiDAS) and the Electronic Warfare Signal Analysis (EWSA) system. MiDAS provides an effective capability to detect, analyze and localize the sources of communications signals. EWSA automatically processes the vast amount of data generated by the MiDAS sensor and produces a detailed estimate of the location of communications emitters and associated information. By reducing the large quantities of sensor data into manageable information, it enables seamless reporting to the ISTAR operational database. ICEWARS has provided the Forces with new and significant electronic warfare capabilities.

MONITORING CANADIAN WATERS FROM SPACE

With increased concern over the sovereignty of the Canadian Arctic and our national waters off the east and west coasts, the Canadian Forces are faced with the difficult challenge of monitoring large areas of sea and land with a minimal force.

DRDC developed Ocean Works, a system for the automatic detection of vessels in the synthetic aperture radar (SAR) imagery of RADARSAT-1, Canada's first in a series of remote sensing satellites. Ocean Works, and the use of commercial SAR for monitoring in the Arctic, were demonstrated during *Exercise NARWHAL 2004*

and will form the operational capability for Polar Epsilon, a Department of National Defence initiative to provide a wide-area surveillance capability for Canada's defence. We developed algorithms to exploit polarimetric SAR data, which will help guide the development of advanced surveillance modes for RADARSAT-2 and future radar satellites. RADARSAT-2 is scheduled for launch in 2006 and will feature all of the modes of RADARSAT-1 as well as more advanced capabilities, such as dual and full polarization radar modes, which can be used to help distinguish different types of targets.



RADARSAT -2 (Courtesy, Canadian Space Agency)

FURTHERING THE CONCEPT OF NETWORK-ENABLED OPERATIONS

As a contribution to an evolving concept for Network-Enabled Operations (NEOps) for the Canadian Forces, the Atlantic Littoral ISR Experiment (ALIX) – conducted off the east coast of Canada in August 2004 – examined ways to integrate and exploit a variety of sensors within an Integrated Intelligence, Surveillance and Reconnaissance Architecture (IISRA) to support more rapid and informed decision making. ALIX was the culminating live joint experiment in a multi-year IISRA/UAV campaign plan led by the Canadian Forces Experimentation Centre. It was designed, in part, to investigate how the Forces might use uninhabited aerial vehicles (UAVs) – aircraft that are operated remotely – to enhance force effectiveness.

DRDC scientists led the experiment design and data collection for the live experiment. ALIX provided an opportunity to understand the potential offered by Network-Enabled Operations that linked tactical sensors and weapons systems to decision makers across three levels of command within the Canadian Forces, and more broadly, to various government departments as security partners. The experiment demonstrated the value of using synthetic environments for mission rehearsal. ALIX also presented an occasion to consider important issues such as the selection of the UAV operating crew, and to advance a UAV simulator capability for the Canadian Forces.

Network-Enabled Operations (NEOps) is an emerging concept, which seeks to improve planning and execution of operations through the use of information and communications technology linking people, processes and ad hoc networks.

*—NETWORK-ENABLED OPERATIONS (NEOps)
SYMPOSIUM 2004*



Canadian Forces personnel with a mini-UAV during ALIX

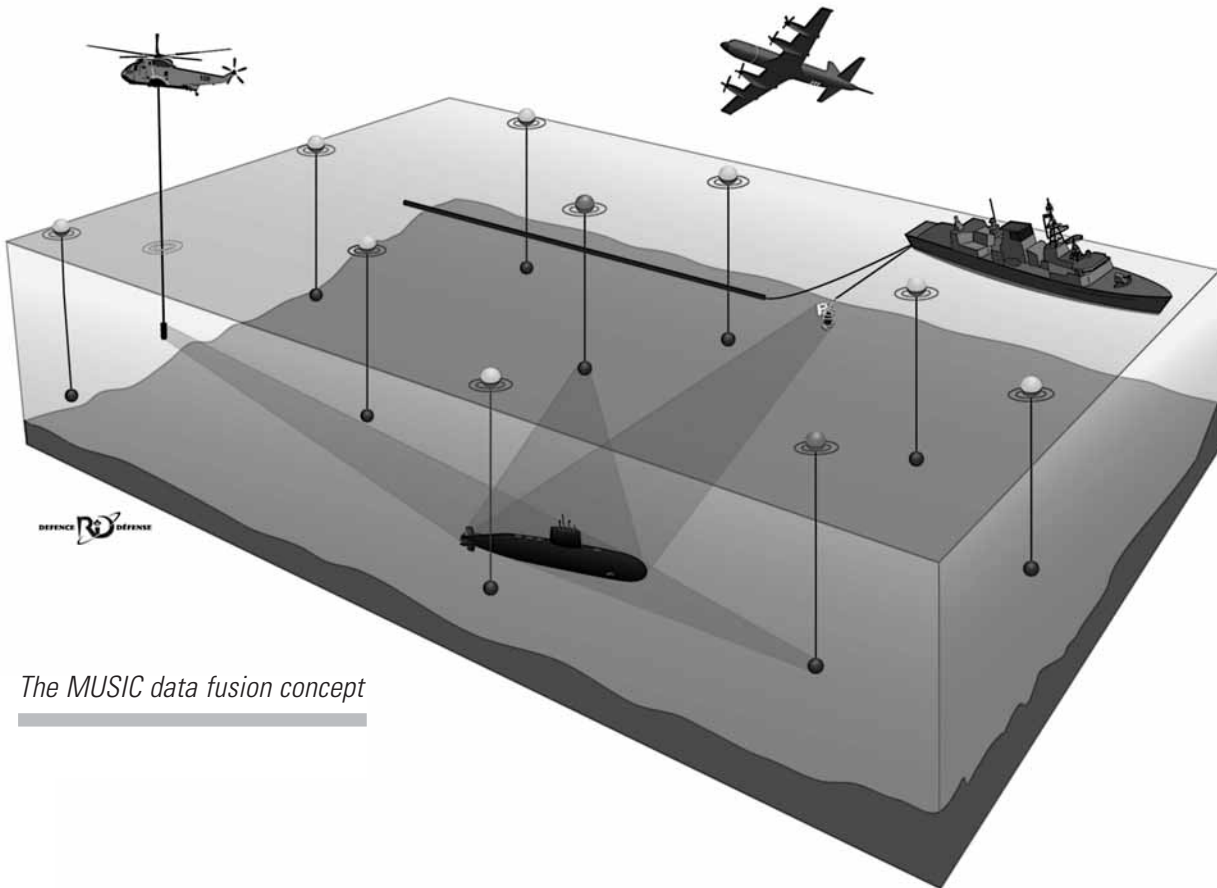
MUSIC AND ALIX SHARE JOINT OPPORTUNITY

The volume of surveillance data generated during ALIX provided a valuable opportunity to bring into play the Multi-Sensor Integration within a Common Operating Environment (MUSIC) project. One of the challenges operations teams face is fusing data from numerous sources and platforms to provide an effective, cohesive picture. The DRDC MUSIC team provided basic manual data fusion techniques for use during ALIX. With the surveillance data collected during ALIX, we conducted further data fusion experiments, and achieved insertion of our manual data fusion procedures into the Maritime Operations Centre in Halifax. While the goal of MUSIC is not manual data

fusion, the exercise was useful in that we established baseline fusion principles that will permit further development towards automated fusion.

GETTING SIRIUS ABOUT SURVEILLANCE

Building on our participation in the warm-water trials of the joint Canada/Netherlands development of the SIRIUS passive infrared surveillance system, DRDC undertook and completed the analysis of the data collected by the trials. The findings showed that SIRIUS met the required specifications, and the Canadian Navy is now undertaking the production of 13 units to equip its HALIFAX class frigates. DRDC will continue to support the Navy in the production and integration phases of the system.



The development of SIRIUS represents a significant milestone in the history of the Canadian Navy, as it will be the first electro-optical surveillance system on board Canadian ships. SIRIUS will complement radar detection of missiles at horizon range and will provide a comprehensive surface and air picture, especially useful in high-density coastal operations. SIRIUS opens the door to a new era of sensing technology for the Canadian Navy, which is traditionally based on radar and sonar.

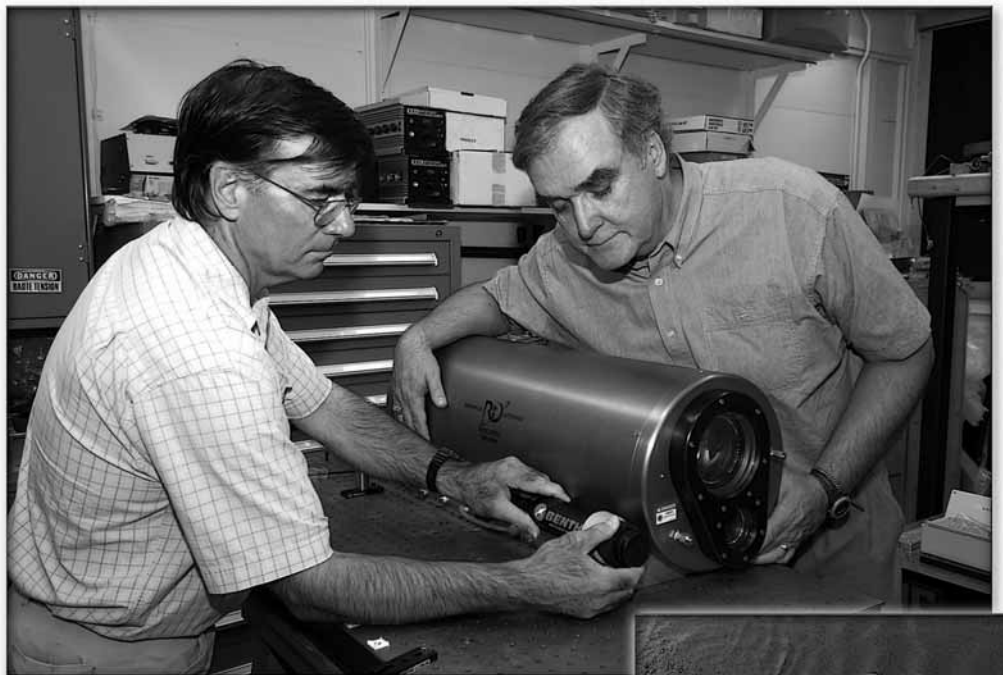
Conducting Operations

The focus of DRDC's work is to impact the creation of capable, modern and sustainable forces that are relevant to a diverse range of operational demands. Many of DRDC's research and development activities are aimed at improving the ability of the Canadian Forces to employ the range of military capabilities required to achieve assigned missions, when and where directed. The following examples highlight some of the achievements of DRDC in this area.

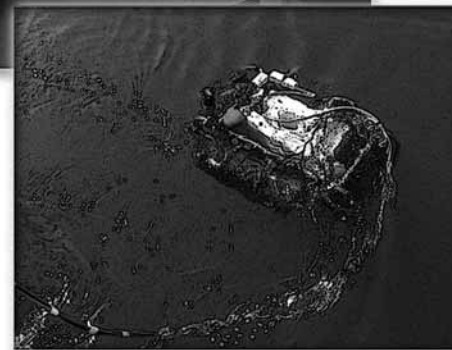
IMPROVED VISION UNDER WATER

The ability to see clearly under water greatly improves the chances of success of aquatic operations. DRDC researchers developed the Laser Underwater Camera Image Enhancer (LUCIE),

an exceptional tool for search and rescue and underwater investigation and security. Designed for underwater observation tasks, LUCIE can generate a clear image of objects on the seabed from a distance three to five times as great as a standard camera, which gives it a significant advantage over other existing search and rescue imaging technologies. From the surface, the system allows for observation at depths five times as great as any conventional system. The shape and other characteristics of the laser beam make it harmless to the eye, providing additional safety for divers. LUCIE can be transported aboard small boats and installed in minutes for a full range of underwater search, inspection and recovery missions.



The Laser Underwater Camera Image Enhancer (LUCIE)



UPDATED SUBMARINE MANOEUVRING LIMITATION DIAGRAMS

Knowing the capabilities and limitations of military platforms is key to successful operations. DRDC conducted a series of static tests to measure hydrodynamic forces on the hull of the VICTORIA class submarine. The tests, performed with the scale model ALBERT, provided baseline data needed to update the VICTORIA class Manoeuvring Limitation Diagrams (MLDs) that define the safe operating parameters of the submarine. MLDs are prepared by performing a large number of emergency submarine recovery simulations involving various combinations of stern-plane jam and accidental flooding scenarios. The stern planes are the pair of horizontal rudders at the tail of the submarine, used to control the angle of the boat and to maintain or change depth. This ability is compromised if the planes become jammed.

To establish a capability for future MLD support to the VICTORIA class submarines, we recalculated an existing MLD. During the course of this work an error was discovered in the original calculations, which indicated that the plane jam boundaries should have been more restrictive. The error was corrected and resulted in an improved margin of safety for VICTORIA class operations. The revised MLD was issued to the fleet in late 2004, in time for HMCS CHICOUTIMI sea trials.

STUDYING TROOP MOVEMENT OPTIONS

To analyze the deployment of recent typical Canadian Forces operations, such as Operations Athena, Apollo, Structure and Halo, DRDC developed Canadian-specific scenarios for use with the Allied Deployment And Movement System (ADAMS) developed by NATO. The resulting models permitted us to study troop movement options using different operational constraints, and to perform sensitivity analysis of the impact of load configurations. This information will allow decision makers to analyze their decisions in order to optimize limited assets and budget dollars. The movement data collected will facilitate future analysis that could be applied to other projects, such as multinational experimentation, NATO movement exercises and studying air mobility requirements.

LEARNING FROM OUR ACTIONS

With the assistance of the Canadian Forces Army Lessons Learned Centre, DRDC developed the Lessons Learned Knowledge Warehouse, a Web application that allows Army personnel to share their observations during peace missions and to respond on the basis of lessons learned during the analysis of information gathered. The system is innovative in that it offers concrete support throughout the life cycle of knowledge management. It centralizes knowledge and reduces delays in the gathering and dissemination of information, while serving as a learning tool. On-line assistance provides working tools related to essential information, such as documentation, a glossary and Internet links.



The Lessons Learned Knowledge Warehouse

This award-winning system saves time and money for the Canadian Forces and improves operational efficiency through timely identification of problems and provision of information. Military personnel are therefore better prepared and risks incurred during subsequent deployments are minimized.

Sustaining Forces

The ability to maintain a high level of operational readiness is key to the success of the Canadian Forces. Thus, providing efficient maintenance and upgrades for the Forces is essential. The following stories show how DRDC has improved the ability of the Forces to repair, upgrade and maintain their equipment, shelter and sustain personnel, and produce the infrastructure and capabilities necessary to support military operations.

