



**Looking Forward | Staying Ahead...**  
Connecting with Users and Partners

*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 and our partners in the Canadian Forces, the Department of National Defence, and the public and private sectors.

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

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

December 2004

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## A Message from Dr. John Leggat

The year 2005 is a special one for Defence R&D Canada, as we will celebrate our fifth anniversary as a Special Operating Agency of the Department of National Defence. We have built upon our legacy of more than 60 years of research and development for the Canadian Forces to deliver a world class service through innovative planning and delivery techniques.

The theme of this year's *Looking Forward Staying Ahead* is "Connecting with Users and Partners."

It reflects our commitment to link industry, academia and allied R&D to build greater breadth and depth of scientific and technological capacity for the Canadian Forces, the Department of National Defence and the Public Safety and Security community in Canada.

The Department of National Defence and the Canadian Forces are in the midst of major transformations driven by a rapidly changing national and global security environment. Technological change and foresight are a major part of their considerations and planning. Defence R&D Canada and its network of partners and collaborators in Canada and around the world are contributing to insights and priorities for transformation initiatives.

NATO and many of our allies are engaging in transformation. Defence R&D Canada contributes to these efforts through our long-standing relationships with the NATO Research and Technology Organization and The Technical Cooperation Program.

Within our own borders, Defence R&D Canada provides critical S&T advice to Departmental strategy and policy. In 2005, we will continue to lead and participate in the development of Department and Canadian Forces perspectives in Network Enabled Operations. Building on a successful symposium on the subject in 2004, we will be producing a guidance document, outlining the road ahead to embrace and implement Network Enabled Operations. The report, which will be published in 2005, will draw on the results of the symposium and associated activities.

Defence R&D Canada's mission, to "ensure the Canadian Forces remain technologically prepared and operationally relevant", means that we strive to engage the right partners and collaborators to deliver the broadest and most relevant research and development program to the Department of

National Defence and the Canadian Forces. It also means we strive to remain as close as possible to those engaged in operations, to ensure that we are truly meeting their needs.

*Looking Forward Staying Ahead* (LFSA) charts the course for defence R&D for the next several years. The program remains dynamic and agile. Our planning framework ensures that we address the most important requirements in the 5, 10 and 15 year horizons. Program delivery employs extensive leveraging of the DND investment, thus ensuring that the Canadian Forces continue to receive great value from DRDC.

I trust that you will enjoy reading this edition of LFSA and that you will find some time in 2005 to celebrate DRDC's fifth anniversary.



Chief Executive Officer  
and Assistant Deputy Minister  
(Science and Technology)



Dr. Leggat, flanked by Dr. D. Daniel, Chair of the NATO Research and Technology Board, addressing the Board.

## Vision, Mission and Values

### Our Vision

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



View from inside the CF-18 Multi-Task Trainer

### Our Mission



Preparing DRDC's Silver Fox UAV for launch.

Defence R&D Canada ensures that the Canadian Forces are technologically prepared and operationally relevant by:

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

## Our Values



Participants in the Joint Warfare Interoperability Demonstration at DRDC Ottawa.

- **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.

## Introduction

As the national authority for providing Science and Technology (S&T) leadership to advance, transform and maintain Canada's defence and security capabilities, Defence R&D Canada (DRDC) synchronizes its activities with the Canadian Forces (CF) and the Department of National Defence (DND), and connects with national and international partners to leverage its investments and capabilities. Accordingly, one of our roles at DRDC is to show what the future holds and how to prepare for that future from an S&T perspective. Our aim is to ensure that the CF can access, evaluate and implement innovative concepts that will improve their capabilities.

The future strategic environment will be dominated by complexity, asymmetry and the globalization of technology. Our allies, including the United States (U.S.), are undertaking massive military transformations that are heavily dependent on S&T. Applications are growing rapidly as a result of the convergence of nano-, bio- and info-technologies and cognitive sciences, and this affects both the civil and the military spheres.

Because of this rapid pace of technological development, the pursuit of innovative uses of existing technology and the emergence of new disruptive technologies, military systems run an increasing risk of rapid technological obsolescence. Innovative approaches are required that will

exploit technology to enhance, transform and maintain operational capability, while taking into account factors such as affordability, and operational and human consequences. The CF capability areas (Command and Control, Information and Intelligence, Conduct Operations, Sustain and Generate Forces) are underpinned by S&T elements that affect strategy, doctrine, tactics, training and procurement.



The Remote Minehunting System submerged in the waters off Esquimalt, British Columbia.





