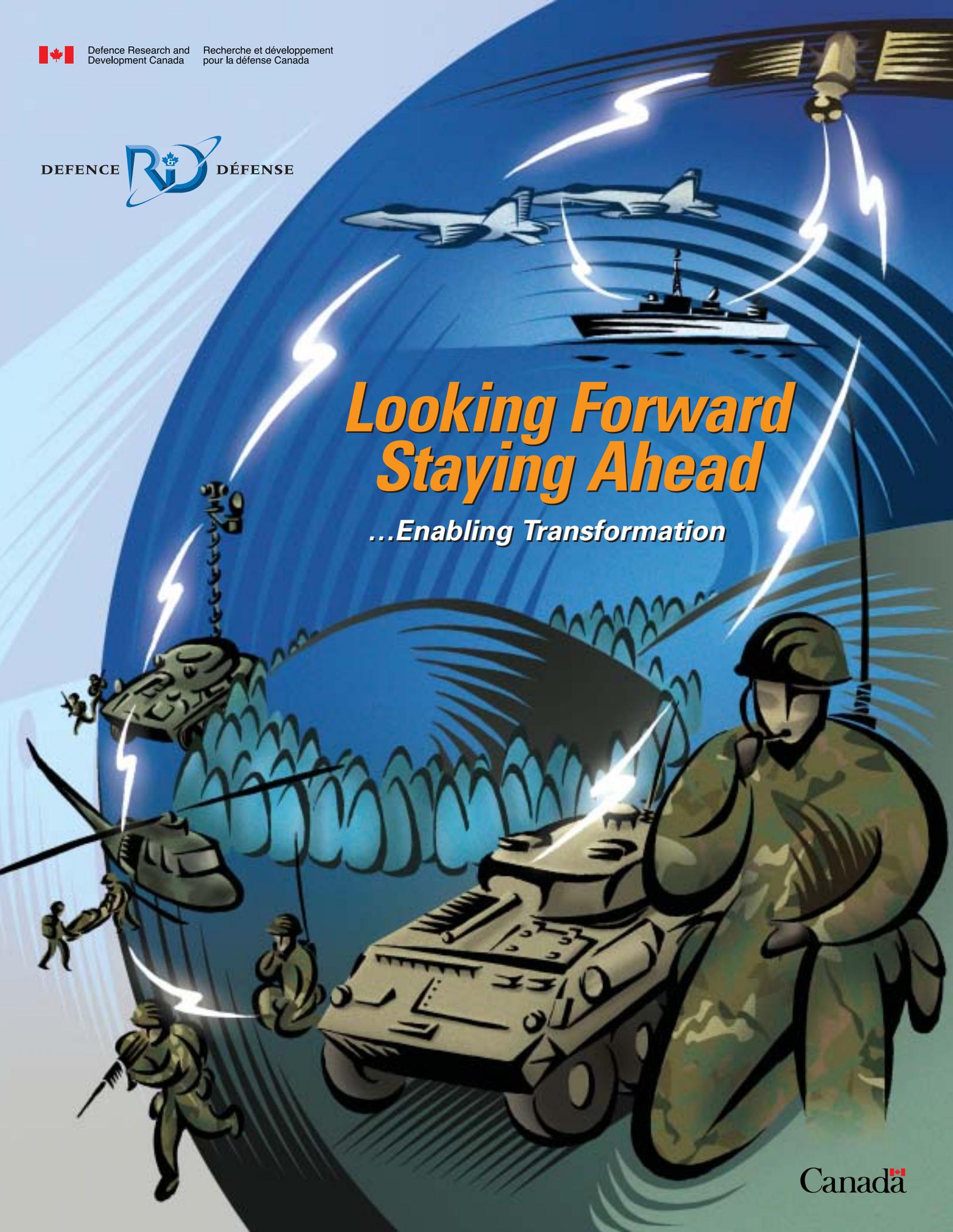




Looking Forward Staying Ahead

...Enabling Transformation



Looking Forward Staying Ahead is a strategic document that challenges all levels of Defence R&D Canada (DRDC) to achieve excellence by setting ambitious goals for the future.

Working within a five-year time frame, *Looking Forward Staying Ahead* outlines strategic directions aimed at bringing together the research centres of DRDC, our partners in the Canadian Forces and the Department of National Defence, and in the public and private sectors.

One of the greatest challenges for DRDC is to anticipate the future requirements of the Canadian Forces, from the technological and operational research and analysis perspectives. *Looking Forward Staying Ahead* lays the foundation for planning research that will push the boundaries of current developments and prepare for future threats and opportunities.

Our commitment to be the “best, most responsive and cost-effective source of information, advice and support in defence science and technology” remains as true today as it did with the inception of *Looking Forward Staying Ahead* in 1994.

February 2004

Additional copies of this report are available from:

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A Message from Dr. John Leggat

Events have been unfolding rapidly since Defence R&D

Canada (DRDC) was created as a Special Operating Agency in 2000.

The Agency has already undergone significant transformation with the implementation of the Technology Investment Strategy, the incorporation of the Operational Research Division, and the establishment of the Chemical, Biological, Radiological and Nuclear Research and Technology Initiative (CRTI). Also, we have embarked on an initiative to articulate our strategy and to put in place a system to manage its execution—a Strategy Map. The Strategy Map outlines what we must accomplish in order to realize our mission, to ensure that the Canadian Forces (CF) remain technologically prepared and relevant, and to achieve our vision, to be known worldwide as the best in defence Research and Development (R&D).

At the same time, the Department of National Defence (DND) and the CF have become engaged in a number of transformative initiatives that respond to the evolving security and defence environment. We will play an important role in this transformation

as DND undergoes a process of strategic re-orientation to shape the CF to ensure their continued effectiveness and relevance. Our contribution includes the R&D to advance defence capabilities. We also provide Science and Technology (S&T) advice to the CF so that informed decisions are made on defence policy, force generation, procurement, doctrine and operational concepts. This advice will be timely, relevant and responsive so as to make a difference in decision-making. Furthermore, we will take on a leading role in the Transformation process by providing assessment, analysis and advice on transformation-enabling technologies that will be deployed within 10 years.

We will play an important role...as DND undergoes a process of strategic re-orientation to shape the CF to ensure their continued effectiveness and relevance.

The world is changing rapidly with technological advances coming from all directions. We are examining a wide range of potentially disruptive technologies with the aim of enhancing CF capabilities and reducing the risk of surprise in future operations. Also, we are cooperating with defence and security partners, both nationally and internationally, to leverage our R&D investments and to exploit new concepts and products to provide the S&T quality and capacity required by both the CF and DND.