PROTECTING OUR SOLDIERS AGAINST BLAST WEAPONS

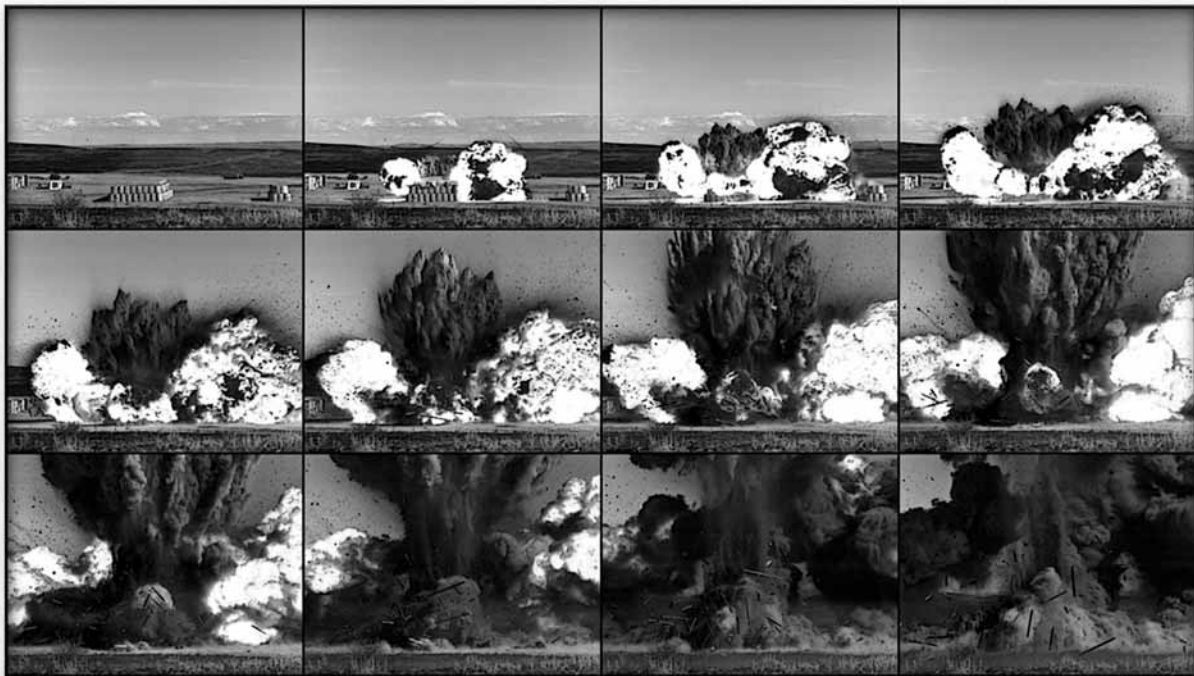
At the request of the Department of National Defence, DRDC provided expert advice on the defensive structures and procedures at Camp Julien in Afghanistan; this advice improved the survivability of Canadian Forces personnel against enhanced blast weapons while on deployed operations.

We validated the design of the Temporary Deployed Magazine facility in use at Camp Julien by constructing two full-scale mock-ups of part of the facility. The first was used to assess the blast vulnerabilities of the structure. Design improvements have since been proposed to address deficiencies that were uncovered during this trial. The second mock-up was used to confirm that the protective walls surrounding munitions containers would prevent sympathetic

reactions upon detonation of one of the containers. In addition, preliminary analysis of the distribution of blast fragments indicated that the minimum distance for inhabited buildings might be safely reduced from 400 metres to 200 metres. These findings are important to the Canadian Forces, as the space available for a temporary camp is often limited.

COMPARING THE EFFECTIVENESS OF HUMAN PROTECTIVE SYSTEMS

Choosing the right protective equipment can significantly enhance the work performance of our Canadian Forces personnel. To ensure that our soldiers have the right protection for the work demanded, DRDC helped determine the operational effectiveness of two different human protective systems in a major trial at Canadian Forces Base Petawawa.



Examining blast impact

The trial compared the operational effectiveness of the collective protection (COLPRO) of an NBC (nuclear/biological/chemical)-proof tent with an individual protection ensemble (IPE) that included a full suit, gas mask, glove and over-boots. Two groups of seven soldiers each were exposed alternately to IPE and COLPRO conditions for a period of 24 hours, while performing command post duty. We examined many physiological parameters (such as dehydration level, body temperature and heart rate) and collected data on psychological workload and situational awareness. We also conducted naturalistic observation where our scientists monitored the test subjects without becoming actively involved or attempting to influence or control the situation.

Preliminary results indicated that work performance decreases faster in IPE than in COLPRO. Problems encountered with the IPE included fogging of the gas mask lens and perpetual humidity in the glove. It was also harder to breathe and to sleep. The Canadian Forces will be able to use these data to help estimate work performance of men and women using these systems beyond a 24-hour period.

EFFECTIVE PROTECTION AGAINST ASYMMETRIC THREATS

Asymmetric or terrorist threats now pose the greatest risk to the Canadian Forces, especially when operating abroad. To analyze the effectiveness of force protection measures to counter terrorist attacks against ships berthed or anchored close to shore, DRDC completed development of models to examine various scenarios, identify deficiencies and recommend ways to mitigate risks. We also conducted a study of the vulnerability of ships to underwater explosions so that safe standoff distances can be determined as input to the models. The project generated two reports that added over 40 recommendations to those already produced under this ongoing area of study.

We further expanded the work to include participation in Maritime Force Protection (MFP) exercises that allow us to validate MFP models, gain useful insights and highlight further deficiencies in defence against this dangerous threat. This work has had a direct impact on tactical development, operational testing, procurement for Naval Dockyard security and planning for actual force protection events.



Modelling a ship protection scenario

SHIELDING OUR SOLDIERS FROM BLAST INJURY

The proliferation of weapons that use blast as the primary damage mechanism has increased the risk of Canadian Forces soldiers being exposed to blast overpressure, secondary fragmentation, acceleration and thermal injuries associated with these new threats. To address this issue, DRDC continues to develop a variety of test methodologies to assess the performance of current and novel protective equipment, to investigate the thoracic injuries caused by blast, and to develop and validate new protective equipment for the soldier that integrates ballistic and blast protection. These methodologies include the Mannequin for the Assessment of Blast Incapacitation and Lethality (MABIL), the first prototype of an instrumented human surrogate, which we recently tested in the field. MABIL assesses thoracic and ear injuries caused by blast overpressure. Work is progressing on a skin burn gauge that will be incorporated into the MABIL surrogate.

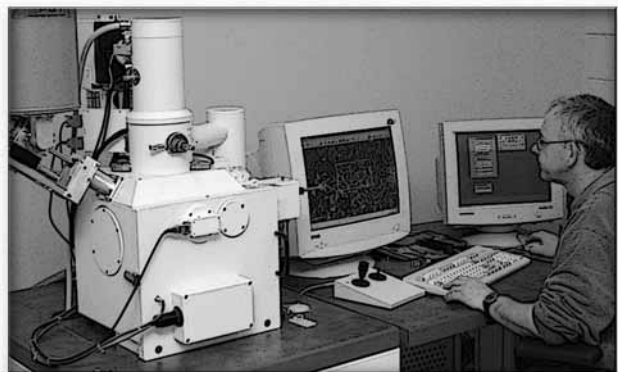
We conducted a number of trials with anthropomorphic test devices (commonly used in automotive crash studies) to assess head, neck and torso acceleration injuries also characteristic of exposure to blast, particularly in an urban environment.

We also completed a preliminary investigation of head injuries caused by blast that led to a more detailed study of head protection from blast and impact. The study determined that the blast threshold for head injuries is lower than that for lung injuries – the lethal injury normally associated with blast weapons. This finding has had a major impact on the scientific perspective on the protection of soldiers.

The numerical modelling of lung injuries is also well advanced. Numerical modelling is a powerful computer-generated method of visualizing the dynamic behaviour of physical systems. DRDC's work in this area gained international recognition through our participation in the Blast Injury Conference sponsored by the U.S. Technical Support Working Group.

SUPPORTING THE HMCS CHICOUTIMI INQUIRY

While en route to Canada in October 2004, a fire broke out on HMCS CHICOUTIMI, a Canadian submarine recently acquired from the British Royal Navy. The Canadian Navy subsequently established a Board of Inquiry to investigate the events surrounding the fire. To assist the Board of Inquiry in its deliberations, DRDC conducted a forensic investigation of material evidence and other debris that had been collected after the fire. The results of the investigation provided scientific data that assisted the Navy in understanding some of the factors associated with the fire, including its most likely cause and the atmospheric contaminants



Examining material collected from HMCS CHICOUTIMI

that resulted from thermal degradation of the materials involved. In addition, the results of the investigation led to studies that have helped the Navy implement changes in materials to minimize the probability of such an event ever occurring again on any of the VICTORIA class submarines.

IMPROVED BATTERY PERFORMANCE

The importance and impact of electrical power on soldier systems and land vehicles cannot be overstated. Inadequate power sources can seriously reduce the effectiveness of the Canadian Forces on deployments. DRDC developed new technology to improve the performance of lithium batteries over the operating temperature range required by the Forces. Using new materials with better thermal stability than conventional cathode materials, our battery is able to deliver 75 percent of its room temperature performance at minus 5 degrees Celsius and perform at higher energy densities than current commercial products. This development is of such value that we were invited to present a paper on this power source research at the U.S. Army Science Conference in December 2004.

A NEW WAY TO COMMUNICATE AND LEARN

DRDC scientists and communications experts produced a training video for Canadian Forces members deployed in Afghanistan that demonstrates the applications, performance and limitations of their personal protective equipment and light armoured vehicles (LAV IIIs). The video provides a demonstration of the protection offered by ceramic body armour plates and stresses the importance of wearing a fragmentation protective vest with them. It also explains the limitations of the LAV III upon impact with a mine, and the basic safety rules for minimizing the risk of injury to military personnel inside the vehicle. This tele-training is an important first step for DRDC, as it introduces a new way of communicating research results to the Forces and increases its support to deployed operations.

Generating Forces

DRDC makes significant contributions to force generation through the conduct of research, based on assessment of the future needs of the Canadian Forces and resulting in development of the best technological solutions for the Forces. The information that follows demonstrates how DRDC has improved the ability of the Forces to recruit and train personnel; to research, test and procure equipment; and to design force structure to produce multi-purpose combat-capable military forces.



Testing the Future Armoured Vehicle Systems (FAVS)

FUTURE ARMOURED VEHICLE SYSTEMS

Present-day armoured vehicles have reached the limit of battlefield effectiveness. However, future armoured fighting vehicles may be able to exploit technological advances for enhanced mission effectiveness. To assess the merits of emerging vehicle technologies and to predict human performance and battlefield effectiveness, DRDC developed the Future Armoured Vehicle Systems (FAVS), which is currently in the demonstration phase. In technical and tactical trials, FAVS compared the performance of a real vehicle with integrated technologies to a virtual vehicle with similar technologies. Some of the technologies demonstrated included immersive visualization (also known as virtual reality), vehicular radar and infrared sensors integrated with automatic target recognition, a multi-function laser defensive aid suite, and vehicle camouflage.

FAVS will have a significant impact on the Canadian Army as several of the demonstrated technologies will likely serve as the basis for capability or requirements specifications. FAVS has also stimulated much interest among our allies. The U.S. Army is expanding cooperation with us as a direct result of their positive experiences with the FAVS team.

This is the first time that surveillance, defence and navigation systems are integrated into the operations management module of this type of vehicle. Selected technologies are now ready to be developed in defence research centres and civilian labs for possible deployment.

—DENIS FAUBERT, DIRECTOR GENERAL, RESEARCH AND DEVELOPMENT PROGRAMS

OPTICAL GUIDANCE AND COUNTERMEASURE LABORATORY

Weapons guided by optical radiation represent a serious threat to Canadian Forces platforms participating in various types of military operations. The risk factor associated with the growing proliferation of man-portable air defence systems is a good example of such a threat. The constant and rapid evolution of these threat systems combined with the increasing requirements of the Forces have brought significant new challenges. DRDC responded to the challenge by creating the new Optical Guidance and Countermeasure (OGC) Laboratory, which brings together many of the techniques and facilities that we have developed over the past 20 years. The OGC laboratory is a unique environment created to design, develop and evaluate countermeasures against the current and future generation of optically guided weapons. It houses all current Canadian experimental capabilities in that field, as well as some unique research tools. It also includes provision for new capabilities to face emerging threats such as infrared imaging seekers. This new laboratory is a clear indication that research and development is evolving to support the strategic transformation of Canada's military.

THE NAVY OF THE FUTURE

What capabilities will the Canadian Navy need in 2015 and beyond? In preparation for an international policy and defence review, the Navy recognized that a more rigorous and maritime-focussed approach to force development was required. To support this force structuring effort, DRDC created a capability-based simulation model to help identify the

most effective mix of capabilities and the capacity that our future Navy must possess to respond to future threats. The model, named TYCHE – after the Greek goddess of good fortune, victory and skill as well as patron of warriors – assigns platforms to missions to best meet the capability demands of the mission. It also fulfils maintenance requirements and the readiness profile of the platforms, as well as the quality of life and personnel tempo of the crew. The results of this study will provide recommendations for the composition and size of the future fleet, for the prioritization of future naval capability requirements, and for the allocation of resources in the near term for capital and for operations and maintenance.

LOGICAL PLACEMENT FOR BIOLOGICAL/CHEMICAL SENSORS

Knowing the optimal locations for biological/chemical sensors can significantly increase the chances of survival of troops in the field. To assist with making acquisition decisions for biological/chemical sensors, DRDC developed a computer model called SensorLogic that calculates the dispersion of a biological or chemical agent over an area of terrain. SensorLogic represents troop locations as well as the placement of sensors to detect an approaching agent cloud. The model computes the risk to the troops of the agent cloud, including warning times. SensorLogic also has potential as a tool for planning troop deployments and for the training of personnel.

Corporate Policy and Direction

DRDC contributes to strengthening the Canadian Forces by conducting studies that enhance the formulation and implementation of corporate policies and strategies in order to achieve broad government objectives. Enhanced ethical decision making and post-deployment reintegration policy are two such studies, detailed below.

ENHANCED ETHICAL DECISION MAKING

The Defence Ethics Program provides the departmental framework to assist military and civilian personnel in maintaining the highest ethical standards of conduct and leadership. In support of this program, DRDC conducted a study that provided a comprehensive assessment of the ethical climate and the individual values of the Department of National Defence and the Canadian Forces. The findings of this study prompted significant changes to the priorities of the Defence Ethics Program, including the development of new learning and orientation tools and the revision of the course “Introduction to Defence Ethics,” to ensure that the proper messages are disseminated throughout the Department and the Forces. Other Canadian government departments and the United States military have shown a strong interest in the methodology used in this study, and we have established effective liaison with each of the organizations that wish to learn from our experience.