As noted by the Chief of the Defence Staff (CDS) in his 2004 *Annual Report*;

*The current security environment calls for professional, highly trained armed forces capable of using new technologies effectively in joint, interagency and multinational operations. New technologies offer fast, flexible solutions to such operational problems as delivering force precisely in a war zone, or monitoring the flow of refugees in a humanitarian crisis. The CF has embraced these new technologies, and we will continue to invest in training and equipping Regular and Reserve personnel to ensure they remain amongst the most highly trained, technologically adept soldiers, sailors, air force personnel in the world.*

DRDC is well positioned to respond to the future defence, security and policy environment. The Technology Investment Strategy (TIS) (Annex A) outlines the research and development (R&D) we will undertake to develop the S&T capacity needed for future defence and national security. Our Strategy Map (Annex B) provides the framework to evaluate how well we are doing. Our continued success depends on influencing and aligning with policy and strategy, strengthening our connections with those who use the results of our work and solidifying strategic linkages with our national and international partners.



### Defence R&D

Defence R&D Canada ensures that the Canadian Forces are technologically prepared and operationally relevant by:

- Providing expert S&T 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 S&T trends, threats and opportunities;
- Engaging industrial, academic and international partners in the generation and commercialization of technology; and
- Providing S&T for external customers to enhance S&T capacity.

At its six research centres, DRDC delivers excellence in leading-edge research, technology and analysis for the CF, so that they can respond to the new realities in military operations and plan for the future. DRDC's strong connections to the CF client community through Overview and Advisory Groups,

as well as linkages to the Concept Development and Experimentation (CD&E) community, provide the framework for deciding what S&T to pursue. DRDC is connected internationally as a key player in The Technical Cooperation Program (TTCP) and the North Atlantic Treaty Organization (NATO) Research and Technology Organization (RTO), and through bilateral and multilateral collaborations with the U.S., the United Kingdom, Australia, France, the Netherlands and Sweden. On the national scene, DRDC plays a leadership role in collaborative horizontal S&T initiatives involving other government organizations, industry and universities.

**Each year LFSA sets key objectives to strengthen our S&T leadership and enhance the relevance and value of our contributions to defence and security. This year we focus on updating the TIS, influencing and aligning with policy and strategy, enabling transformation, exploiting the results of R&D, and connecting nationally and globally. The following key objectives support these goals.**

- 1. Update the TIS by 2006.**
- 2. Undertake a benchmarking study to assess DRDC's international standing in the niche S&T activities of the TIS.**
- 3. Develop a business model by 2006 for providing advice on defence and security policy, strategy and decision making.**
- 4. Provide a forward-looking S&T perspective for the Strategic Capabilities Investment Plan (SCIP) by 2006.**
- 5. Enhance our assistance to CF operations (domestic and international) in providing expert support, advice and material.**
- 6. Engage the CF in public security S&T network initiatives under the Chemical, Biological, Radiological and Nuclear Research and Technology Initiative (CRTI) and the Public Security Technical Program (PSTP) by 2006.**

## Updating the Technology Investment Strategy

In response to the strategic direction provided by *Defence Strategy 2020* and the evolving global security environment, DRDC's TIS was updated in 2002. The TIS outlines the R&D we will undertake to develop the S&T capacity needed for future defence and national security. The TIS is based on 22 Activities that span the defence S&T spectrum.

A major review of the TIS is planned in 2005 to ensure that it is properly aligned with advances in technology, changes in the security environment and the CF transformation agenda. As part of the review, we will undertake a benchmarking study to assess our international standing in the niche S&T activities as defined by the TIS.

One of the considerations in updating the TIS will be to include the changes suggested by our research under the Technology Investment Fund (TIF) program. This program funds high-risk, high-payoff research projects with potential military applications, which point to new opportunities for investment.

### Key Objectives

- Update the TIS by 2006.
- Undertake a benchmarking study to assess DRDC's international standing in the niche S&T activities of the TIS.

### New Technology Investment Fund Projects Started in 2004

- Stochastic Grammatical Modelling and Processing for Electronic Support and Electronic Intelligence
- Meta-Materials Based Adaptive Radar Signature Management
- Proteomics at DRDC - Development of Protein Suspension Array Technology
- Development of a Practical Capability for Emerging Energetic Material Simulations at the Atomic Level
- Carbon Nanotechnology to produce efficient electrodes
- Miniature Infrared (IR) Spectrometer with Micro-Electro-Mechanical Systems (MEMS) Optical Coding for Advanced Surveillance Systems
- Trusted Unmanned Vehicle Autonomy Through Time Constrained Decentralization
- Chem-Bio Agents Detection using powerful Femto-Second Laser Pulses
- Exploiting Ultra-wide-band and Coded Sonar Pulses
- Integrated Cognitive and Physiological Modelling of Human Performance



A conceptual rendering of unmanned multi-vehicle coordination, based on R&D undertaken at DRDC Suffield.