This year's version of *Looking Forward Staying Ahead* continues our practice of setting out the Agency's strategic plan as we look ahead at the next two decades. It provides guidance on how DRDC will inform, enable and respond to Transformation as we draw on our strengths in the core business of defence R&D to meet the challenges of Transformation.



L.J. Leggat
Chief Executive Officer and
Assistant Deputy Minister
(Science and Technology)



*Acoustic signature
measurements for
an Operational
Research study.*

Introduction

Defence R&D Canada (DRDC) has undergone significant transformation and has emerged as a revitalized leading Science & Technology (S&T) organization since becoming a Special Operating Agency in 2000. The Defence Technology Investment Strategy defines our niche areas of Research and Development (R&D) excellence, and is currently being implemented across the organization. The Technology Demonstration Program demonstrates the role of technology in defence solutions while the Technology Investment Fund Program supports research in high-risk high-payoff technology applications. Technology Outlook is providing foresight and advice on potentially disruptive and emerging technologies that are likely to have an impact on defence and national security.

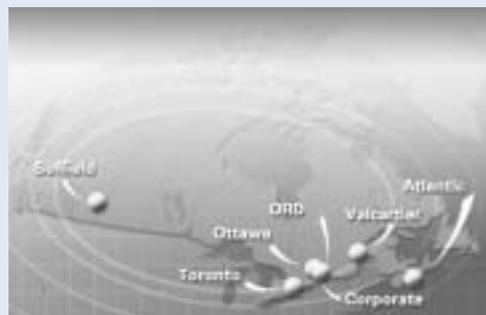
At its six Centres, DRDC delivers excellence in leading-edge research, technology and analysis for the Canadian Forces (CF) so that they can respond to the new realities of military operations and plan for the future.

We are well linked internationally as key players in The Technical Cooperation Program (TTCP) and the NATO Research and Technology Organization (RTO), and through bilateral and multilateral collaborations with the United States, the United Kingdom, Australia, France, the Netherlands and Sweden. On the national scene, we play a leadership role in horizontal S&T collaborative initiatives involving other government

Defence R&D Canada

The national authority for providing S&T leadership to advance and maintain Canada's defence capabilities.

- Advise on Science & Technology
- Conduct Defence R&D
- Assess technology trends, threats, and opportunities
- Support the Canadian Defence industrial base
- Conduct S&T projects for non-DND clients



organizations, industry and universities. Two such projects are the Chemical, Biological, Radiological and Nuclear Research and Technology Initiative (CRTI), which now has 41 collaborative projects in progress, and the Public Security Technical Program.

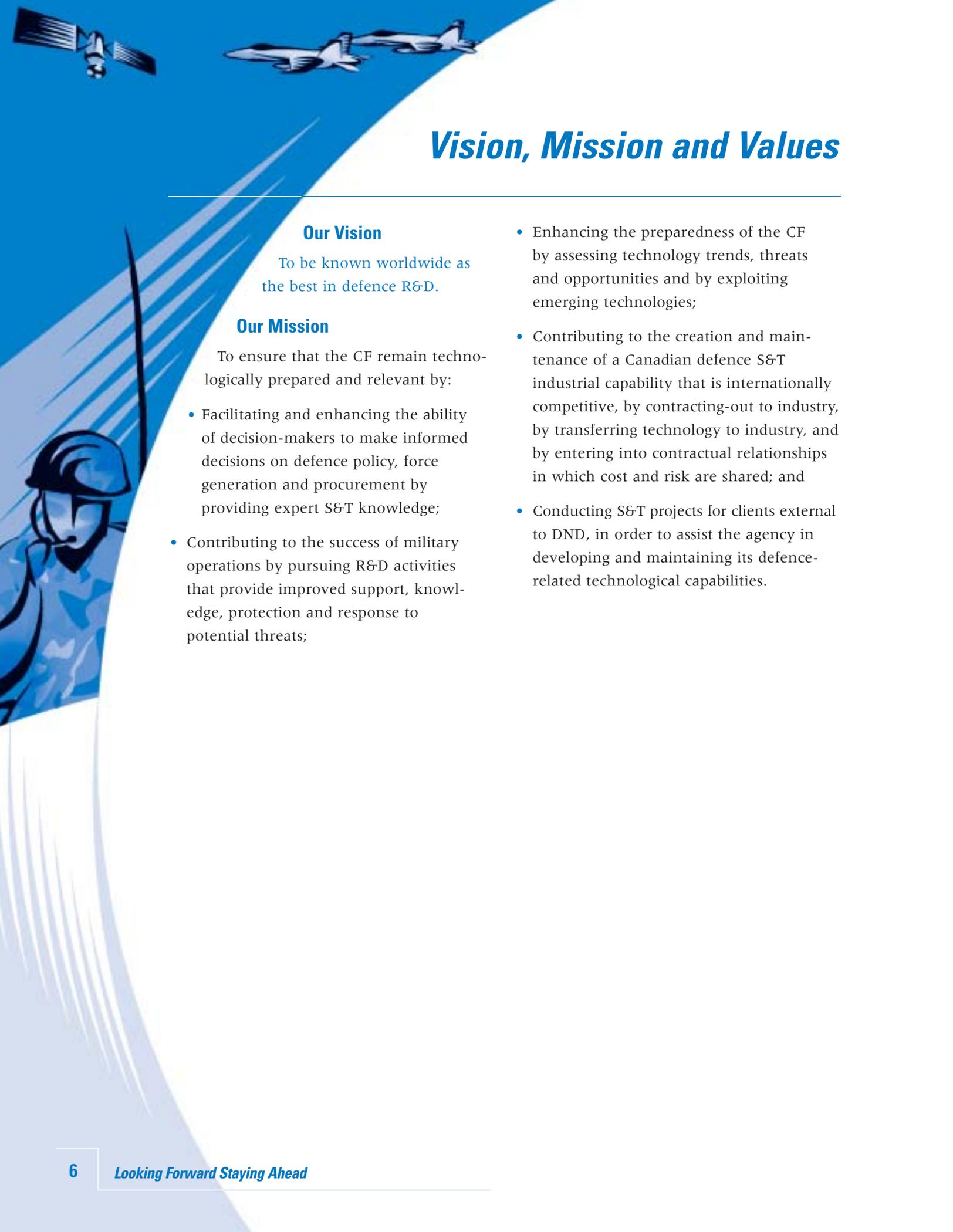
DRDC is now well-situated to respond to S&T issues in the areas of defence, security, intelligence and the national innovation agenda. We will continue focusing on our defence clients and partners. Drawing on our strengths in the core business of defence R&D and Operational Research and Analysis (ORA), we will pursue opportunities both nationally and internationally to exploit new concepts and products and to incorporate new technology into existing systems. We will augment our scientific capacity and provide the CF with more than they pay for by leveraging our capabilities. We will work with the security and intelligence community and build stronger ties with national security agencies.