POST-DEPLOYMENT REINTEGRATION POLICY

DRDC conducted a major research initiative that contributed significantly to the Department of National Defence Ombudsman’s report *From tents to sheets: An analysis of the Canadian Forces Experience with Third Location Decompression after Deployment*. The report provided the chain-of-command with guidelines to assess the benefits of post-deployment decompression periods, taking into account the duration and intensity of individual Canadian overseas missions. The research was the only large-scale empirical study cited in the report. It was the initial study in a research program that developed a questionnaire reflecting soldiers’ reintegration experiences associated with their overseas deployments. We conducted a second study that confirmed the validity of the questionnaire, as well as additional research to address the reintegration experiences of Air Force support personnel. The initial findings of this research were recently well received by senior Air Force commanders.

I am really pleased to see how quickly our research has had an impact at the Canadian Forces policy level.

—MEGAN THOMPSON, DRDC STRESS AND COPING GROUP LEADER

Enhancing Public Security

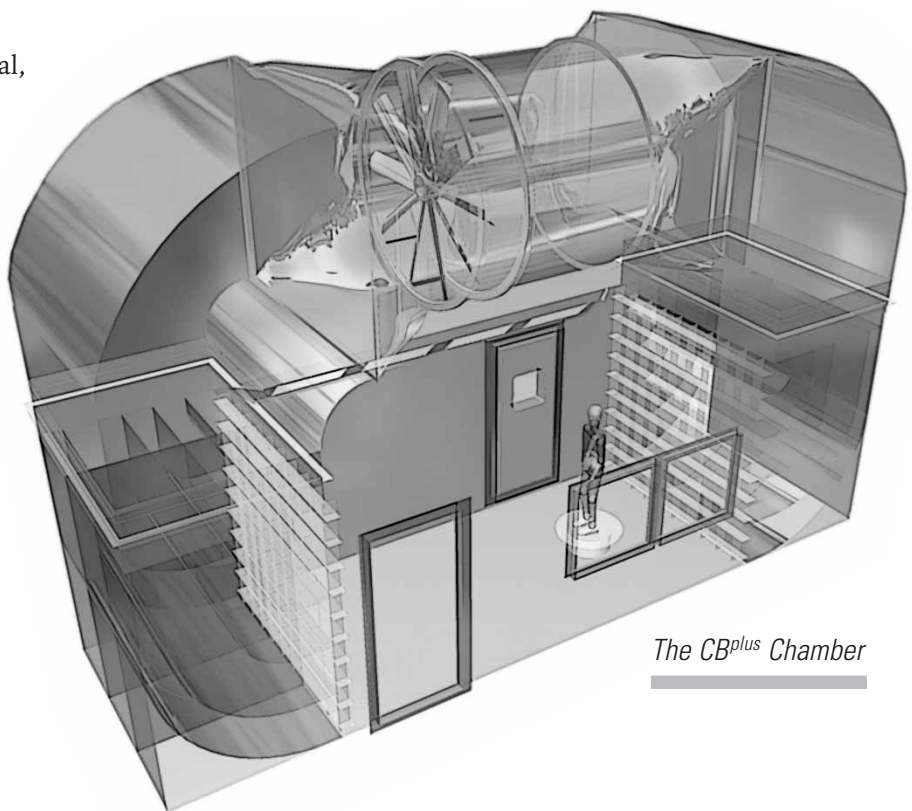
Public security continues to be of paramount importance both nationally and internationally. DRDC has made significant contributions in this area, not only in its research activities, but also in building relationships with other organizations and in offering unique training opportunities to personnel involved in emergency response. At the national level, public security, innovation and commercialization drive policy and activities. DRDC has proven to be a key player in responding to these public security policy drivers.

ENHANCING RESEARCH IN CHEMICAL/BIOLOGICAL PROTECTION

With support from the Chemical, Biological, Radiological and Nuclear (CBRN) Research and Technology Initiative (CRTI), DRDC acquired a new world-class facility that provides a leading science and technical capability in exposure-chamber-based chemical/biological protection. The *CB^{plus}* facility houses a state-of-the-art, stainless steel exposure chamber capable of generating vapour, liquid and aerosol exposures. The new facility permits scientists to

carry out research and technical studies in materials science and in the performance of military and first-responder personal protective systems used against toxic chemical and biological compounds. It also serves as a platform for research on chemical and biological detection and identification systems, and for defining medical countermeasure protocols.

This unique facility includes a life-sized, fully articulated, mannequin test platform and a separate head form. The mannequin permits, for the first time in Canada, simulation-based research, development and validation studies of materials and protective systems. This provides an unprecedented capability to replicate realistic test conditions and to extend test duration.



The CB^{plus} Chamber

FORGING AHEAD IN PUBLIC SECURITY

In June 2003, DRDC established the Public Security Technical Program (PSTP), aimed at developing a coordinated program to enhance collaboration across government and to deliver science and technology solutions across many dimensions of public security. The program currently focusses on the following four mission areas:

- (1) chemical, biological, radiological, nuclear and explosive (CBRNE) threats;
- (2) critical infrastructure protection;
- (3) disruption and interdiction; and
- (4) systems integration, standards and analysis.

In its first full year of activity, the PSTP made many strides forward. The governments of Canada and the United States signed the historic Agreement for Cooperation in Science and Technology for Critical Infrastructure Protection and Border Security. The agreement will allow the two countries to leverage each other's scientific and technological expertise to develop and adopt security measures that will ensure cross-border security and the protection of critical infrastructure.

DRDC developed the PSTP Strategic Plan, which lays out the guiding principles that direct and shape the PSTP's collaborative activities. The goal of the Plan is to contribute to identifying and enhancing national public safety and security capabilities that will provide demonstrable and significant reduction of risk to both countries, and to develop and implement science and technology cooperation that will enable those capabilities.

We also developed a Roadmap document that describes the status of all collaborative projects under the PSTP, as well as the policies, organization and procedures to be used by all elements of the PSTP in the execution of both science and technology activities and management activities.

DRDC conducted consolidated risk assessments in the CBRNE, disruption and interdiction, and critical infrastructure protection mission areas. Based on basic threat scenarios, the assessments contributed to defining the technology and capability gaps and the science and technology investment priorities in each mission area. We also merged the assessments and identified cross-cutting issues that could have an impact on these mission areas and the greater public security domain.

Both of our countries have outstanding scientific and technological resources. This agreement gives us the opportunity to leverage both communities in the fullest possible way to serve the common good.

—GEORGE ATKINSON, SCIENCE AND TECHNOLOGY ADVISOR TO U.S. SECRETARY OF STATE, DEPARTMENT OF STATE, WASHINGTON, D.C.

MOBILE NUCLEAR LABS

The ability to quickly identify a radiological or nuclear hazard is critical in providing an effective response.

The CRTI acquired four Mobile Nuclear Laboratories (MNLs), which will provide support in the event of a radiological or nuclear incident.

Each lab consists of a truck with a suite of state-of-the-art data acquisition, analysis and communication equipment. The labs will allow scientific teams to identify the nature and extent of radiological contamination at an incident site and predict the dispersal pattern of contamination. The MNLs are available for deployment across Canada, and trained technical personnel ensure successful operation of the labs during an incident.

NUCLEAR SMUGGLING EXERCISE

Working with other organizations enhances our ability to develop novel ways of addressing the issue of public security. In collaboration with Health Canada, the Canadian Nuclear Safety Commission, the Royal Canadian Mounted



Working inside and outside the Mobile Nuclear Lab

Police, the University of Alberta and the Royal Military College, DRDC led a two-month international nuclear smuggling exercise. The objective of the exercise was to characterize a confiscated sample of highly enriched uranium and, if possible, establish attribution. This exercise was the first step in establishing a Canadian network of nuclear forensic laboratories, and led to international agreement on the prioritization of nuclear forensic techniques to provide relevant information regarding the material in a timely manner. The forensic laboratory network is continuing to refine its techniques, improving Canada's capability to respond effectively to a radiological or nuclear event.



Scientific responders pass through decontamination in Exercise FOLLOW ON

PROVIDING CBRN RESPONSE TRAINING

Through the CRTI, representatives from federal and first-responder organizations participated in a training exercise at the Counter Terrorism Technology Centre (CTTC) to improve capabilities in taking forensic samples for evidence in the event of a CBRN terrorist event. In addition, CRTI organized and conducted *Exercise FOLLOW ON* (EXFO) at the CTTC, the second of four planned radiological/nuclear exercises. EXFO involved over 60 representatives from eight government agencies and observers from the United States.

DRDC also advanced the development of the CTTC as a key capability for CBRN instruction. In 2004, the CTTC trained over 700 personnel from eight countries to respond to a CBRN attack, and expects to double that figure in 2005.

DETECTING RADIATION FROM A DISTANCE

Conventional radiation detectors work on the principle of “direct” detection, whereby the radiation must actually enter the detector to be counted. This has the significant drawback that a radiation surveyor must enter a radiation field in order to detect it. With support from the CRTI, DRDC developed a standoff radiation detector that works via “indirect” detection, specifically by detecting the faint light emitted by ionized air molecules around a radioactive source. During extensive field tests, the detector demonstrated the ability to detect alpha, beta and gamma radiation from distances up to 500 metres, well beyond the limit of conventional detection.



The Standoff Radiation Detector



MAKING THE BEST USE OF OUR RESOURCES

DRDC makes concerted efforts to offer to clients and stakeholders the most cost-effective scientific and technological solutions to the challenges they face. One of the ways we do this is by collaborating with international and national organizations. Through areas of niche technology, DRDC is able to increase opportunities for research and development, build capacity to meet the needs of the Canadian Forces, and enhance public security.

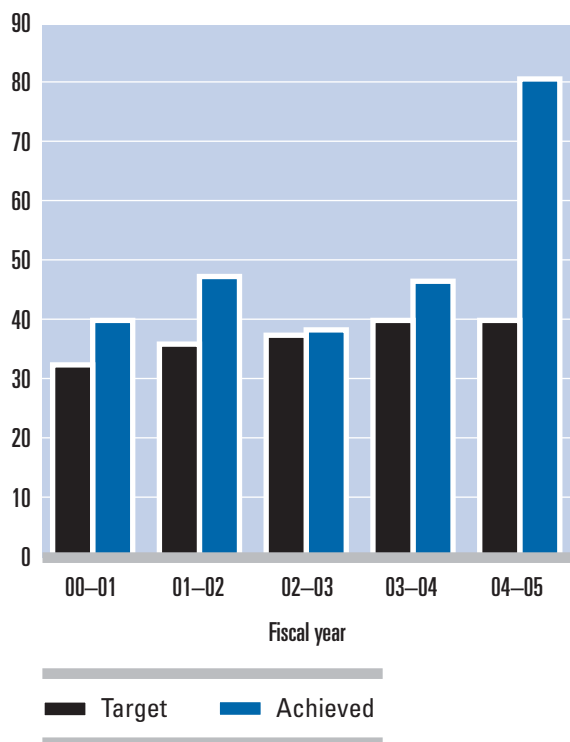
In this chapter, we feature some of our successful collaborations, both national and international, and show how we augment our capacity for science and technology by offering our services to organizations outside of the Department of National Defence.

Collaborating with Our Allies

DRDC engages in many collaborative activities with other nations. In this way, we benefit from joint research, obtaining increased value through leveraging financial and human resources.

DRDC's goal is to leverage a value of about \$40 million each year through our international collaborations. We estimate the value of our collaborations based on the expected cost of acquiring similar value through research contracts. We approximate the value of our international collaboration in fiscal year 2004–2005 to be \$80.7 million. The following chart shows a five-year history of the value of our leveraging from international collaborations.

Value of international leveraging (\$M)



Our collaborations are carried out with allied countries under a number of different international agreements, most notably The Technical Cooperation Program (TTCP) and the North Atlantic Treaty Organization (NATO) Research and Technology Organization (RTO). DRDC actively participates in all of the TTCP groups and NATO panels, which span the wide range of their research and technology activities. (For more information on these organizations, visit their web sites, at www.dtic.mil/ttcp and www.rta.nato.int.)

DRDC also participates in other international agreements, such as the Technology Research and Development Projects (TRDP) agreement and the Master Data Exchange Arrangement (MDEA) with the United States, the Memorandum of Understanding concerning cooperative science and technology with the Netherlands, and the Trilateral Technology Research and Development Projects (TTRDP) agreement with the United States and the United Kingdom. These agreements are of particular importance as they promote interoperability, facilitate collaboration, and help us obtain the most efficient and cost-effective results through cooperation in joint research activities.

The following stories highlight some of our collaborations with our allies.

FIRST WAVE

DRDC participated in the NATO RTO demonstration of First WAVE or Warfighter Alliance in a Virtual Environment. This demonstration of new training capabilities enabled by advanced simulation technology was the largest, most complex activity ever undertaken by the RTO and featured networked, real-time simulation of combined air operations. The exercise brought together personnel, training simulators and

systems from Canada, France, Germany, Italy, the Netherlands, the United Kingdom and the United States. The demonstration showed that distributed simulation could provide significant contributions to transformation, and enhance and complement national training.

DELIVERING TREATMENT FOR RESPIRATORY INFECTIONS

DRDC entered into an agreement with Aradigm Corporation, a California company specializing in drug delivery technologies. This system will result in the development of an aerosolized delivery system for the antibiotic Ciprofloxacin, to treat respiratory infections caused by biological warfare agents, including inhaled anthrax. Northern Lipids, of British Columbia, will complete the formulation development. DRDC is funding product and formulation development and initial pre-clinical studies. The agreement is intended to build upon the proof-of-principle work that DRDC has already completed successfully and extends the technology as an effective alternative for drug delivery, thereby increasing options for the Canadian Forces for the treatment of respiratory ailments in the field.

RESUSCITATION OUTCOMES CONSORTIUM

In the first initiative of its kind, the Canadian Institutes of Health Research, working with DRDC, the U.S. National Institutes of Health, the U.S. Department of Defense and the Heart and Stroke Foundation of Canada, announced the creation and multi-year funding of a national Resuscitation Outcomes Consortium. This ambitious Canada/United States program will conduct multiple clinical trials that will test interventions to improve the chances of survival from cardiac arrest and trauma. The initial funding for this program is US\$50 million. National objectives include reducing the logistical burden

of Canadian Forces medical personnel in the field and lowering the extent to which other resuscitation and life-support measures are required, fewer inflammatory complications, and improving overall survival and clinical outcomes.

MILITARY TRAINING AND THE ENVIRONMENT

Understanding the various impacts of training with live weapons is imperative if we wish to protect our environment, sustain operational military activities and maintain the readiness of our Armed Forces. In collaboration with national and international partners, DRDC initiated a research and development program to address the many challenges posed by the environmental impacts of military training. With significant funding leveraged from the United States and with the help of scientists from Sweden and the Netherlands, we assessed live-fire training ranges at Canadian Forces bases across Canada, and developed a protocol to characterize ranges that have been contaminated by explosives. By understanding the nature and extent of the effects munitions have on the environment, we will be able to develop future weapons that will greatly lower adverse consequences.