## Influencing and Aligning with Policy and Strategy

Specific ongoing national strategic policy initiatives, especially in DND and the CF, will have a significant impact on DRDC. Canada is committed to playing a more significant role internationally. In part, this will be facilitated through an integrated review of Canada's international policies, including defence and security. Canada's defence priorities will be identified and a fundamental review of the future capabilities of the CF will be undertaken.

In DND, much effort has been devoted to the development of strategic policy documents such as *Strategy 2025*, the *Strategic Operating Concept* (SOC) and the SCIP. In addition, the department is pursuing various concepts such as Joint, Interagency, Multinational and Public (JIMP) integration and Network Enabled Operations (NEOps). DRDC influences and aligns with these initiatives in order to identify opportunities and threats presented by S&T.

One of our key objectives is to develop a business model to enhance our capacity to participate in DND and CF decision making by providing S&T input to policies and strategies. We will provide this input by drawing on the expertise of our scientists at the defence research centres. S&T subject matter experts in the defence research centres can also make a valuable contribution to other national and international issues and initiatives, including the innovation agenda, federal S&T integration and various federal policy documents.

### Key Objective

- **Develop a business model by 2006 for providing advice on policy, strategy and decision making.**

The Centre for Operational Research and Analysis (CORA) provides operational research and analysis (ORA) services directly to the CF and DND. These services include strategic analysis that is playing an important role in the development of major "layers" of the strategy pyramid, such as the *Future Security Environment 2025*. These contributions could benefit from S&T input from our scientists at the regional defence research centres.

The Technology Assessment Working Group (TAWG) is responsible for promoting excellence and innovation in defence S&T. However, this group does not have the capacity to provide policy input on a continuous basis to support DND and CF policy initiatives. DRDC requires an enhanced S&T policy capacity to provide timely, responsive and quality advice to senior and working-level DND and CF policy and strategy authorities. It also needs to augment its participation in working groups, committees and other fora that analyse, debate and produce DND and CF policy and strategy. S&T issues will only be properly reflected in strategic DND and CF documents with the enthusiastic and informed involvement of DRDC scientists.



## Connecting with Client Organizations

DRDC's strong connections to the CF client community through Overview and Advisory Groups provide the framework for decisions on what S&T to pursue.

R&D supporting naval requirements responds to the Navy's evolving priorities: Maritime Command and Control (C2); Maritime Intelligence, Surveillance and Reconnaissance (ISR); Maritime above water and underwater warfare capabilities; and naval platform technology. The new Maritime Research Steering Group (MRSRG) provides strategic guidance and coordination of the maritime research program, including Operational Research (OR), CD&E and R&D.



Supporting the Air Force – The H-92 Cyclone.  
Photo courtesy of Sikorsky.

A major review and restructure of the Land Force R&D program is close to completion. The broad scope of the restructure redefined the governance of the R&D program and its thrusts, devised better ways to establish priorities and evaluate projects, and set up an effective function to coordinate R&D across thrusts in a systems orientation. A key objective is to align the organization and program with the Land Force strategic priorities. In particular, the thrust structure has been aligned along the Army's five operational functions — Command, Sense, Act, Shield and Sustain. This approach allows for a broader scope than before, while ensuring that the R&D program will be guided across the notions through the stages of conceiving, designing and building combat capabilities.

Under the Air Force's guidance, the Scientific Advisor to the Chief of the Air Staff (SA Air) has developed an evolving program of S&T activities, building on past successes and linking the Air Force's transformation goals with DRDC's TIS. DRDC supports the S&T needs of the Air Force through a series of five air R&D thrusts, as well as through other thrusts addressing S&T of common



Supporting the Navy –  
Preparing the Remote Minehunting System for deployment.

interest. These efforts will address the following key R&D challenges during the next three to five years: interoperable Command, Control, Intelligence and Surveillance (C2IS) for joint and combined operations; inhabited and uninhabited vehicles sharing the same environment; a common operating picture; and synthetic environment concepts.