For the CF to be able to continue to make the kinds of military contribution that they have made at home, in North America and internationally during the last decade, they are implementing a modernization and transformation plan to become a more agile, networked and sustainable military force based on knowledge-age technologies. Science and technology are among the major drivers for modernizing and transforming military forces. As such, disruptive innovations using

new or existing technologies and advances in areas such as nanotechnology, biotechnology, material sciences and power sources, will have a significant impact on future military operations. To ensure interoperability with allies, such as the United States, the CF of the future must embrace technology-driven warfare. New capabilities will also be required to deal with asymmetric threats such as weapons of mass destruction and information and biological/chemical attacks. We are taking a leadership role in the Transformation process by providing assessment, analysis and advice on relevant technologies, and by applying and enabling the adoption of R&D results.



First responders receive live-agent training at DRDC Suffield.



Vision, Mission and Values

Our Vision

To be known worldwide as the best in defence R&D.

Our Mission

To ensure that the CF remain technologically prepared and relevant by:

- Facilitating and enhancing the ability of decision-makers to make informed decisions on defence policy, force generation and procurement by providing expert S&T knowledge;
- Contributing to the success of military operations by pursuing R&D activities that provide improved support, knowledge, protection and response to potential threats;
- Enhancing the preparedness of the CF by assessing technology trends, threats and opportunities and by exploiting emerging technologies;
- Contributing to the creation and maintenance of a Canadian defence S&T industrial capability that is internationally competitive, by contracting-out to industry, by transferring technology to industry, and by entering into contractual relationships in which cost and risk are shared; and
- Conducting S&T projects for clients external to DND, in order to assist the agency in developing and maintaining its defence-related technological capabilities.

Our Values

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

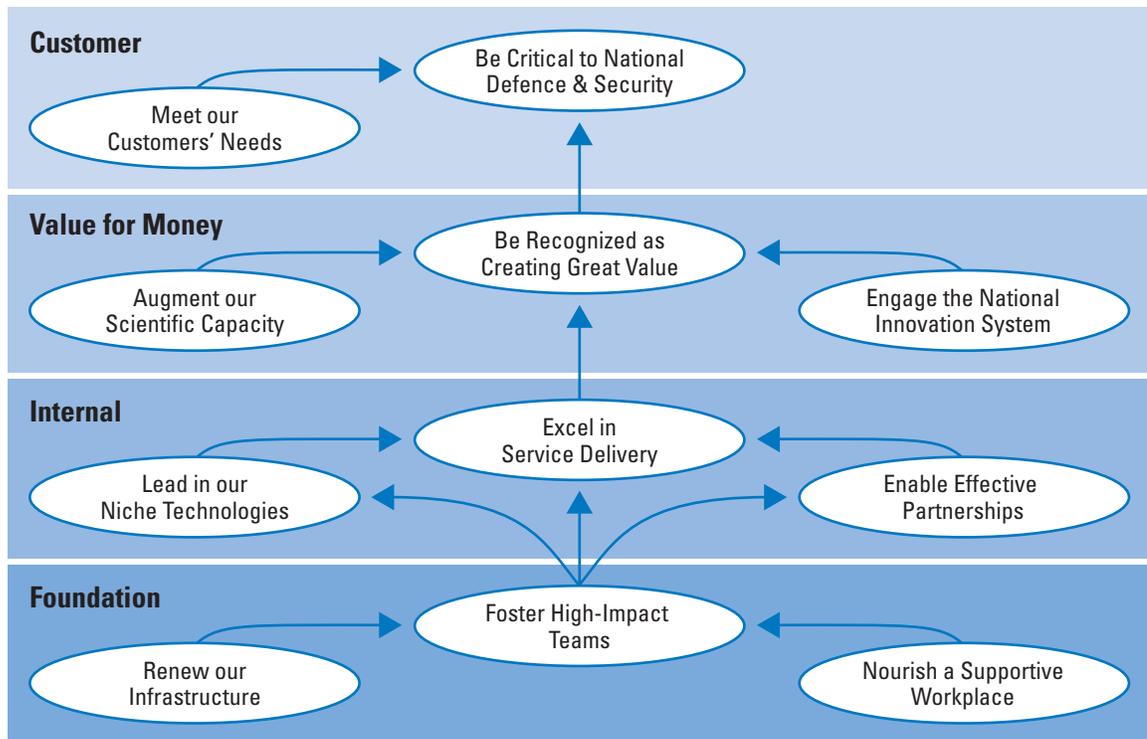
*We demonstrate dedication
and pride in working
towards Defence R&D
Canada's vision.*

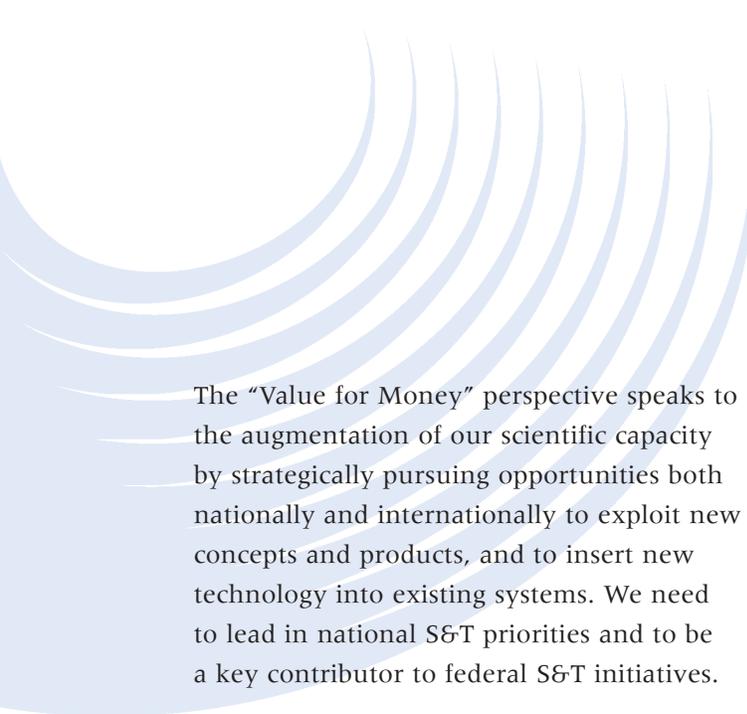
Our Strategy

We have embarked on an initiative to articulate our strategy and to put in place a system to help us manage the execution of that strategy. DRDC's Strategy Map, shown in the figure below, employs a balanced scorecard with four perspectives: customer, value for money, internal and foundation. There are two or three strategic objectives associated with each perspective; these are the areas in which DRDC must excel in order to realize its mission and achieve its vision.