COLLABORATIVE ACTIVITIES WITH NATO

In one of several trials undertaken in collaboration with the NATO Undersea Research Centre (NURC), DRDC scientists conducted an array of experiments to study acoustic scattering from the sea bottom. This trial was aimed at developing practical techniques to distinguish true active sonar targets, such as submarines or mines, from natural scatterers, such as boulders, debris or an undulating seabed, which will ultimately improve active sonar capabilities in shallow coastal waters.

In another trial we obtained data required to develop broadband, environmentally adaptive sonar concepts and to evaluate new software for estimating the performance of multi-static active sonar systems. This trial demonstrated the benefits of operating multiple low-frequency active, towed array systems in multi-static configurations.

We also carried out Next Generation Autonomous Sensor trials under a joint research project with the United States, Norway and the NURC that is investigating multi-influence sensors to provide an autonomous intelligence, surveillance and reconnaissance capability in coastal waters.

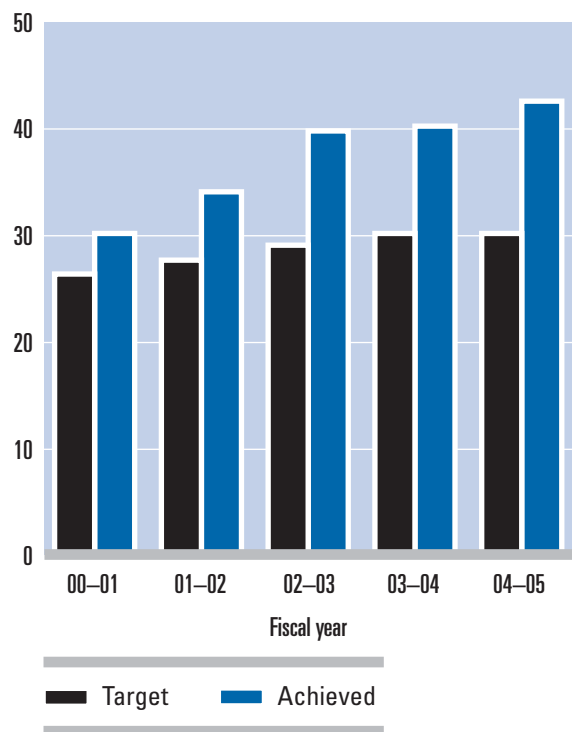
DRDC participated on the Allied Command Transformation (ACT) Analysis Team during NATO's Crisis Management Experiment (CMX) 2005. Work involved analyzing the operation and effectiveness of the Crisis Management Fusion Centre, and providing observations and insights that were included in the final report prepared by the analysis team. The experiment ran parallel to the annual Crisis Management Exercise that is held at NATO Headquarters each year. The CMX venue is extremely important because it provides the only opportunity for the ACT organization to examine Decision Superiority challenges at the political-military level. Decision Superiority is the state where decision makers can gain situation understanding, evaluate options, make decisions and initiate execution more rapidly and effectively. The exercises are designed to test current and evolving crisis management arrangements and procedures. They play a key role in maintaining and improving NATO's ability to manage crises and to consolidate lessons learned.

Collaborating with National Organizations

DRDC collaborates with many Canadian organizations, including industry, academia and government, on joint projects. Leveraging the expertise and resources of our partners increases the rate of return on our investment and provides DND with additional value for money.

The goal of DRDC is to leverage a value of \$30 million each year from national collaborations. We estimate that the value of our national leveraging in fiscal year 2004–2005 was \$42.4 million. The following chart shows a five-year history of the value of our leveraging from national organizations.

Value of national leveraging (\$M)



The stories that follow feature examples of our collaboration with national organizations.

MANAGING SECURE ACCESS

The ability to protect national information is an important strategic capability for the world's military forces. In partnership with Magar Security Architecture Inc., and supported by Entrust, Microsoft Canada and Sun Microsystems, DRDC developed the Secure Access Management Proof-of-Concept (SAMPOC), a prototype system capable of policy-based secure access control and management for Canada's military. Built from commercial off-the-shelf products, SAMPOC demonstrated how leading-edge software technology could be used to implement and manage secure access controls. SAMPOC was demonstrated to representatives of the Department of National Defence, who plan to evolve it into a concept demonstration system in an operational environment. Fully implemented, SAMPOC would allow the Canadian Forces to enforce access controls to information on a need-to-know basis, including those between Canada and its allies. SAMPOC has also sparked the interest of the Office of the Secretary of Defense, Chief Information Officer of the U.S. Navy.

KEEPING TRACK OF GEOSPATIAL DATA

In response to a request from the Department of National Defence to develop a software tool to manage and analyze their inventory of geospatial data, such as satellite maps, images and photos, DRDC, in collaboration with Natural Resources Canada, developed the GEOLAP application based on OLAP and GIS technology. OLAP (On-Line Analytical Processing) is a well-known technology in the banking, insurance and corporate world where it is used to bring aggregated and high-level decisional information to decision-support systems. GIS (Geographic Information System) creates a geographic view, with dynamically generated features, of analysis

data. Together, the two systems present a coherent view of both geographic and subject-oriented information. We demonstrated GEOLAP to the Department of National Defence, who are now reviewing a possible investment in the next phase – the development of a deployable application that they would adopt and implement.

JOINT FUNDING OF HEALTH RESEARCH PROJECTS

In March 2005, DRDC engaged in a Memorandum of Understanding (MOU) with the Canadian Institutes of Health Research (CIHR). The goal of the MOU is to identify and jointly fund mutually agreeable projects that capitalize on research and development capacity in universities, the private sector and DRDC; to build strong linkages between researchers in DRDC, CIHR, academia and industry; to transfer the results of research and technology to the public and private sectors; and to train and develop qualified personnel in priority areas, in anticipation of future needs in both these sectors.

Expanding Our Marketing Networks

DRDC participated in a variety of corporate marketing events with the aim of increasing our collaborative opportunities and enhancing our visibility with our allies, industry and academia. These events provided a showcase where we could demonstrate our capabilities and make our research and development partners and the Canadian Forces more knowledgeable about the science and technologies at their disposal. Some of the notable events of the past year are:

- Sponsored by the Canadian Defence Industries Association (CDIA), CANSEC 2004 brought together, for potential collaboration,

defence and national security practitioners and their supporting industry counterparts. This annual event provides an excellent opportunity for DRDC to demonstrate its capabilities in both the defence and the national security arenas.

- In conjunction with the CDIA, we presented the DRDC Technology Opportunities Day. The event focussed on “Commercialization – Then and Now” and included a consultative session on Industry Engagement on the Technology Demonstration Program.
- The Federal Partners in Technology Transfer Annual Conference & Workshop provided an excellent opportunity for networking and promoting as well as a chance to learn from other experts in the innovation arena, including technology transfer and intellectual property management professionals.
- For DRDC’s participation at the Farnborough Airshow 2004, one of the world’s premier aerospace business events, we engaged the Aerospace Engineering Test Establishment (AETE) for the first time and focussed our presentation on the combined research, development, test and evaluation capability of the Department of National Defence. This capability across the science and technology spectrum drew quite a bit of attention as it included the civilian capabilities of the National Research Council’s Institute of Aerospace Research as well as AETE and DRDC.



Canada/United States joint demonstration at the U.S. Army Science Conference

- DRDC participated for the first time at the 24th annual U.S. Army Science Conference, whose theme this year was “Transformational Science and Technology for the Current and Future Force.” The strong Canadian presence at this event emphasized the importance that Canada places on collaboration with the United States. Our participation at the event is expected to open doors to new shared research opportunities with the U.S. Army.
- The Alberta High-Tech Technology Opportunities Seminar prominently featured DRDC as Canada’s leader in the development of technology for defence and public security. It proved to be an excellent opportunity to network as well as to raise the profile of DRDC.

Augmenting Our Capacity

We augment our scientific and technological capacity by offering our services to clients outside the Department of National Defence and the Canadian Forces. By taking advantage of our expertise in niche technology areas, DRDC is

able to increase opportunities for research and development, build capacity to meet the needs of the Forces, and enhance public security.

DRDC's goal is to generate about \$10 million in revenues each year from business development activities. This year, we were able to realize revenues of \$10.8 million from external sources. The chart on the right shows our history of revenue generation over the last five years. It should be noted that these figures represent net revenues. Much of this revenue generated by DRDC is further leveraged by flow-through to our partners, particularly those in industry.

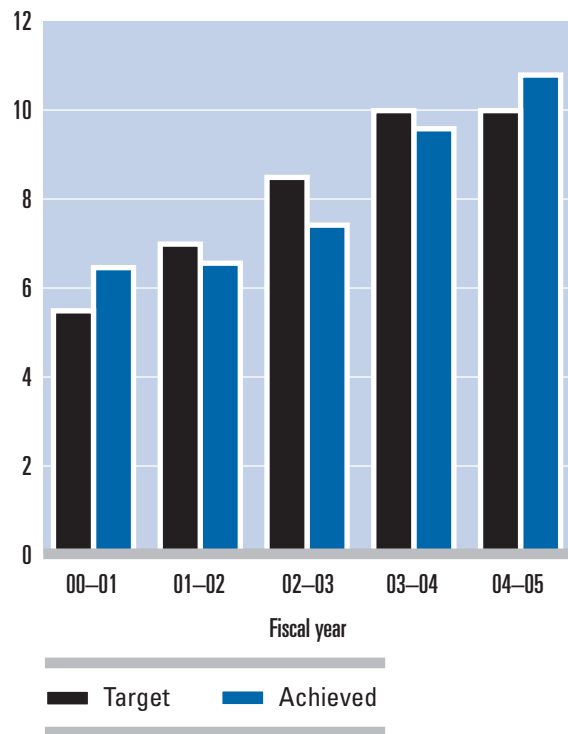
The following stories are just two examples of the work we have done for clients outside of the Department of National Defence and the Canadian Forces.

NEW AND IMPROVED FASSET

Under a contract with Harris Corporation of Melbourne, Florida, DRDC delivered the refurbished FASSET (Functional Advanced Development Model of an EHF Satellite Communications System for Evaluation and Test) to assist Harris in the development of their EHF modem. FASSET is an extremely high frequency (EHF) satellite communications payload and test bed that was developed in the 1990s for one of our research centres. Since Harris had no appropriate test equipment of its own, using FASSET was viewed as a means of mitigating the risk associated with the development of the modem.

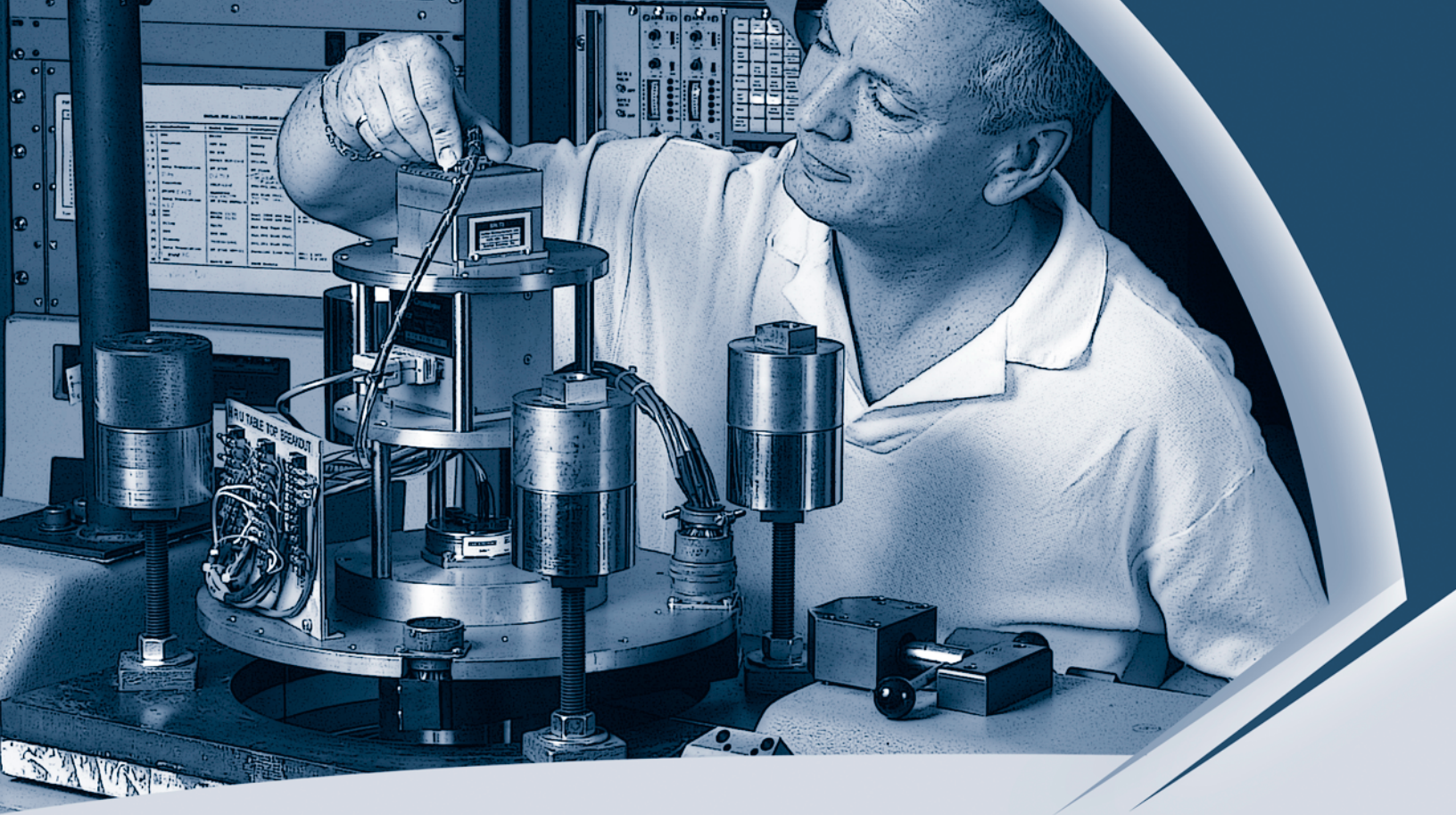
Under tight deadlines, DRDC faced the challenge of reviving a system that had been in storage for an extended period of time. We employed innovative techniques to replace and/or repair items that were no longer available, and made improvements to the FASSET system that enhanced its capabilities and performance. The refurbished system met or exceeded all of its objectives and resulted in a lease agreement and revenues of over \$450,000.