The *CF Command, Control, Computers, Communications, Intelligence, Surveillance and Reconnaissance (C4ISR) Command Guidance and Campaign Plan* (issued by the C4ISR Oversight Committee in December 2003) represents the intent of CF leadership with respect to C4ISR capability development. The most transformational and challenging part of the plan is the creation of an information-based culture in a network-enabled organization. The plan identifies four lines of operations: obtaining timely, relevant and trusted information; processing and fusing multi-source data and information; protecting and sharing information; and exploiting information. Also, recognizing the complexity of achieving a system-of-systems end-state at all levels of command and in all operational environments, the R&D coordination effort is working across DND and the CF to bring about synergy and work towards a strongly harmonized C4ISR R&D program. The approach will focus on developing a “common intent” while enabling “distributed execution.”

A strategy to increase and prioritize the investment in “human capabilities” in the Human Performance R&D program will be developed through a series of workshops, consultations and executive meetings.

Transformation of this program and the Joint Operations R&D Overview Group is essential if R&D in human capabilities is to become more relevant and achieve a greater visibility within the CF. It is expected that the transformation will evolve in harmony with, and align with the DND’s SCIP.

Within the context of the TIS, CORA is reviewing its technical and program goals and developing recommendations on the future size and structure of the organization to meet these goals. The review will include wide consultations within DND, and will address the internal management structure needed to formulate and deliver the operational research program.



Supporting the Army – Operating the C4ISR lab at DRDC Valcartier.

## Enabling Transformation

One of the overarching themes affecting the CF is transformation. According to the 2004 CDS Annual Report:

*The transformation process is evolutionary and has no definable end state. Transformation focuses on people, technology, ways of conducting operations and ways of thinking. It does not seek to restructure the CF completely, or re-equip it, but rather to blend existing and emerging systems and structures to create greatly enhanced capabilities relevant to future missions, roles and tasks. Transformation is an iterative and continuous process, and its success is easy to see only in hindsight.*

– CDS Annual Report 2004

### Last Year's Key Objective

- **Identify and analyze by 2004 five technology concepts that will have significant implications for defence and national security within 10 years.**

In response to last year's key objective, a multi-disciplinary team of DRDC scientists undertook an investigation of transformation concepts and technologies in order to provide input to the transformation agenda. These concepts and technologies will help the CF to blend existing and emerging systems and structures, which will enhance capabilities relevant to future missions, roles and tasks.

Two of the transformation concepts that were identified by the team are key integrating concepts for the CF SOC. These concepts are NEOps and Effects Based Operations (EBO).

- Joint network-enabled concepts of operations are central to the transformation of defence and security organizations in response to the new security environment. The progress in information and communications technology at the centre of the current technology cycle coincides with the increasing need for information superiority in joint and combined operations. Networking of systems will become the dominant operational feature of future military systems. NEOps will greatly improve information sharing, allowing decentralized and dispersed forces to more efficiently communicate, manoeuvre and conduct non-contiguous operations.

To further advance the NEOps concept, DRDC co-sponsored with the Vice Chief of the Defence Staff (VCDS) and the Deputy Chief of the Defence Staff (DCDS) organizations a departmental symposium in late 2004. The aim is to establish a DND/CF roadmap for NEOps that includes the relationships with allies and national security partners.