The "Customer" perspective addresses our customers, both those in the CF and DND. "Being Critical to National Security" is to be recognized by the Canadian Forces as a key contributor to defence capability, to be positioned to support the national security needs of Canada, and to be connected effectively with the United States on defence and security issues. We "Meet our Customers' Needs" by being a robust scientific organization that understands intimately the business of the Canadian Forces and National Defence.

Ensure that the Canadian Forces are technologically prepared and relevant





The “Value for Money” perspective speaks to the augmentation of our scientific capacity by strategically pursuing opportunities both nationally and internationally to exploit new concepts and products, and to insert new technology into existing systems. We need to lead in national S&T priorities and to be a key contributor to federal S&T initiatives.

The “Internal” perspective positions DRDC as an organization that promotes excellence and innovation, with laboratories that have the best people, relevant technologies, efficient processes, and strong linkages, and that are established as regional innovation hubs with the private sector and university participants. We are engaged with our customers through a simple and effective client interface and are partnered strategically with the world’s best organizations.

The “Foundation” perspective focuses on our people and our infrastructure. In order to thrive, we will enhance our productivity and creativity by “Fostering High-Impact Teams” and “Nourishing a Supportive Workplace” with a learning culture. We will provide the tools, facilities and support mechanisms that allow our people to realize their full potential.

The Strategy Map will also form the basis of our performance management framework with performance indicators for each of the strategic objectives. In this manner, the relevance and health of the organization can be monitored on a regular basis.

We are engaged with our customers through a simple and effective client interface and are partnered strategically with the world’s best organizations.



Informing, Enabling and Responding to Transformation

The term “Transformation” is widely used in many nations and international organizations such as the U.S. and NATO to describe the course of change undertaken by militaries to respond to the new and emerging security environment. In the Canadian context, DND uses the following definition:

Transformation is a departmental process of strategic re-orientation in response to anticipated or tangible change to the security environment, designed to shape a nation’s armed forces to ensure their continued effectiveness and relevance.

Transformation involves all elements of the defence enterprise including operational concepts, doctrine, structures and technologies, within a supportive culture context. It is an iterative process of improvement, refinement and adaptation; therefore, transformation is not linear. Indeed, transformation can be thought of as being asymmetric as capabilities evolve and mature in different ways and at varying tempos. As a result, transformation blends existing technology with emerging systems and structures. In turn, decisions regarding new concepts and capabilities have to be made as will those related to discarding or downplaying old ones.

The forces of the 21st century need to be inherently mobile and agile. Networking, sensor integration, knowledge and understanding will be key components of achieving

Attributes that should be considered for transformed force

- Joint net-centric concepts of operations
- Precision targeting
- Full spectrum protected
- Simulation enabled
- Capability designs for complex operations and environments
- Task-tailored forces for foreign and domestic deployments
- Inherently mobile forces
- Joint, interagency, multinational and public
- Agile

more effective forces. The human dimension is characterized and shaped by the ever-changing role of the human in command, in complex military systems and in hostile environments. Since the terrorist attacks against civilian and defence targets on September 11, 2001, the existence of an asymmetric threat environment—with the capabilities of delivering large-scale mass

casualty events on military and civilian populations—has received increased prominence and profile, and therefore needs to be addressed.

Technology and its application underpin the Departmental emphasis on producing high-capability forces in a fiscally responsible defence environment. Military power will depend increasingly on the quality and usage of sensors, communication networks, and space-based assets. This view of force capability is reflected in *Defence Strategy 2020*, which states:

The Defence Team will generate, employ and sustain high-quality, combat-capable, inter-operable and rapidly deployable task-tailored forces. We will exploit leading-edge doctrine and technologies to accomplish our domestic and international roles in the battle space of the 21st century and be recognized at home and abroad, as an innovative, relevant knowledge-based institution.

In support of these departmental objectives, DRDC conducts research in a variety of areas that span the defence technology spectrum. All CF capabilities areas (Command and Control, Information and Intelligence, Conduct Operations, and Sustain and Generate Forces) are underpinned by technological elements that affect strategy, doctrine, tactics, training and procurement.

The **Technology Investment Strategy** (TIS) outlines the R&D required to develop the S&T capacity necessary for future defence and national security, taking into account the strategic direction provided by *Defence Strategy 2020* as well as the new approach of Strategic Capability Planning. The Strategy reflects R&D Activities that are integral to Transformation, including information technology and sensors, as well as projected advancements in areas such as nanotechnology, biotechnology, material sciences and power sources. The well-established Operational Research Division (ORD) has now joined DRDC. This organization provides practical application of scientific principles, systematic investigation and critical reasoning to the study of complex systems. This includes the development and mastery of qualitative and quantitative concepts, mathematical algorithms, modelling and simulation as well as decision-making methodologies. The ORD plays a key role in assessing the balance between S&T concepts and other competing factors such as cost/affordability, effectiveness and sustainability.

The **Technology Demonstration Program** (TDP) is designed to contribute to defence modernization by demonstrating the use of technology to provide defence solutions. The TDP portfolio currently comprises 38 active projects with an average of \$10 million in total resources per project.

The TDP includes many projects that explore transformational concepts. One such example is the *Collaborative Capability Definition, Engineering and Management (CapDEM)* project that will define, demonstrate and validate the concept of Capability Engineering as a transformative process for departmental force development and acquisition. Other projects that investigate transformational concepts include *Uninhabited Surveillance Vehicle, Force Protection Against Enhanced Blast, Networked Underwater Warfare and CB^{plus} Combat Uniform for Broad Spectrum Toxic Hazard Personal Protection.*

DRDC Atlantic's Remote Minehunting System (RMS) Technology Demonstration Project.