Revenues from external sources (\$M)



FERRET MOVES TO WATER

Through the Canada/United States Public Security Technical Program, DRDC was engaged to adapt the FERRET for a maritime environment. The FERRET is a passive acoustic system that detects and localizes small-arms fire. Recently deployed in Afghanistan, the FERRET was designed to operate from a light armoured Coyote vehicle. For operating in its new environment, FERRET was fitted with a Global Positioning System and a motion tracker/compass. In May 2005, the system was tested and proved to be well suited for the application. Final installation of the system on the U.S. and Canadian platforms took place in July 2005. This project saw an investment of \$200,000 for DRDC from the Canada/United States public security community.



PROMOTING OPERATIONAL EXCELLENCE

At DRDC, we aim for excellence in the conduct of all of our operations. Our goal is to provide high-quality and relevant science and technology products to the Department of National Defence and the Canadian Forces. Our approach to our activities – including the way we deliver our research and development programs, build relationships with our clients and partners, and strengthen our internal processes – reflects our commitment to achieving operational excellence.

Managing Organizational Performance

DRDC's credibility and success depends upon its ability to maintain its standing as a world leader in science and technology for defence and security. To ensure our continuing relevance on the world stage, we need to be certain that we are conducting the right science in the right way, and working towards the right goals. We do this through constant vigilance in overseeing our operations, using peer reviews and performance measurement.

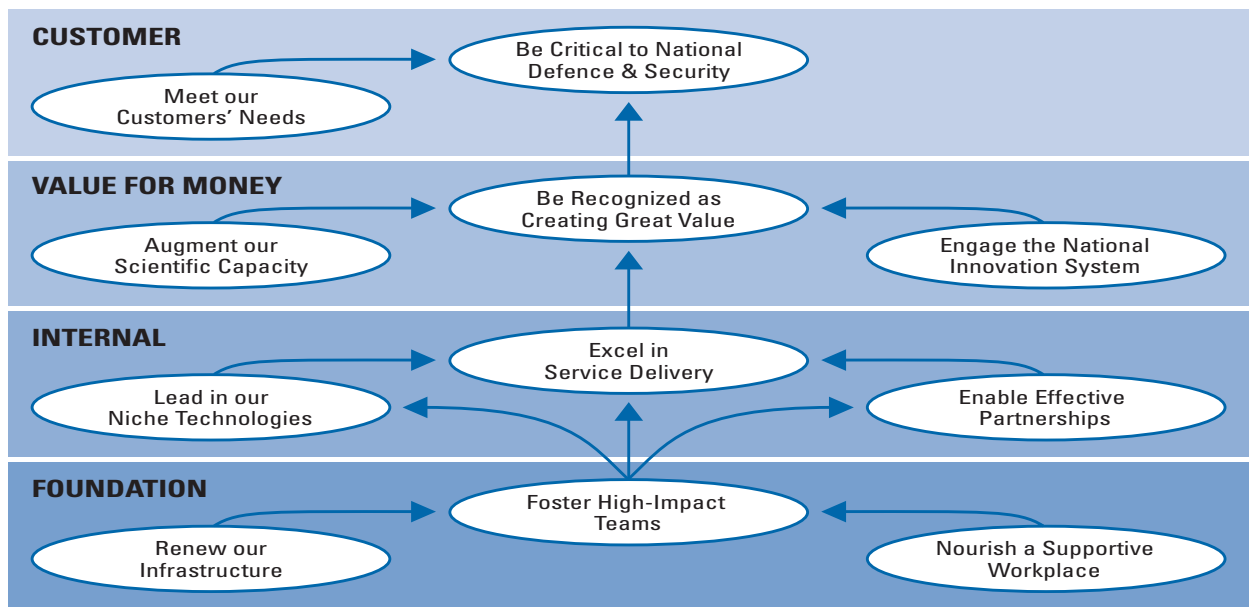
REVAMPING PEER REVIEWS

DRDC undertook a major overhaul of the peer review process. We created a more interactive proceeding, aimed at bringing together scientific managers and outside experts to develop recommendations to improve our science and technology program through a series of facilitated discussions. We applied the new process to

reviews of both Electro-Optical Warfare and Radio Frequency Electronic Warfare. The reports emanating from these two examinations were the best analysis of our research work, expertise, facilities and equipment to date. The peer review process continues to be updated and is being applied to those peer reviews conducted during the writing of this report. Part of this is the provision of a process for a generic response to the recommendations of the peer review.

MEASURING OUR PERFORMANCE

DRDC continued to monitor its performance by using measures and indicators for each of the strategic objectives of its Strategy Map. The DRDC Strategy Map is closely aligned with the Department of National Defence Strategy Map and works from four perspectives: Customer, Value for Money, Internal and Foundation. Each perspective is associated with two or three strategic objectives, areas in which we must excel to fulfil our mandate. Through monthly performance reports to senior management, we are able to identify and address areas where attention is needed.



DRDC Strategy Map

Leading in Our Niche Technologies

DRDC's vision is to be known worldwide as the best in science and technology for defence and security. We strive to achieve this vision through leadership in our niche technology areas as we deliver our science and technology program.

DRDC SCIENCE AND TECHNOLOGY PROGRAM

DRDC focusses its science and technology activities in areas of critical importance to future Canadian Forces 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 Science and Technology Program is comprised of our Research and Development Program and the provision of scientific analysis and advice to the Canadian Forces and the Department of National Defence. The Research and Development Program is developed in consultation with our client groups in the following areas: Maritime; Land; Air; Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) and Human Performance.

The Science and Technology 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 2004–2005, the total value of our Science and Technology Program was approximately \$307 million. (See Table 2 at the end of this report for more information on our S&T Program.)

Maritime

The Maritime research and development program is arranged in five thrusts: Maritime Integrated Above Water Warfare; Maritime Command and Control; Maritime Underwater Warfare; Naval Platform Technology; and Maritime Intelligence, Surveillance and Reconnaissance.

Land

The Land Force research and development program is organized along five thrusts: Command, Sense, Act, Shield and Sustain. These thrusts parallel the Army's operational functions.

Air

The Air Force research and development program is delivered through five thrusts: Air Force Command, Control, Intelligence, Surveillance and Reconnaissance; Air Combat Systems; Air Vehicle Systems; The Human in Air Systems; and Air Mission Systems.

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

The C4ISR research and development program comprises four thrusts: Command and Control / Information and Intelligence, Information Operations, Military Information Technology Infrastructure, and Space Systems and Technology for Defence Applications.

Human Performance

The Human Performance research and development program is packaged into five thrusts: Simulator Training Technologies; Military Operational Medicine; Diving and Underwater Intervention; Human Factors in Military Systems; and Defence Against Chemical, Biological and Radiological Hazards.

Providing scientific analysis and advice

DRDC provides strategic and operational advice to the Canadian Forces and the Department of National Defence on products and services related to science and technology. These activities are arranged in four thrusts: Technology Outlook, Scientific and Technical Intelligence Support and Advice, Science and Technology Services for Operations, and Operational Research.

The Research and Development Program is delivered via two interconnected mechanisms: the Applied Research Program and the Technology Demonstration Program. In addition to these, there are two programs designed to fund smaller projects: the Technology Investment Fund provides funding to DRDC scientists, and the Defence Industrial Research Program supports partnerships with Canadian industry. Projects in all four programs span the range of the Maritime, Land, Air, C4ISR and Human Performance client groups.

Some projects draw funds from more than one program. To avoid duplication in the tables at the end of this report, we apportion project figures according to the program from which they are funded.

Applied Research Program

The Applied Research Program (ARP) is designed to advance the knowledge base of defence science, investigate novel and emerging technologies, and explore the military application of those technologies.

In fiscal year 2004–2005, we expended approximately \$39 million on research and development contracts and received \$30 million in external contributions. (See Table 3 at the end of this report for more information on the ARP.)

Technology Demonstration Program

The Technology Demonstration Program (TDP) is designed to meet the challenges of developing new defence capability in the face of rapidly changing missions. Its objective is to demonstrate new technologies within the context of future capabilities, concepts, doctrine, operations and equipment for the Canadian Forces. The TDP is typically aimed at concept development and evaluation, with projects spanning three to four years in duration.

The Technology Demonstration Program expended approximately \$43 million in contracted research and development and received \$16 million in external contributions in fiscal year 2004–2005. (See Table 4 at the end of this report for more information on the TDP.)

Technology Investment Fund

The Technology Investment Fund (TIF) supports forward-looking, high-risk – but potentially high-payoff – research projects with potential for significant impact on military applications. External reviewers from universities and other research

organizations assess each proposal based on scientific merit, technical methodology, team capability and novelty. Proposals are also evaluated for potential military impact.

Typical projects are three years in duration, with a total contract budget of up to \$750,000. The results of successful TIF projects are subsequently absorbed into our Applied Research Program, thereby ensuring effective impact and uptake of ground-breaking research. The TIF expended approximately \$6 million in contracted research and development and received approximately \$1 million in external contributions in fiscal year 2004–2005. (See Table 5 at the end of this report for more information about the TIF.)

Defence Industrial Research Program

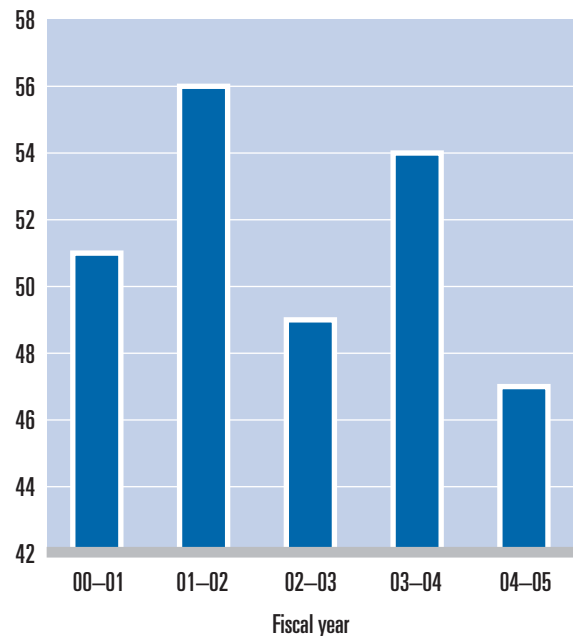
The Defence Industrial Research Program (DIRP) is our approach to working with private sector enterprises to identify and exploit emerging technologies with potential defence applications.

In fiscal year 2004–2005, the DIRP expended approximately \$6 million in research and development contracts and received approximately \$10 million in external contributions. (See Table 6 at the end of this report for more information about the DIRP.)

CAPITALIZING ON OUR INTELLECTUAL PROPERTY

DRDC manages its intellectual property through patents, copyrights, trademarks and licences. Over the course of the year, we were granted 19 patents and filed 28 new patents. (See Table 7 for a list of patents granted.) The following chart shows a five-year history of our patent activities.

Number of patents filed and issued



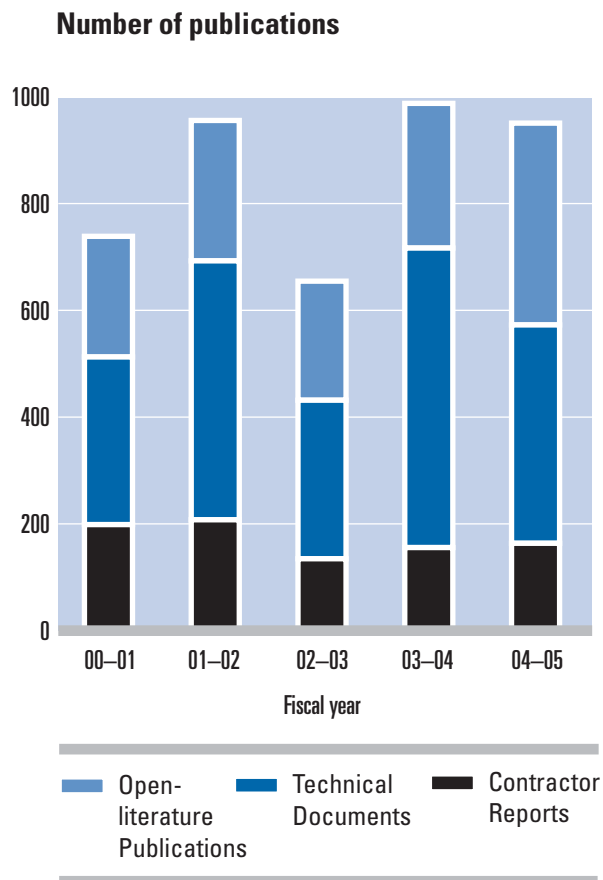
In addition, we issued four licences to Canadian companies for the commercial exploitation of our technologies, as follows:

- Black Coral Inc., for the Globe Geospatial Intelligence Tool;
- D-Fense Limited, for the Laser Underwater Camera Image Enhancer (LUCIE);
- Biokinetics and Associates Limited, for the Complex Lower Leg Surrogate; and
- Marentec Inc., for the Portable Analyzing Refractometer.

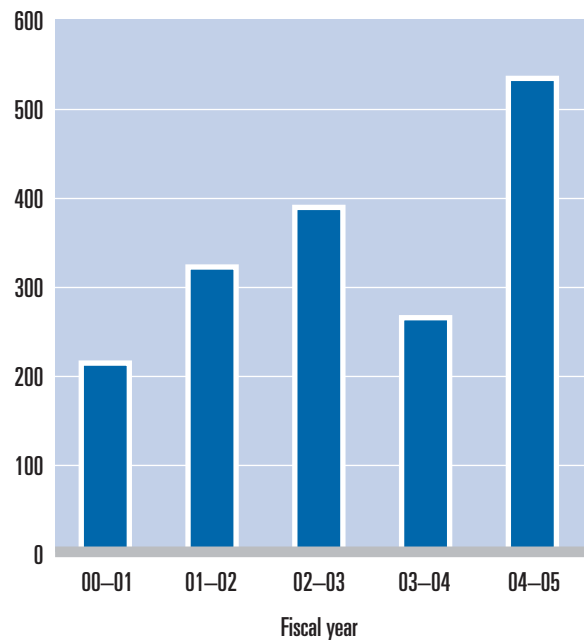
We received \$1.6 million in royalties; of this amount \$287,000 went to our inventors.

COMMUNICATING RESULTS

By promoting the results of our research and development activities, either through publication or conference presentation, DRDC transfers knowledge to clients in the Canadian Forces and the Department of National Defence 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 histories of our publication and presentation activities over the last five years.



Number of conference presentations



Building Effective Partnerships with the Canadian Forces

DRDC's continuing relevance to the Canadian Forces depends on promoting close and effective relationships with the Forces as they transform and evolve. Aligning our activities with theirs helps strengthen these relationships, which results in strategies and technological developments that serve their current and future needs. The following stories demonstrate some of our successes in building these vital partnerships.

WORKING WITH THE CANADIAN FORCES EXPERIMENTATION CENTRE

As a centre of excellence for joint concept development and experimentation, the Canadian Forces Experimentation Centre (CFEC) leads the exploration of emerging concepts and experimentation with new military capabilities. DRDC provides embedded scientific staff at CFEC who support joint concept development and experimentation by providing expert advice

on the design, conduct and evaluation of military experiments sponsored by Canadian Forces clients. In 2004–2005, DRDC collaborated with CFEC on two large experiments as part of an ongoing effort to refine the concepts of Network-Enabled Operations and Effects-Based Operations: the Atlantic Littoral Intelligence, Surveillance and Reconnaissance Experiment (ALIX) and the Multi-National Experiment III.



Collaborating with the Canadian Forces Experimentation Centre

RESPONDING TO NAVY TRANSFORMATION

DRDC is working with the Navy to develop a Campaign Plan to ensure that our thrusts are well aligned with evolving naval missions and with emerging technologies. The Campaign Plan seeks to link the research and development, operational research, and concept development and experimentation programs with the Strategic Capability Investment Plan (SCIP) and its capability-based planning objectives, and to ensure that these activities will have maximum impact for the Navy. The SCIP is the Department of National Defence's high-level approach to investment in defence capabilities for the next 15 years.

As part of the Campaign Plan, DRDC is ensuring that "way-ahead" studies are conducted on a regular basis for each thrust, with a nominal cycle of one study per year. The studies, typically spanning a year in length, include client membership from the supporting engineering organization, and review the operational requirements and acquisition plans of the Navy across all horizons. As a result of these studies, we plan to re-evaluate our research program and adjust our work programs accordingly.

EXPANDING ON OUR RESEARCH

Building on a small DRDC investment in the research, development and demonstration of a Human Systems Integration program, the Canadian Forces contributed significant funding to expand the program and to evaluate the

methodologies it defined. Human Systems Integration (HSI) is the technical domain leading to the integration of the areas of human factors, personnel, training, systems safety and health hazards into the materiel life cycle and operational doctrine to ensure safe and effective operability. The goals of HSI in the materiel life cycle are to incorporate effective human-system interfaces; minimize life cycle costs; and to manage the risk of loss of or injury to personnel, equipment and the environment.

As a result of this collaboration, DRDC realized a 1,450 percent return on its initial investment of \$273,000 over the five-year lifespan of the project. The success of this partnership is leading to recommendations on how to implement the process within the Department of National Defence.

Excellence in Service Delivery

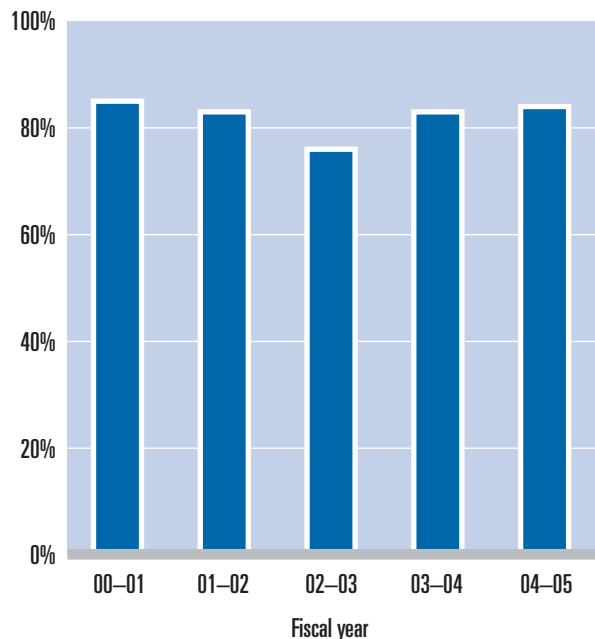
DRDC strives to achieve excellence by ensuring we deliver our products and services on time and within budget. We develop milestones for each project and evaluate our performance against those objectives. In this way, we can determine whether we are meeting our goals and providing services in a timely manner.

We also aim for excellence by continually improving our internal processes so that we become more effective and efficient, and better able to meet the needs of our clients.

MEETING OUR MILESTONES

The following chart shows DRDC's success in meeting project milestones over the past five years. This year, we achieved a completion rate of 84 percent. However, it should be noted that in meeting our milestones we will never reach 100 percent, in view of the uncertain nature of the conduct of research and development.

Milestones achieved



NEW PUBLICATION STANDARD

Publishing the findings of our scientific and technological research is one of DRDC's core functions. To assist scientists in the authoring process and to provide consistently high quality publications, we developed a new publishing standard; we also created a template to enable scientists to implement the new standard. As well, we facilitated the workflow between our research centres and the Corporate Office publishing and distribution section through the introduction of new software.

COSTING POLICY

DRDC introduced a costing policy that provides a consistent framework through which we can recover costs for the use of our facilities and services from our three main clients: the Department of National Defence and the Canadian Forces, other federal government departments and agencies, and external clients. Previously, no organizational policy existed, with the result that clients were being charged different amounts for similar work. Since becoming a special operating agency in 2000, we have examined our fees and how to make them consistent. Created by business development officers across the organization and the Resources and Administration group at DRDC Corporate Office, the Cost Recovery and Charging Policy outlines the types of costs that are applicable and establishes a fee structure. An implementation guide to support the policy is currently under development.

STRENGTHENING OUR INFORMATION TECHNOLOGY FOUNDATION

DRDC undertook the enhancement of our research and development network, and the addition of a new capability, to provide the foundation for the introduction of new tools and capabilities. We spent \$1.1 million to upgrade the infrastructure by acquiring new software, and to enhance employee skills and user support. We doubled the bandwidth of two of our research centres and replaced hardware and services across the network. All senior computer services staff completed their Information Technology Infrastructure Library certification of best practices, and we acquired new help desk and network manager software. The result is a smoother flow of traffic to and from our Intranet; reliable bandwidth for research and development experiments; and faster e-mailing, downloading and Internet connection times for both DRDC employees and external users connecting to our web sites.

IMPROVING CORPORATE EFFICIENCY

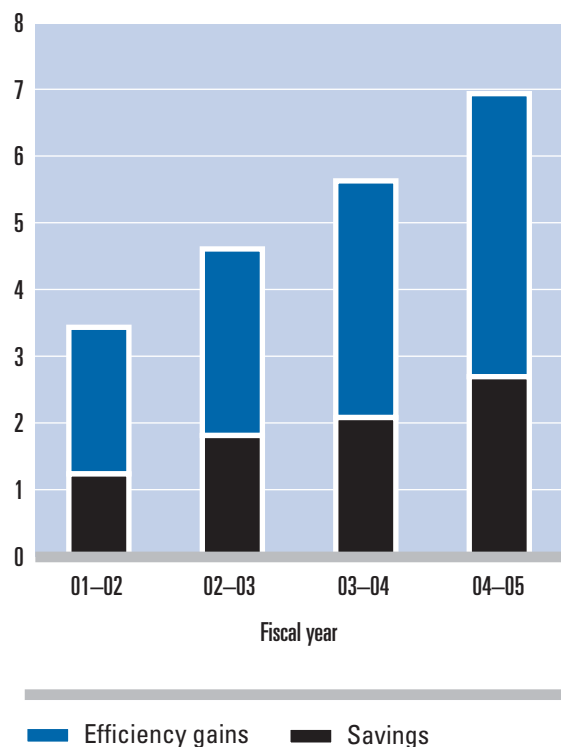
DRDC's corporate processes have become more efficient through the development of an electronic forms capability. We replaced the myriad of forms in various applications with new or enhanced bilingual versions of government, departmental and organizational forms. The new web-based forms application speeds the processing of workflow and permits electronic approval. It also allows the building of back-end databases to enable managers to create reports and perform analyses.

EFFICIENCIES AND SAVINGS

One of DRDC's key corporate commitments is to become more efficient. We do this by looking for ways to save money by reducing the costs of delivering services, and to increase our efficiency by doing more with the same resources. DRDC aims to realize \$6 million in savings, a goal we accomplished this year, having reached a cumulative total of \$6.9 million. In most cases, the savings have been reinvested in administrative and support activities.

The following chart shows the cumulative savings we have realized over the past four years.

Cumulative savings (\$M)





PEOPLE AND INFRASTRUCTURE

DRDC's success is fundamentally based on its skilled and professional people supported by state-of-the-art equipment and facilities. The investments we make in our employees – in providing them with valuable training opportunities, in creating a motivating environment and in maintaining a world-class infrastructure – all contribute to realizing our vision of being known worldwide as the best in science and technology for defence and security.

Enabling a Supportive Workplace

DRDC strives to support its people by developing new initiatives and building on government and departmental programs that enrich the work environment. The following stories demonstrate some of our efforts to create a supportive workplace.

MODERNIZING HUMAN RESOURCES

The *Public Service Modernization Act* (PSMA), which came into effect in April 2005, is the most significant human resources legislative reform in over 35 years. It was designed to facilitate hiring the right people where and when they are needed, to promote more collaborative labour-management relations, to focus on learning and training for employees at all levels and to clarify roles and accountability. The PSMA propels the necessary changes required to sustain a motivated, productive and competitive workforce.

In preparation for the implementation of the PSMA, DRDC participated in a revision of all related departmental policies to ensure that they reflected the new provisions of the act. In addition, DRDC reviewed two training packages, one for managers, and the other intended for other employees. While the training package for managers provided an in-depth analysis of their new roles and responsibilities, the training package for employees provided a general overview of the new act.

The PSMA highlights the employer's responsibility to determine the human resource requirements and provide for the allocation and effective utilization of these resources in

the Public Service. In keeping with this approach, DRDC developed a Human Resources Plan and raised awareness of the importance of the process within the human resources community.

PROMOTING OUR OFFICIAL LANGUAGES

DRDC is committed to promoting the use of Canada's official languages in the workplace. As part of this cultural evolution, DRDC recognizes the need to develop bilingualism amongst its managers and its employees. To this end, beginning in 2004, managers were encouraged to fully integrate second-language training into their career plans as early as possible, and to build it into DRDC's corporate learning plans as part of our investment in life-long learning to develop well-rounded, qualified and committed personnel.

This initiative is perfectly aligned with the new official languages policies and directives that came into force in April 2004 in the Public Service of Canada. These policies introduced changes to staffing and language training. Their objectives are to strengthen bilingual capacity in the Public Service and integrate language training into professional development.

WORKING TOWARDS EMPLOYMENT EQUITY

DRDC strives to build a workforce that is representative of the Canadian population. To track our progress towards this objective, we conduct periodic analyses of our workforce to identify areas of under-representation in the four designated groups: women, Aboriginal peoples, persons with disabilities and visible minorities. The following chart shows our performance compared to our objectives over the past two years. The plus (+) and minus (-) figures indicate the number of employees by which we exceed or fall short of our employment equity goals.

CATEGORY	WOMEN		ABORIGINAL PEOPLES		PERSONS WITH DISABILITIES		VISIBLE MINORITIES	
	2003	2004	2003	2004	2003	2004	2003	2004
Management	0	-1	0	0	0	0	0	0
Scientific and professional	-46	-10	-1	-3	-12	-14	-17	+23
Administrative and foreign service	+19	-7	+4	0	+3	-2	+1	-1
Technical	-74	-17	0	-3	-9	-5	-14	-21
Administrative support	+5	+6	0	-1	0	+3	-2	-3
Operational	-1	-2	0	-1	0	-1	+3	+1
Total	-97	-32	+3	-8	-18	-19	-29	-2

The findings show that, while there still remains under-representation in all of the designated groups, some progress has been made over the past year. We will continue to implement the measures laid out in the DRDC Employment Equity Plan to meet our goals, such as ensuring representative selection boards during competitive processes; stating our support for the Employment Equity Program on our job competition posters; and monitoring the results of job competitions, file audits and employment statistics to identify gaps and set goals.

A HELPING HAND FOR NEW EMPLOYEES

New employees go through an adjustment period that can sometimes prove to be a confusing and unsettling experience. To facilitate this transition period, DRDC built a framework for an organizational Orientation Program, designed to supplement other programs already in place at some of our research centres. Developed in conjunction with similar government and departmental initiatives, the program will help ensure that new employees have a positive experience and integrate quickly. The program describes roles and responsibilities of

employees at all levels and provides tools to be used through all stages of the orientation process. The program's ultimate goal is to improve employee learning, motivation, productivity, satisfaction and retention through a team effort at all levels of the organization.

MAKING THE JOB OF MANAGERS EASIER

To increase and enhance managers' awareness of the issues and challenges they face on a daily basis, and of their responsibilities associated with managing budgets and people, DRDC developed a two-day training session entitled "Managing in a Changing Environment." The first day was dedicated to financial and procurement management, and the second day to human resource management. We structured the course to provide participants with the opportunity to raise issues, exchange ideas and discuss challenges. Attendance was mandatory for all managers; however, other employees were strongly encouraged to attend. Over 200 managers and employees attended the two-day sessions, which were offered in all our centres.

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 for 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. This international organization promotes collaborative defence research among the five member nations: Australia, Canada, New Zealand, United Kingdom and the United States. The TTCP was created as a means to facilitate cooperation between the participants on defence applications of science and technology. Each year, the TTCP recognizes individuals who have made significant contributions to cooperative research activities as well as to enhancing the technological strength of military forces. This year, TTCP awards were granted to eight scientists from DRDC:

Fred Dilkes and **Pierre Lavoie**, for significant contributions and achievements in the development of new Electronic Support Measures library representations and processing algorithms, leading to improvements in the separation and identification of radar emitters;

Douglas Bell (retired) and **Tom McLellan**, for collaborative research that validated the operational effectiveness of caffeine in maintaining cognitive and physical function and marksmanship for both conventional and Special Forces personnel during periods of sustained continuous operation; and

Robert Burton, **Mark Hazen**, **Barry Richards** and **Paul Sutherland**, for excellence in research on the implications of network-centric maritime warfare (NCMW). Their collaborative work helped to establish the foundational first principles of force networking from a coalition perspective, and resulted in the development of unique and creative models and metrics applicable to NCMW analysis.

NATO AWARDS

Denis Faubert received the North Atlantic Treaty Organization (NATO) Excellence Award as outgoing chair of the Sensors and Electronics Panel, for his valuable contribution to the work of this international organization.

PUBLIC SERVICE AWARDS

Guy Ampleman and **Sonia Thiboutot** received the Public Service Excellence Award for their outstanding contribution to the project that deals with the environmental aspects of munitions to ensure sustainable training for the Canadian Forces.

DEPARTMENTAL AWARDS

Phyllis Browne and **Ross Pigeau** received the 2004 Deputy Minister / Chief of the Defence Staff Innovation Award, for their vision, dedication and effort in the development of the manual *Duty with Honour: The Profession of*

Arms in Canada. Thanks to their contribution, this manual is the definitive document on the Canadian Military Ethos, and demonstrates how Canada's profession of arms serves the national interest.