New Technology Demonstration Projects Approved for 2004 Start

- Force Threat Evaluation and Weapon Assignment
- Multi-Mission Effects Vehicle
- Advanced Linked Extended Reconnaissance and Targeting
- High Earth Orbit Space Surveillance
- Multi-Environment Decision Support and Knowledge Exploitation in Terrorist Emergency Responses
- Joint Network Defence and Management System
- Advanced Deployable Day/Night Simulation



Several projects focusing on communications and networking transformation-enablers are also underway. The *Joint Network Defence and Management System* project addresses the issue of how to ensure effective and secure networks while the *Advanced Satcom* project exploits the advantages of software-defined radios to provide greater communications flexibility and reduce inventories. The *Radarsat 2 GMTI* will demonstrate space-based Ground Moving Target Indication (GMTI) and the *High Earth Orbit Space Surveillance* project will demonstrate surveillance of space technologies by developing and flying two micro-satellites with optical imaging systems. Recently approved TDP projects, which are currently in the definition phase, will also contribute to modernization and transformation. These projects include the *Force Threat Evaluation and Weapon Assignment* project that will develop and demonstrate next generation command and decision support concepts; the *Multi-Mission Effects Vehicle* project that aims to show how vehicle crews could manage multiple weapons systems to engage more enemy targets at greater distances; and the project on *Advanced, Linked, Extended Reconnaissance and Targeting* that will demonstrate a network-enabled capability by integrating several sensors, including a beyond line-of-sight mini-Uninhabited Aerial Vehicle. In response to the increase in terrorist activities, the *Multi-Environment Decision Support and Knowledge Exploitation in Terrorist Emergency Responses* project will focus on supporting the CF in the context of asymmetric threats.



Ground Moving Target Indication (GMTI) radar equipment.

The Applied Research Program carried out for DRDC's CF Client Groups are also being updated to support Transformation. To respond to the new security environment and the increased importance of Intelligence, Surveillance and Reconnaissance (ISR) of Canada's maritime approaches, a new Maritime ISR Thrust has been established to consolidate and expand work in this area. This Thrust includes a new project on *Improved Data Fusion and Decision Support for Maritime ISR*. A number of projects have also been introduced to support the Network Centric Warfare paradigm including

Senior officers visit troops in Afghanistan.



Network Centric Concepts for Multi-Platform Above Water Warfare Operations, Unmanned Systems for Mine Detection, and Deployable and Fixed Sensors for Littoral Underwater Warfare.

The Army remains committed to supporting and exploiting S&T. The *Army Strategy*, published in 2002, refers to the need for leading-edge technologies in a medium-weight, information-age Army, and for operations in complex terrain. The Land Force R&D program will address these needs by focusing on the longer-term scientific and technological needs of the Army's Transformation. For example, several new projects will address the

special problems of protecting lighter armoured vehicles against a variety of threats. Other projects will explore the use of autonomous systems and mobile radios in congested urban environments.

To support Transformation of Air capabilities, the Air Mission Systems Thrust will identify and address high-level system-of-systems and multi-disciplinary S&T issues, and their application to force transformation. Transformational projects will demonstrate a scaleable, integrated and interoperable information system for operations planning, mission preparation and rehearsal to facilitate

joint operations. Another initiative is the integration of all sensors, including airborne Electronic Support Measures to investigate how aircraft, equipped with these sensors working in concert through suitable digital data links, could be more effective in providing threat location, in enhancing situational awareness for the Joint Commander, and in cueing counter-measures.

The Command, Control and Information Systems (CCIS) program has been renamed Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) to coordinate the C4ISR R&D work across the Agency and respond to joint C4ISR force development work. The CF are in the process of defining a

C4ISR campaign plan that will integrate and harmonize all related activities in the CF/DND and provide a plan for the future. Two major CF projects are also underway: the next phase of the *CF Command System (CFCS II)* and the *Joint Intelligence and Information Fusion Capability (JIIFC)*. A key step in confirming the requirements for this work was a C4ISR workshop jointly sponsored by DRDC and the Deputy Chief of the Defence Staff. Another step will be the establishment of a Capability Transition Team for JIIFC at DRDC Valcartier.

DRDC has enhanced its work on Defence against Chemical, Biological and Radiological (CBR) hazards through our leadership of the Chemical, Biological, Radiological and



Interior view of the C4ISR mobile laboratory developed at DRDC Valcartier

Nuclear Research and Technology Initiative (CRTI) and the Counter-Terrorism Technology Centre (CTTC). For CRTI, the unique experience and expertise resident at DRDC Suffield and DRDC Ottawa are supporting the development of improved detection, identification, decontamination and physical protection against CBR agents. The CTTC provides a training centre for military and civilian first responders, a forensic reference centre, a capability for CBR equipment and material validation, as well as a source of advice for the first responder community. The ongoing R&D in medical countermeasures and physical protection benefits from collaboration with many of our close allies.

The research and expertise at the Centres put DRDC in a position to inform, enable and respond to Transformation by providing assessment, analysis and advice on Transformation-enabling technologies that will increasingly be seen in operations within 10 years. We are also developing an integrated process from the concept development stage to R&D results adoption. This process will take account of opportunities for technology insertion and the emergence of disruptive and new technologies.

Examples of technologies that will increasingly be seen in operations in the next 10 years

- Wide-band mobile wireless networking
- Directed energy weapons
- Alternative power technologies
- Autonomous intelligent systems and platforms
- Micro-satellites
- Hyper-spectral sensing
- Biosensors
- Embedded C4ISR
- Enhanced physiological and cognitive capabilities

New and emerging technologies are also being developed in cooperation with Canadian industry under the Defence Industrial Research (DIR) Program. This program provides up to 50 per cent of eligible R&D costs, to a maximum of \$500,000. Currently, the DIR program supports 36 active projects. An example of a recently-initiated DIR project is next-generation lightweight fibre for personal protection systems using specific strains of replicated spider silk from the milk of transgenic goats.

DIR Projects Approved in 2003

- Pyrotechnics Applications of Nanometric Formulation
- Information and Knowledge Management Technologies Supporting Network Centric Warfare
- Software Radio-Based Receiver and Transmitter
- Un-cooled Light Thermal Weapon Sight
- Near Net Shape Forming of Light-weight Armour
- Phage Therapy as a Safe and Effective Alternative to Conventional Antibiotics for the Management of Anthrax and Brucella
- Recombinant Spider Silk-Based Advanced Performance Fibre
- Ultra-Light CERAMOR Bullet Resistant Plates for Personal Protection
- Launch and Flight Behaviour of Kinetic Energy Projectiles
- NESS—Near Earth Surveillance Satellite



Disruptive Technology Innovations

Understanding the relevance and potential impact of disruptive technologies is integral to providing state-of-the-art S&T leadership in defence and security. To ensure that the CF remain technologically prepared and relevant in the future defence environment, it is essential to be aware of the emergence of potentially disruptive innovations that significantly alter established practices. A key pillar of our research on

disruptive innovation is the **Technology Investment Fund** (TIF) Program. This program funds high-risk high-payoff research with potential military applications. There are currently 28 active TIF projects with an average effort equivalent to \$1 million per project. New initiatives in 2003-04 cover a broad-spectrum of innovative concepts including adaptive and creative decision-making, sensing in complex environments, camouflage and new drugs.