Denis Faubert received the 2005 Deputy Minister / Chief of the Defence Staff Innovation Award for his contribution to the development of the Technopôle – Defence and Security concept.

Pierre Lessard was awarded the Commendation for Ethics of the Ombudsman for National Defence and Canadian Forces, in recognition of his exemplary dedication to the values of integrity, honesty, fairness and openness.

Jean-Marc Julien received the 2005 Deputy Minister Commendation for his leadership and diligent management of the infrastructure and environment at DRDC Valcartier.

DRDC AWARDS

Performance Excellence Award

Paul Bender, for outstanding and sustained scientific leadership in human resources modelling, and for support to the department in modelling and analysis of deployed operations and force structure options;

Sanela Dursun, for outstanding contribution to the Defence Ethics Program through hard work, dedication and innovative research, which garnered national and international attention;

George Schattschneider, for excellence in the development and creation of innovative electronic systems in underwater electro-magnetic detection systems and ship signature reduction, recognized worldwide as being without equal;

The **CBRN (chemical, biological, radiological and nuclear) Research and Technology Initiative (CRTI) Secretariat**, for outstanding achievement in establishing and growing the CRTI as a recognized pillar of Canada's defence against CBRN threats, through its community building and its scientific program for innovation within the academic, industrial and government science and technology communities. Team members included **Camille Boulet, Shaye K. Friesen, Alain Goudreau, David Griffin, Kirsten McDowell, Susan McIntyre, Allan Parisien, Margaret Porter-Greene, Dorothy Schryburt, Helen Spencer, Ted Sykes, Robert Walker** and **Norman Yanofsky**; and

The **Future Armoured Vehicle Systems (FAVS) project team**, for developing a unique vehicle prototype for the military that provides a concept for the future of armoured vehicles with combined surveillance, protection and navigation features. Team members included **Ron Anderson, Stephen Bogner, Yves Bouchard, James Cruickshank, Yves De Villers, Jean Dumas, Richard Durand, Maj (Ret'd) Mark Espenant, Alain Fernet, Jean Fortin, Stéphane Giroux, Bruno Gravel, Sgt Marc Grenier, André Houde, Maj (Ret'd) Pierre Lapierre, Jean Maheux, Pierre Mathieu, Georges Ménard, Benoît Montminy, Paul Pace, Ghislain Pelletier, Maj Yan Poirier, David Saint, Jocelyn Tessier** and **Éric Thibeault**.

ADM (S&T) Commendation Award

Jos Verreault, for his sustained performance, excellence and outstanding knowledge of DRDC strategic and financial issues, which are an essential element of our success in obtaining substantial resources, and which have ensured the ongoing resource stability in DRDC.

Outstanding Performance Award

Lisa Monette, for successfully planning and implementing a communications program for the Multi-Mission Effects Vehicle (MMEV) Technology Demonstration Project;

LCol Robert Poisson, for continuous high-quality work and dedication to his professional responsibilities; and

Philip Staal, for consistent high-quality and high-impact contributions to DRDC, frequently beyond the call of duty.

Leadership and Creative Management awards

Caroline Légaré, for significantly surpassing expectations and for developing and maintaining a positive relationship with DRDC's representative unions;

Jean-Maurice Rioux, for his work in managing the MATLAB computing environments at DRDC Ottawa;

Julie Tremblay-Lutter, for significant, sustained and impressive contributions to improving the quality of the work of teams of scientists from DRDC and the international community involved with chemical and biological individual protection; and

Lucie Martineau and **Henry Peng**, who inspired a group of students through their example of dedication and passion for their work.

Performance Recognition Award

Doug Lambert, **Bruce Liao**, **Pierre Richer** and **Lyle Wagner**, for outstanding work that resulted in the successful delivery of the FASSET system; and

Kathie McHale, in recognition of her dedication in providing outstanding administrative support.

Outstanding Contribution Award

Robert Gervais, for his ongoing dedication to client service;

Alain Joyal, in recognition of his sustained effort in the development of the Military Digital Analysis System (MiDAS);

Jim Rody, **Lauchie Scott** and **Brad Wallace**, for providing exceptional support to the Canadian Forces' Surveillance of Space Project (SAPPHIRE);

David Schlingmeier, for his exceptional support to DRDC Ottawa operations; and

Mike Vinnins and **Caroline Wilcox**, for their ongoing leadership in support of DRDC Ottawa's Employee Association Committee.

Stockhausen Award

Gordon Ebbeson, for his significant contribution to the research and development program in the areas of broadband correlation and acoustic propagation, and for his consistent effort and enthusiasm during his years as an Employees' Association executive.

Outstanding Achievement Award

Dawn Gardham, for her role in the planning, management and completion of Phase 1 of a major building upgrade project at DRDC Toronto; and

Rhonda Sutherland, for her creativity and initiative in implementing electronic publishing and developing sound internal procedures at DRDC Atlantic.

Teamwork Award

Eric Fresque, LCol Rob Poisson, Shawn Rhind and **Pang Shek**, for their commitment to using the teamwork approach in making the Combat Fluid Resuscitation Interoperable Capability (CFRIC) clinical trial a major success; and

Greg Baker, John Bottomley, LCdr Mario Boutin, Chris Browne, David Chapman, Prakash Deonarine, David Hazen, Gavin Hemphill, Mike Keddy, Mel MacKenzie, Brian Maranda, Sean Pecknold, Isaias Peraza, Trevor Ponee, Ken Rhyno, Bill Roger, Bruce Skinner, Grant Stocker and **Jim Theriault**, for being integral members of DRDC Atlantic's team of scientists, engineers and technologists whose combined leadership, expertise and dedication contributed to the success of the Towed Integrated Active-Passive Sonar (TIAPS) project.

PROFESSIONAL AWARDS

John Leggat, DRDC's former Chief Executive Officer, was welcomed into the prestigious Canadian Academy of Engineering, an independent, self-governing organization that addresses matters of Canadian engineering concern. Fellows of the Academy include engineers from all disciplines elected by their peers on the basis of their distinguished achievements and their contributions to the profession, to the country and to society.

Bob Cheung was elected Fellow of Aerospace Medical Association at its 75th Annual Scientific Conference, for his significant contribution to aerospace medical research.

OTHER AWARDS

Patrick Brousseau received the Thomas C. Keefer medal from the Canadian Society for Civil Engineering for his contribution as co-writer of the article entitled "Carbon monoxide poisoning associated with blasting operations close to underground enclosed spaces."

Robert Charpentier and **Frédéric Painchaud**, along with students of *l'École Polytechnique de Montréal*, won the OCTAS *Relève universitaire* prize for their creation of SOCLe (Secure OCL extensions), an innovative tool for use in the design phase of software development.

Michael Crawford received the ORBITA Award for the project report entitled *Capabilities and Tactics Versus Small Boat Swarms*.

Paul Labbé, First Secretary of TTCP, was honoured with an Enduring Achievement Award from the U.S. Department of Defense, Office of the Assistant Secretary of Defense for Networks and Information Integration. The award was given for his many contributions to the body of knowledge related to command and control, as well as for his efforts to build a professional community of researchers.

Mark McIntyre earned the Gary F. Wheatley Best Paper Award at the 10th International Command and Control Research and Technology Symposium, for co-writing the paper entitled "An Operational Framework for Battle in Network Space."

Michel Paul received the William E. Collins Award from the Aerospace Human Factors Association, for outstanding human factors publication of the year, *Sleep-inducing pharmaceuticals: A comparison of melatonin, zaleplon, zopiclone and temazepam*.

Stephen Murray was presented with the 2005 Rem Soloukhin Award for outstanding contribution in the experimental or diagnostics aspects of the Dynamics of Explosions and Reactive Systems.

Susan Truscott received the Harry Greer Award from the International Military Testing Association, for her long-standing exceptional work contributing to the purpose and aims of the Association.

Paris Vachon received a commendation from the Canadian Aeronautics and Space Institute Council, in recognition of his sustained commitment and the many invaluable initiatives taken as Editor-in-Chief in support of the *Canadian Journal of Remote Sensing*.

The U.S. Consul General to Calgary honoured **Camille Boulet, Jim Ho, Bill Kournikakis, Lt(N) Megan McKenzie, Jim Ogston** and **Mel Spence** for their efforts in responding to the anthrax bioterrorism events of 2001. The only international group asked for assistance, these scientists were requested to go to the Brentwood Postal Facility in Washington, D.C. where two workers had been killed and two others infected by anthrax, to test the air for traces of anthrax. Fluorescent Aerodynamic Particle Sizer (FLAPS) technology and slit samplers were used to help determine the presence and quantity of anthrax in the building.

Anne-Claire Boury-Brisset, Marlène Gauvin and **Gaétan Thibault** were recognized for their significant contributions to the Lessons Learned Knowledge Warehouse project, which won the 2004 Diamond Award of Excellence from the

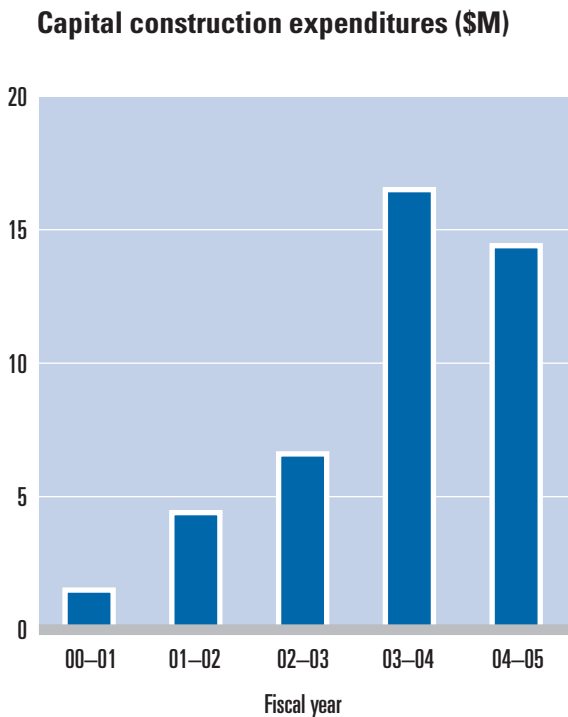
Canadian Information Productivity Awards (CIPA), as the best information technology (IT) project implemented in Canada. CIPA is the most prestigious awards program in the field of IT innovation, recognizing the ability of Canadian organizations to change, adapt and innovate. The project also won the Gold Award in the Efficiency and operational improvements category, and an OCTAS in the E-training and knowledge management category from the *Fédération de l'informatique du Québec*.

DRDC Valcartier was presented with the *Fidéide Hommage 2005* award by the *Chambre de commerce des entrepreneurs de Québec* for its 60 years of history and progress, and for its contribution to the Québec region.

Renewing Our Infrastructure

DRDC's major initiative to renew its infrastructure is continuing at a steady pace. For over 10 years, as a result of severe funding reductions, the investment injected into our facilities was minimal, resulting in their deterioration. This initiative is aimed at correcting the situation. Several projects are planned and many of them are already under way, notably a major renovation of the main laboratory complex at DRDC Toronto and a major upgrade of the road system at the Experimental Proving Grounds at DRDC Suffield.

The following chart shows our expenditures on capital construction over the last five fiscal years.



The following stories highlight two major projects that were completed during this last year.

MOVING TO A NEW HOME ...

After four decades of providing service to the Canadian Navy from a circa 1940 building unsuited to their needs, DRDC Atlantic's Emerging Materials Section was relocated to a newly renovated edifice adapted to their requirements. With funding of \$3.8 million, spatial and functional requirements were taken into consideration in the architectural design of the new facility. For example, in contrast to the old

metallographic laboratory, which had poor workflow and inadequate separation of clean and dirty operations, the new structure was designed to separate dirty grinding operations from cleaner polishing operations and provides an ergonomically designed space that facilitates the required workflow. Microscope rooms were separated and enhanced with variable lighting to assist the eye adjustment that occurs when using a microscope. The laboratory was equipped with low vibration benches and air, water and power for in-situ experiments. The air was appropriately filtered to reduce dust build-up on microscope optics.

... AND REFURBISHING AN OLD ONE

DRDC also undertook the refurbishment of the French Cable Building at our Atlantic research centre to provide increased office space for scientists and workstations for technologists. The repairs included the complete electrical rewiring of the building, a new roof and heating plant, air conditioning and upgraded network cabling. Special labs were constructed and equipped for electromagnetic testing and ceramic work. The basement of the building was designed as an industrial workspace for facilitating preparation of equipment and for the maintenance and storage of scientific equipment. The building was also equipped with water tanks for the calibration of hydrophones as part of our underwater acoustics program. The exterior of the building, constructed in 1916, was restored to its original appearance. Costing approximately \$2.4 million, the renovations served to increase usable workspace by 1,500 square metres and provided improved work environments for a considerable number of staff.

FINANCIAL STATEMENT

This table summarizes the funds DRDC received and expended in fiscal year 2004–2005 to carry out its program. The values shown are thousands of dollars, with negative variances shown in parentheses.

FUND TYPE	REVENUES (\$000)	EXPENDITURES (\$000)	VARIANCE (\$000)
Salary and Wages	88,805	96,451	(7,646)
Operations and Maintenance	24,726	25,873	(1,147)
R&D Contracting	94,197	94,237	(40)
Capital – R&D Equipment, Construction	7,462	13,492	(6,030)
Environment	5,336	1,654	3,682
CCMAT – Salary and Wages, Operations and Maintenance	2,911	2,115	796
CRTI – Salary and Wages, Operations and Maintenance, R&D Contracting	27,400	30,417	(3,017)
CRTI – Capital Equipment	4,000	2,954	1,046
CTTC – Salary and Wages, Operations and Maintenance	4,000	1,500	2,500
Local Revenues and Intellectual Property	6,356	0	6,356
Revenues from Collaborative Agreements	2,822	0	2,822
Transfers from Other Government Departments	1,636	0	1,636
Total	269,651	268,693	958

Notes:

- The difference between the Revenues and the Expenditures for 2004–2005 is due to the following:
 - Salary and wage costs were higher than anticipated due to allowances, bonuses and salary increases paid to certain employment groups.
 - Capital research and development requirements were higher than anticipated.
- An additional amount of approximately \$10 million, funded by sources other than DRDC's budget allocation, was spent on capital construction.
- CCMAT is the Canadian Centre for Mine Action Technologies.
- CRTI is the Chemical, Biological, Radiological and Nuclear (CBRN) Research and Technology Initiative.
- CTTC is the Counter Terrorism Technology Centre.

TABLES

TABLE 1:
DEFENCE R&D CANADA'S CENTRES

Defence R&D Canada (DRDC) is made up of six research centres – each with a unique combination of expertise and facilities to carry out world-class research and development – in addition to a programs centre and a corporate services centre.

Defence R&D Canada – Atlantic

DRDC Atlantic possesses world-leading expertise in anti-submarine warfare, mine and torpedo defence, shipboard command and control, and air and naval platform technology. It also has growing research programs in emerging materials, signature management, maritime information and knowledge management, virtual platforms and virtual combat systems.

Defence R&D Canada – Valcartier

DRDC Valcartier is our main facility for combat, optronics and information systems. Scientists and technicians from all these disciplines cooperate closely in dealing with complex integration issues in order to support the current and future operations of the Canadian Forces.

Defence R&D Canada – Ottawa

DRDC Ottawa is our lead authority and centre of expertise for the exploitation of radio frequency communications, space systems, network information operations, synthetic environments and radiological defence.

Defence R&D Canada – Toronto

DRDC Toronto is Canada's leader in defence research and development for human protection and performance in extreme environments, human systems integration, command effectiveness and behaviour, simulation and modelling, and military operational medicine. Its mission is to enhance the effectiveness and ensure the health and safety of the human in any human-machine system or adverse environment.

Defence R&D Canada – Suffield

DRDC Suffield is one of Canada's main defence science and technology assets and has 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, mobility systems and weapons system evaluation. The Canada Centre for Mine Action Technologies and the Counter-Terrorism Technology Centre are co-located with and supported by DRDC Suffield.

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

DRDC CORA provides expert, objective and timely operational research, analytical support, and advice to the Canadian Forces and the Department of National Defence. The effort supports force development, resource allocation, acquisition, improved operational effectiveness and efficiency, strategic analysis, scientific and technical intelligence, and the achievement of departmental policy and human resource goals.

Defence R&D Canada – Programs

DRDC Programs provides central coordination and strategic planning for our science and technology programs through interfaces with our client groups in the Canadian Forces and with 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, the Department of National Defence and the Government of Canada.

**TABLE 2:
DRDC SCIENCE AND TECHNOLOGY PROGRAM¹ FOR FISCAL YEAR 2004–2005**

THRUST	INTERNAL COSTS ² (\$000)	R&D CONTRACTS (\$000)	EXTERNAL CONTRIBUTIONS ³ (\$000)	TOTAL VALUE (\$000)
Maritime				
Maritime Integrated Above Water Warfare	4,797	4,063	750	9,610
Maritime Command and Control	4,663	3,705	1,511	9,879
Maritime Underwater Warfare	9,205	5,194	5,385	19,784
Naval Platform Technology	5,200	2,898	996	9,093
Maritime Intelligence, Surveillance and Reconnaissance	3,273	4,797	2,700	10,770
Sub-total	27,138	20,657	11,341	59,137
Land				
Command	1,953	2,065	468	4,486
Sense	9,246	7,704	5,399	22,350
Act	7,101	8,581	1,814	17,497
Shield	6,750	4,297	5,961	17,007
Sustain	2,677	1,735	2,440	6,852
Sub-total	27,727	24,383	16,082	68,191
Air				
Air Force C2ISR	5,110	5,968	2,497	13,575
Air Combat Systems	4,845	3,437	4,380	12,662
Air Vehicle Systems	580	4,320	4,073	8,973
The Human in Air Systems	2,365	1,433	357	4,154
Air Mission Systems	910	1,053	1,041	3,004
Sub-total	13,809	16,210	12,348	42,368
Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance				
Command and Control / Information and Intelligence	6,144	6,725	3,572	16,441
Information Operations	5,896	4,050	381	10,327
Military Information Technology Infrastructure	6,131	2,499	268	8,897
Space Systems and Technology for Defence Applications	6,516	6,469	4,741	17,725
Sub-total	24,686	19,743	8,961	53,390

¹ The S&T Program includes the R&D Program and the provision of scientific analysis and advice. The R&D Program includes the Applied Research Program, the Technology Demonstration Program, the Technology Investment Program and the Defence Industrial Research Program. For more information on these programs, please refer to the following tables and to the section entitled "Leading in Our Niche Technologies."

² Internal costs include salary and wages, overhead, and operations and maintenance.

³ External contributions include cash and in-kind contributions from sources external to DRDC.

TABLE 2: CONTINUED

THRUST	INTERNAL COSTS (\$000)	R&D CONTRACTS (\$000)	EXTERNAL CONTRIBUTIONS (\$000)	TOTAL VALUE (\$000)
Human Performance				
Simulator Training Technologies	1,585	1,827	1,822	5,233
Military Operational Medicine	1,059	2,259	1,659	4,977
Diving and Underwater Intervention	1,492	247	150	1,889
Human Factors in Military Systems	2,009	1,593	1,682	5,285
Defence Against CBR Hazards	11,019	8,196	3,292	22,507
Sub-total	17,164	14,122	8,605	39,891
Sub-total R&D Program	110,524	95,115	57,338	262,976
Providing Scientific Analysis and Advice				
Technology Outlook	2,377	661	0	3,038
Scientific and Technical Intelligence Support and Advice	3,346	1,623	0	4,969
Science and Technology Services for Operations	9,515	0	77	9,592
Operational Research	26,970	0	0	26,970
Sub-total	42,208	2,285	77	44,570
Total S&T Program	152,732	97,399	57,415	307,546

TABLE 3:
APPLIED RESEARCH PROGRAM (ARP) FOR FISCAL YEAR 2004–2005

THRUST	INTERNAL COSTS ¹ (\$000)	R&D CONTRACTS (\$000)	EXTERNAL CONTRIBUTIONS ² (\$000)	TOTAL VALUE (\$000)
Maritime				
Maritime Integrated Above Water Warfare	4,105	1,555	200	5,860
Maritime Command and Control	3,298	1,779	1,421	6,499
Maritime Underwater Warfare	7,467	2,310	3,780	13,557
Naval Platform Technology	4,798	1,707	798	7,303
Maritime Intelligence, Surveillance and Reconnaissance	1,439	790	1,200	3,429
Sub-total	21,107	8,141	7,399	36,647
Land				
Command	1,125	470	0	1,595
Sense	7,090	1,943	114	9,146
Act	3,232	1,804	300	5,336
Shield	5,019	2,331	1,483	8,833
Sustain	2,504	1,115	2,200	5,819
Sub-total	18,970	7,663	4,097	30,729
Air				
Air Force C2ISR	3,750	2,383	1,884	8,017
Air Combat Systems	4,675	2,892	3,908	11,475
Air Vehicle Systems	545	3,455	3,015	7,015
The Human in Air Systems	2,349	1,301	200	3,850
Air Mission Systems	802	336	0	1,138
Sub-total	12,121	10,367	9,007	31,495
Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance				
Command and Control / Information and Intelligence	2,677	1,154	110	3,941
Information Operations	5,258	3,276	60	8,594
Military Information Technology Infrastructure	5,421	1,190	15	6,626
Space Systems and Technology for Defence Applications	5,200	1,955	3,813	10,967
Sub-total	18,556	7,575	3,998	30,128
Human Performance				
Simulator Training Technologies	1,469	774	1,501	3,744
Military Operational Medicine	856	1,200	809	2,865
Diving and Underwater Intervention	1,492	247	150	1,889
Human Factors in Military Systems	1,883	897	46	2,826
Defence Against CBR Hazards	10,314	2,505	3,151	15,970
Sub-total	16,014	5,623	5,657	27,294
Total	86,767	39,369	30,157	156,293

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 4:
TECHNOLOGY DEMONSTRATION PROGRAM (TDP) FOR FISCAL YEAR 2004–2005**

THRUST	INTERNAL COSTS ¹ (\$000)	R&D CONTRACTS (\$000)	EXTERNAL CONTRIBUTIONS ² (\$000)	TOTAL VALUE (\$000)
Maritime				
Maritime Integrated Above Water Warfare	536	2,063	450	3,049
Maritime Command and Control	1,277	1,676	0	2,953
Maritime Underwater Warfare	1,546	2,225	1,365	5,136
Naval Platform Technology	223	619	0	843
Maritime Intelligence, Surveillance and Reconnaissance	1,834	4,007	1,500	7,341
Sub-total	5,417	10,591	3,315	19,323
Land				
Command	811	1,300	0	2,111
Sense	1,946	4,856	4,551	11,353
Act	3,647	5,617	637	9,900
Shield	1,731	1,823	3,263	6,817
Sustain	0	0	0	0
Sub-total	8,134	13,596	8,451	30,181
Air				
Air Force C2ISR	1,010	2,506	533	4,049
Air Combat Systems	0	60	272	332
Air Vehicle Systems	0	0	0	0
The Human in Air Systems	0	0	0	0
Air Mission Systems	0	0	0	0
Sub-total	1,010	2,566	805	4,381
Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance				
Command and Control / Information and Intelligence	3,452	5,034	2,724	11,210
Information Operations	621	462	0	1,084
Military Information Technology Infrastructure	710	1,309	253	2,272
Space Systems and Technology for Defence Applications	1,170	3,861	560	5,591
Sub-total	5,954	10,666	3,537	20,156
Human Performance				
Simulator Training Technologies	115	1,053	0	1,168
Military Operational Medicine	12	200	0	212
Diving and Underwater Intervention	0	0	0	0
Human Factors in Military Systems	0	0	0	0
Defence Against CBR Hazards	490	4,692	63	5,245
Sub-total	617	5,945	63	6,625
Total	21,132	43,363	16,171	80,665

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 5:
TECHNOLOGY INVESTMENT FUND (TIF) FOR FISCAL YEAR 2004–2005**

THRUST	INTERNAL COSTS ¹ (\$000)	R&D CONTRACTS (\$000)	EXTERNAL CONTRIBUTIONS ² (\$000)	TOTAL VALUE (\$000)
Maritime				
Maritime Integrated Above Water Warfare	156	445	100	701
Maritime Command and Control	88	250	90	428
Maritime Underwater Warfare	175	500	75	750
Naval Platform Technology	179	510	136	825
Maritime Intelligence, Surveillance and Reconnaissance	0	0	0	0
Sub-total	597	1,705	401	2,703
Land				
Command	0	0	0	0
Sense	158	450	0	608
Act	156	445	0	601
Shield	0	0	0	0
Sustain	137	390	0	527
Sub-total	450	1,285	0	1,735
Air				
Air Force C2ISR	350	1,000	0	1,349
Air Combat Systems	170	485	200	855
Air Vehicle Systems	35	100	0	135
The Human in Air Systems	0	0	0	0
Air Mission Systems	89	255	330	674
Sub-total	644	1,840	530	3,014
Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance				
Command and Control / Information and Intelligence	0	0	0	0
Information Operations	0	0	0	0
Military Information Technology Infrastructure	0	0	0	0
Space Systems and Technology for Defence Applications	112	320	35	467
Sub-total	112	320	35	467
Human Performance				
Simulator Training Technologies	0	0	0	0
Military Operational Medicine	168	480	0	648
Diving and Underwater Intervention	0	0	0	0
Human Factors in Military Systems	88	250	0	338
Defence Against CBR Hazards	199	569	0	768
Sub-total	455	1,299	0	1,754
Total	2,257	6,449	966	9,672

¹ Internal costs have been estimated as a percentage of R&D contracts.

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

**TABLE 6:
DEFENCE INDUSTRIAL RESEARCH PROGRAM (DIRP) FOR FISCAL YEAR 2004–2005**

THRUST	INTERNAL COSTS ¹ (\$000)	R&D CONTRACTS (\$000)	EXTERNAL CONTRIBUTIONS ² (\$000)	TOTAL VALUE (\$000)
Maritime				
Maritime Integrated Above Water Warfare	0	0	0	0
Maritime Command and Control	0	0	0	0
Maritime Underwater Warfare	17	159	165	340
Naval Platform Technology	0	62	62	124
Maritime Intelligence, Surveillance and Reconnaissance	0	0	0	0
Sub-total	17	220	227	464
Land				
Command	18	295	468	781
Sense	52	456	735	1,243
Act	66	716	877	1,659
Shield	0	143	1,215	1,357
Sustain	36	230	240	506
Sub-total	173	1,839	3,534	5,547
Air				
Air Force C2ISR	0	80	80	159
Air Combat Systems	0	0	0	0
Air Vehicle Systems	0	764	1,058	1,823
The Human in Air Systems	15	132	157	304
Air Mission Systems	19	462	711	1,192
Sub-total	34	1,438	2,006	3,478
Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance				
Command and Control / Information and Intelligence	15	538	738	1,290
Information Operations	17	312	321	649
Military Information Technology Infrastructure	0	0	0	0
Space Systems and Technology for Defence Applications	34	333	333	700
Sub-total	65	1,182	1,392	2,639
Human Performance				
Simulator Training Technologies	0	0	321	321
Military Operational Medicine	23	379	850	1,252
Diving and Underwater Intervention	0	0	0	0
Human Factors in Military Systems	39	446	1,636	2,122
Defence Against CBR Hazards	16	430	78	524
Sub-total	78	1,255	2,885	4,218
Total	367	5,935	10,044	16,346

¹ Internal costs include salaries of DRDC personnel managing the program, plus overhead.

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

**TABLE 7:
PATENTS GRANTED**

The following patents were granted during fiscal year 2004–2005:

- Highly Accurate Digital to Analog Converter
- Comfort Liner for Chemical Protective and Other Impermeable Polymer Gloves
- Cloning, Expression, Sequencing and Functional Enhancement of Monoclonal ScFv Antibody Against VEE Virus
- Construction and Characterization of Monoclonal Antibodies Against Western Equine Encephalitis Virus
- Strain of the Western Equine Encephalitis Virus
- Field-Deployable Forced Air Warming System
- Laser Diode-Excited Biological Particle Detection System
- Nozzles for Pyrophoric IR Decoy Flares
- Combination Vaccine for Enhancing Immunity Against Brucellosis
- Apparatus for Dithering
- Landmine Neutralizer Using a High-Power Microwave Device
- XDM Pyrophoric Countermeasure Flare
- Fluted Link for Wiring
- Hidden Markov Modelling for Radar Electronic Warfare
- Flow-through Device for Ultrasonic Destruction of Micro-organisms in Fluids
- Force Generating System
- Active Cooperative Tuned Identification Friend or Foe (ACTIFF)
- Method and Device for Measuring Systolic and Diastolic Blood Pressure and Heart Rate in an Environment with Extreme Levels of Noise and Vibrations
- A Propellant Composition Containing Energetic Copolyurethane Thermoplastic

CONTACT INFORMATION

DRDC publishes this report annually to describe its operations for the previous fiscal year, and includes information about DRDC's performance with respect to the objectives established in its business plan, its financial performance, and any other information that the Deputy Minister of National Defence may require to be included.

Reports like this one should meet audience expectations. 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 defence R&D. We invite you to get in touch with us should you have any suggestions or questions.

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