TIF Projects started in 2003

- Adaptive and Creative Decision-Making Under Stress
- Volumetric Sensing of Complex Environments for Control of Complex Vehicles
- Advanced Electrochromic Polymer Technologies for Adaptive Camouflage Applications
- Low Probability of Intercept Synthetic Aperture Radar
- Emerging Material Technologies for Applications in Battlefield Wound Care
- Decision-centred evaluation capability of decision support systems from a net decision-making and an operational perspective
- Supersonic Missile Flight Control by Manipulation of the Flow Structure using Micro-Actuated Surfaces
- Nucleic Acid-Based Drugs Against Biological Warfare Agents
- Aural discrimination of true targets from geological clutter
- The Application of Evolutionary Algorithms to the Optimization of an Adaptive Control System for Closed-Loop Electronic Counter-Measures Systems

DRDC's Technology Outlook activity also plays a role in the longer-term Transformation agenda by providing foresight and assessment of emerging and potentially disruptive technology concepts likely to have an impact on the CF and DND.

Rapidly advancing technologies with potentially disruptive implications include:

- Nanotechnology;
- Biotechnology and Biomedicine;
- Advanced Computing and Information Technologies; and
- Cognitive Neuroscience.

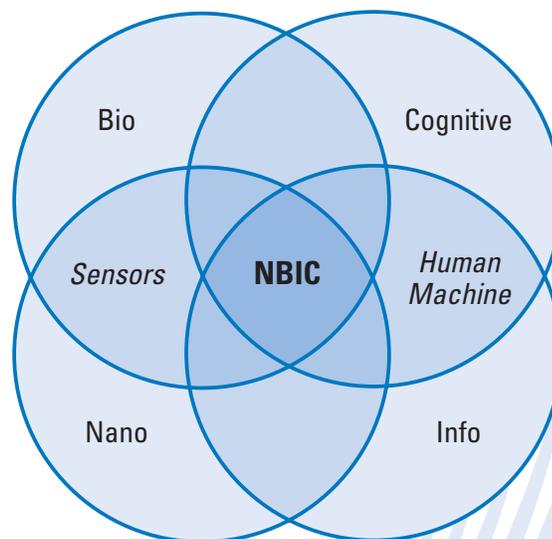
New developments in each of these technologies will have a significant impact on society, however, the most disruptive innovations will likely occur at their intersections. The convergence or synergy arising from their combination is expected to lead to capabilities such as:

- Expanded human cognition and communication enabled by brain implants, new drugs, rapid learning and direct brain-to-machine interfaces;
- Improved human health and physical capabilities enabled by nano-biosensors to monitor and repair bodily functions, and systems that enhance human sensors; and
- Responsive and collaborating autonomous intelligent systems to support decision-making, and nano robots for surveillance and medical applications.

Technology Outlook: Concepts and Technologies currently being assessed

- Network Centric Warfare
- Non-Conventional/Non-Lethal Weapons
- Convergence of nano/bio/info/cognitive (NBIC) technologies
- Technology for Advanced Logistics
- Autonomous Intelligent Systems
- Quantum Computing and Encryption
- Advanced Power Sources

Nano-Bio-Info-Cognitive (NBIC) Technologies



To engage the defence community in discussions of the role of potentially disruptive technologies, DRDC sponsored a symposium in Ottawa in April 2003 addressing several emerging areas:

- Convergence of Technologies;
 - Autonomous Intelligent Systems;
 - Communications Technology;
 - Technologies for Stealth; and
 - Quantum Computing and Encryption.
- Land, sea and space based sensing;
 - Robotics and wireless data infrastructure;
 - Advanced imaging capabilities, pattern interpretation, location-based functionalities;
 - Intelligent systems, with emphasis on real-time identification and decision-making;
 - New tools for monitoring and managing Canada's environment, resources, and agriculture; and
 - Understanding of disease network structures and threats.

Discussions of potentially disruptive and emerging technologies continue through a community of practice involving representatives from various organizations from across DND as well as other government departments.

DRDC also participated in an interdepartmental Science and Technology Foresight Pilot Project during 2002-2003 involving 13 federal departments and agencies. The project explored S&T foresight with the aim of better understanding some of the longer-term, integrative and horizontal challenges and opportunities facing the federal S&T community to 2015 and beyond.

Two topic areas, Geo-Strategics and Bio-Systemics, were selected through a collaborative process that included most of the individual topics submitted by departments. Geo-spatial applications derived from technological advances are expected in:

Projected areas of strategic bio-systemic research are based on convergence opportunities in emerging technologies involving:

- Genomics and proteomics;
- Nanoscience and nanotechnology;
- Bio-informatics and bio-computing;
- Intersection of cognition and information science;
- Environmental sciences and human ecology; and
- Disease systems and spread factors.

One of the main results of the Foresight exercise was that the rapidly evolving technology landscape will present both opportunities and threats to Canada, including defence and national security. Many of these will be transformational and sometimes disruptive.



Key Objectives

Our key objectives will enable Transformation, grow our S&T capacity and build increased team effectiveness and renew our infrastructure.

We will engage the rest of the Department and the CF in co-sponsoring a symposium on Transformation in 2004 similar to the “Revolution in Military Affairs” symposium in 1998, the “Modelling and Simulation and Concept Development and Joint Experimentation” symposium in 2000, and the “Knowledge Management” symposium in 2002. In preparation for the symposium, we will identify and analyse at least five technology concepts that could have significant implications for defence and national security within 10 years.

With the pace of technological development and the emergence of disruptive new technologies, military systems run an increasing risk of technological obsolescence or irrelevance. New approaches are required to exploit technology to enhance, transform and maintain operational capability, while taking into account factors such as affordability, operational and human consequences as well as opportunities for technology insertion. To facilitate the regular and quick migration of successful R&D products into operational systems, the R&D model will have to evolve. This challenge has led to developmental approaches such as spiral development, capability engineering and

New Key Objectives

- Engage the rest of DND and the CF in co-sponsoring a symposium in 2004 to explore Transformation concepts, issues and operational implications.
- Identify and analyse by 2004 five technology concepts that will have significant implications for defence and national security within 10 years.
- Develop and implement improved mechanisms for technology exploitation and insertion by 2005.
- Establish each of the regional research Centres as an innovation hub by 2006.
- Initiate and lead two new inter-departmental S&T initiatives by 2005.
- Renew 20 per cent of aging DRDC infrastructure by 2007.
- Have in place the mechanisms to ensure that 30 per cent of new S&T hires are women and members of visible minorities starting in 2004.

*DRDC celebrates its 2003
Recognition & Awards recipients.*

exploitation management. These approaches are already being evaluated in Technology Demonstration projects. By 2005, we will develop and implement improved mechanisms for technology exploitation and insertion of R&D results.

By 2006, DRDC will establish each R&D Centre as an innovation hub. These hubs will include partnerships, pooling of resources, sharing of facilities and networking with the private sector, government units and universities in the region. The hubs will provide integrated capabilities and services from R&D, testing, evaluation and engineering, to technology exploitation by private sector partners. One such example is DRDC Valcartier's proposed Technopole, which includes the Munitions Evaluation and Test Centre and co-located and nearby government, private sector and university partners.

As one of the key players in establishing a framework for horizontal collaboration among federal science-based departments and agencies, we will initiate and lead two new interdepartmental S&T initiatives by 2005. We already lead CRTI and we are well on the way to establishing a Public Security Technical Program that will draw on Canadian R&D expertise across departments and agencies and link it to collaborative programs with the U.S.

The final two key objectives address the Foundation perspective of our Strategy Map. In order for DRDC to thrive, we cannot afford to let aging infrastructure prevent us



from providing the R&D that the CF and DND require in the future. We must invest in our infrastructure to avoid "rust out" and to remain competitive in attracting and retaining the best people. Therefore, DRDC will renew 20 per cent of aging DRDC infrastructure by 2007.

To have the best and brightest employees we must be an inclusive organization that attracts women and visible minorities science workers. Today, only 16 per cent of DRDC scientists are women. Our objective is to hire more women S&T workers starting in 2004, by continuing to develop an environment that is accommodating to work/life balance issues. Also, we will take advantage of the changing population, educational and cultural demographic composition in Canada by recruiting more staff from visible minority communities. DRDC will play a leadership role, integrating employment equity into human resource management, supporting self-identification programs, and creating a comfortable and supportive work environment for all.



Conclusion

As a robust scientific organization that understands intimately the business of the CF and defence, DRDC will continue to focus on our defence clients and be responsive to their needs. We will help shape, anticipate and satisfy their requirements through science and technology. Drawing on our strengths in the core business of defence R&D we will pursue opportunities both nationally and internationally to exploit new concepts and products, and to insert new technology into existing systems. We are taking a leading role in the transformation process by providing assessment, analysis and advice on transformation-enabling technologies, and by applying and enabling the adoption of R&D results to transformation.

DRDC will support national security needs and connect effectively with the U.S. on defence and security issues. We will maintain a leadership role in the national S&T community and be a key contributor to federal S&T. We will secure resources for infrastructure and facilities requirements to avoid “rust-out” and achieve renewal,

consistent with the requirements of the Technology Investment Strategy. As a learning organization, we will nourish a supportive workplace and culture that is inclusive of women and visible minorities.

We have instituted an initiative to articulate our strategy and put in place a system to help us manage the execution of that strategy. This system is based on a Strategy Map with four perspectives: customer, value for money, internal, and foundation, each with strategic objectives in areas in which we must excel in order to realize our mission and vision. The key objectives that are put forward in this strategic plan will assist us in achieving the strategic objectives by focusing on the customer perspective to enable transformation, growing our S&T capacity to provide value for money, and pursuing infrastructure renewal and an inclusive workplace as basic components of the foundation of our organization.

DRDC will continue to focus on our defence clients and be responsive to their needs.

The left side of the page features a vertical illustration. At the top, a satellite orbits in space. Below it, two fighter jets fly in formation. Further down, a large naval ship is shown on the water's surface. At the bottom, a soldier in a helmet and camouflage uniform is depicted. The background of the illustration is a gradient of blue and white, suggesting a sky or ocean horizon.

Annex A: The Technology Investment Strategy

The Technology Investment Strategy (TIS) outlines the R&D we will undertake to develop the S&T capacity needed for future defence and national security, taking into account the strategic direction provided by Defence Strategy 2020 and the new approach of Strategic Capability Planning. The TIS represents our strategy for R&D. It involves both the reallocation of existing resources and new investments. We draw on Canadian industry, universities, other national partners and our allies to leverage the additional capabilities we need to deliver a defence R&D program based on the Service Level Agreements with our CF Client Groups.

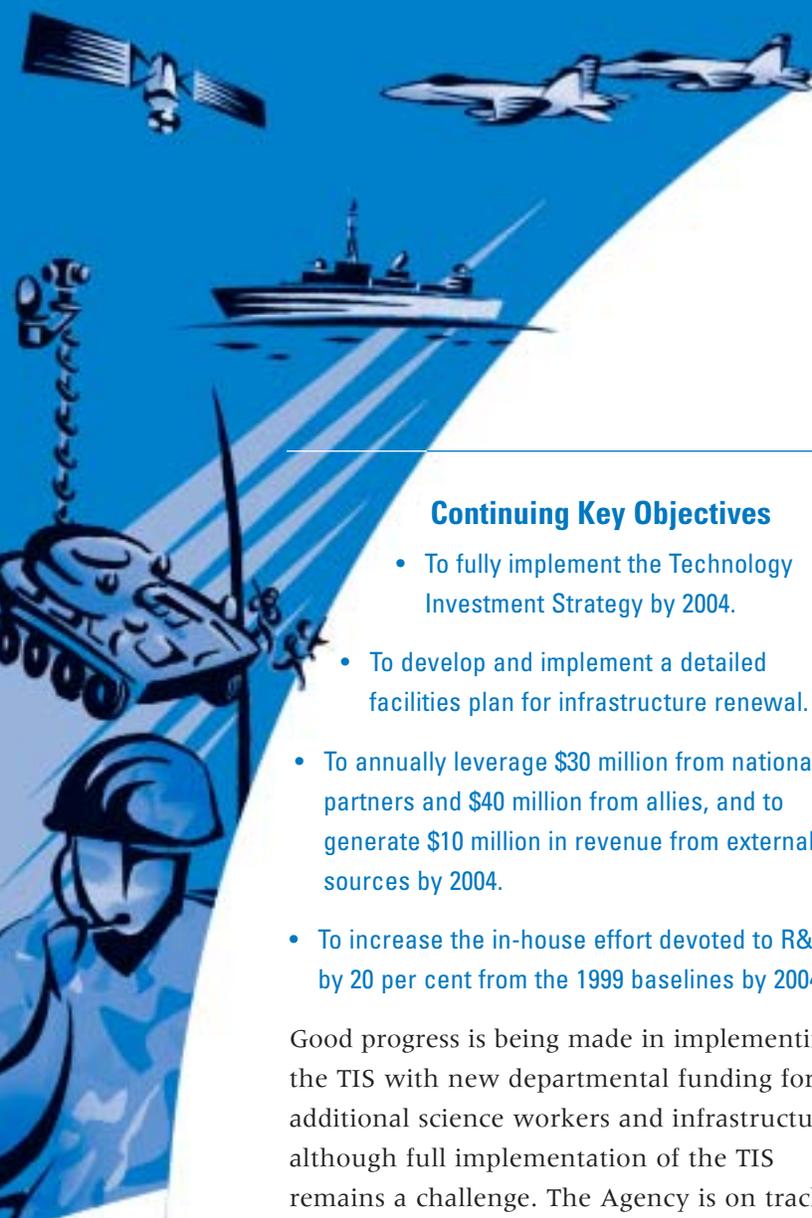
The TIS is based on 22 R&D Activities that span the defence technology spectrum. The TIS will evolve in response to advances in technology, changes in the security environment, and departmental strategic planning.

It was recently updated to better reflect technologies that are integral to the Revolution in Military Affairs, including adjustments in information technology and sensors, and projected advancements in areas such as nanotechnology, biotechnology, material sciences and power sources. Also, Operational Research and Analysis is being added to the TIS as the 22nd R&D Activity to reflect the incorporation of the Operational Research Division into DRDC.

Detailed plans, including requirements for human resources and S&T facilities, have been developed. Significant progress toward implementation has already been made but there are still capacity gaps to be filled. The implementation of the TIS has been partially funded by the Department.

TIS R&D Activities

- Command and Control Information Systems Performance and Experimentation
- Information and Knowledge Management
- Communications
- Human Factors Engineering & Decision Support Systems
- Command Effectiveness and Behaviour
- Autonomous Intelligent Systems
- Sensing (Air and Surface)
- Underwater Sensing and Countermeasures
- Space Systems
- Electro-Optical Warfare
- Radio Frequency Electronic Warfare
- Network Information Operations
- Precision Weapons
- Weapons Performance and Countermeasures
- Emerging Materials and Bio-Technology
- Signature Management
- Platform Performance and Life Cycle Management (LCM)
- Multi-Environment Life Support Technologies
- Operational Medicine
- Chemical/Biological/Radiological Hazard Assessment, Identification and Protection
- Simulation and Modelling for Acquisition, Requirements, Rehearsal and Training
- Operational Research and Analysis



Annex B: Progress on Continuing Key Objectives

Continuing Key Objectives

- To fully implement the Technology Investment Strategy by 2004.
- To develop and implement a detailed facilities plan for infrastructure renewal.
- To annually leverage \$30 million from national partners and \$40 million from allies, and to generate \$10 million in revenue from external sources by 2004.
- To increase the in-house effort devoted to R&D by 20 per cent from the 1999 baselines by 2004.

Good progress is being made in implementing the TIS with new departmental funding for additional science workers and infrastructure although full implementation of the TIS remains a challenge. The Agency is on track to meet its targets in revenue generation, and national and international leveraging, as well as the projected increase in in-house effort devoted to R&D.

Continuing Key Objectives

- Produce concept papers on strategic S&T issues for Navy, Air Force, Army and Joint operations in the future by 2004.

- Develop an enhanced Technology Watch program, and identify and analyze five strategic technologies that could have significant impact on defence and national security by 2004.

A major review of the Land Force R&D program was completed. Highlighted by a four-day workshop, the review revealed that several improvements could be made to the program.

DRDC provided advice on the refinement of the Aerospace Capability Framework document, and the integration of S&T into the capability-based Air Force development process.

In October 2003, the CF convened a C4ISR workshop that was co-sponsored by the Deputy Chief of the Defence Staff and DRDC. The workshop provided input for the further development of the CF overarching Command and Control System and developed a way forward for C4ISR.

A Technology Watch capability is in development. A community of practice supported by a portal to facilitate interaction is in place and, as described previously, several technological concepts are currently being assessed.

Continuing Key Objectives

- Work with other federal science-based departments and agencies to develop new models and to obtain increased funding for federal S&T. Garner at least 10 per cent of the increased funding.
- Develop a strategy to maximize the benefits from international collaboration.

We have taken the lead in establishing a framework for horizontal collaboration among federal science-based departments and agencies led through the recently formed Assistant Deputy Ministers' S&T Integration Board. This Board will provide strategic leadership, guidance and direction for mobilizing and integrating S&T efforts across departments and disciplines, focusing on the priorities of Canadians. We also lead the CRTI as well as the development of the Public Security Technical Program.

A report examining the international activities of DRDC introduces reasons why international collaboration is undertaken, develops concepts of values related to collaborative activities and outlines what factors should be considered in project and partner selection. The report recommends different strategies related to leveraging, performance measurements and management information system requirements. These recommendations are now being evaluated for potential implementation.

Continuing Key Objectives

- Expand the Defence Industrial Research program and link to the U.S. Dual Use S&T program with three joint projects by 2004.
- To partner with industry on five international projects.

An initiative saw the potential linkage of the DIR program with the United States Air Force (USAF) Dual Use Science & Technology program through the co-sponsorship of research projects. As such, a major event was undertaken with the USAF to examine and identify such projects through a DRDC-hosted workshop in Toronto in November 2002. This workshop provided Canadian industry with the opportunity to discuss with USAF and DRDC personnel technologies of mutual interest in both the military and commercial sectors. The possibility of Defence leading a dual-use development program specifically linked to the U.S. market has been discussed with Industry Canada and was strongly supported by industry associations during consultations on the Innovation Strategy. We also worked with the U.S. Army to obtain information about Canadian technologies in companies and laboratories as input to Global Technology Opportunities of the U.S. Army S&T Master Plan.

*A model of the
High Energy Missile
(HEMi).*

Continuing Key Objectives

- Initiate five joint activities among research centres and the Operational Research Division over the next two years.
- Establish a Defence Research Institute in partnership with the Royal Military College with full operational capability by 2005.

The Operational Research Division (ORD) is now an integral part of DRDC. Joint activities were initiated with the Technology Demonstration Program both at the program level and at the individual project level. Examples of TDP projects that ORD staff are working on with staff from the other research centres include: Multi-Mission Effects Vehicle (MMEV); Collaborative Capability Definition, Engineering and Management (CapDEM); Future Armoured Vehicle System (FAVS); and High Energy Missile (HEMi). Other joint projects include Modelling and Simulation of the Defensive Aid Suite System (DAS); Technology Watch; and a study of Non-Conventional Weapons.

The initiative to establish the Defence Research Institute is progressing with the deployment of a Defence Scientist to the Royal Military College of Canada.