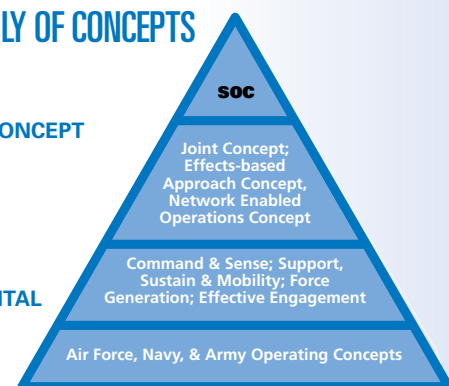
### SOC FAMILY OF CONCEPTS

**CAPSTONE OPERATING CONCEPT**

**INTEGRATING CONCEPTS**

**FUNCTIONAL CONCEPTS**

**ENVIRONMENTAL OPERATING CONCEPTS**



## Last Year's Key Objective

- **Engage the rest of the Department and the CF in co-sponsoring a symposium in 2004 to explore transformation concepts, issues and operational implications.**
- Effects Based Operations are “operations designed to influence the will of an adversary, one’s own forces or neutrals, through the coordinated application of all available capabilities, in order to achieve the desired objectives.” An effect is “the cumulative consequences across the ...environment of any one or more actions (or tasks) taken at any level with any Instrument of Government.” EBO envisages coordination of diplomatic, information, military and economic levers. Effects themselves can be physical or cognitive. One requirement is an understanding of friends’, foes’ and neutrals’ perceptions; hence the emphasis on human factors and in complex adaptive systems. Enabling factors include a common information environment, integrated ISR, multi-level security, a common operating picture and operational net assessment.
- Other concepts identified by the team included the following:
  - *Full spectrum protection against threats.* Limited full-spectrum protection sensors will probably be achieved within the 2025 time frame. Armour and camouflage technology will be enabled by results from materials research. New fibres, such as spider silk produced by genetically modified organisms, and polymeric and ceramic multi-impact resistant materials, will be developed. Active systems will be developed to allow soldiers’ suits and vehicle coverings to exhibit chameleon-like properties across the Electro-Optical (EO) spectrum.
  - *Protection against Nuclear, Biological and Chemical (NBC) threats.* The first level of protection against NBC threats will be long-range remote agent detection and identification, combined with accurate propagation prediction models. Reactive neutralizing materials and self-decontaminating surfaces on military platforms will offer the second level of protection. Comprehensive personal archival devices will help medical personnel to accurately identify exposure and treatment methods.
  - *Emerging materials to enhance operational sustainment.* New clothing as well as equipment components, advanced power sources, coatings and lubricants will reduce maintenance, transportation and power requirements. Such innovations provide the logistical and operational benefits of longer shelf life and better performance in environmental extremes. Durability and effectiveness will be improved in tandem to reduce wear-out, lengthen operational lifetimes and lower





Radiation detection exercise in Chalk River, Ontario.

sustainment requirements in the field. In combination, these characteristics result in a reduced 'footprint' for the future CF. Other innovations include embedded sensors and bar-coded material to improve logistics management in the same way that commercial checkout counters automatically re-order stock for items that are being purchased or drawn down — allowing the CF to adopt a “just in time” re-supply approach.

## The Strategic Capabilities Investment Plan

The SCIP is a key departmental transformational initiative. The SCIP provides a comprehensive roadmap to ensure that the CF has the capabilities needed for the future. The current plan identifies modernization and acquisition priorities. It will be expanded to also guide our investments in other areas, such as personnel, infrastructure and S&T. The plan enables the CF to make strategic and planned choices about the capabilities they will need in the future as they adapt to changes in the security environment and military technology.

*Future technology development needs will have to be factored in. Accordingly Defence will seek to create closer linkage of the Technology Development Program planning with Strategic Capability Investment planning. Indeed the interconnectedness of future plans for technology development, experimentation, human resources, infrastructure and equipment will be key to successful capability investment.*

### – Strategic Capability Investment Plan

As part of the evolution of the SCIP, we are mapping the elements of our current R&D program to correspond with the capability and capital priorities in the SCIP. We will propose forward-looking technologies and concepts that will influence mid- to long-term evolution of capability, and work with the CD&E community to advance future concepts for further development and experimentation.

#### **Key Objective**

- **Provide a forward-looking S&T perspective for the SCIP by 2006.**

## Exploiting the Results of Research and Development

### Key Objective

- **Enhance the assistance to CF operations (domestic and international) in providing expert support, advice and material.**

An important and immediate key objective in our work is to assist CF operations (domestic and international) by providing expert support, advice and material in response to emerging requirements. Such assistance tends to be reactive in nature, responding to an uncertain strategic environment that frequently has urgent and unforeseen technical requirements. However, such calls for support validate the direct relevance of the S&T program for the operations customer.

The challenge for the CF and DRDC is to pursue S&T concepts, that will lead to results that can be exploited at an affordable cost to improve defence capabilities. According to the SOC this requires

*A robust capability to generate detailed concepts for experimentation and research and development, and the integration of validated concepts with technology, doctrine and organization to develop the future CF.*

– Strategic Operating Concept

DRDC has a variety of programs, all of which contribute to exploitation objectives:

- The Technology Demonstration Program (TDP) has as its objective to demonstrate technologies fostered by DRDC and Canadian industry in the context of real and potential future CF capabilities, concepts, doctrine, operations and equipment;

### New Technology Demonstration Projects Approved for 2005 Start

- **The Multi-Sensor Torpedo Detection, Classification and Localization**
  - **Space-Based Hyper-Spectral Image Exploitation**
  - **Advanced Integrated Multi-Sensing Surveillance System**
  - **Interoperable Combat Fluid Resuscitation Capability**
  - **Code Division Multiple Access Geo-location Demonstrator**
- The Applied Research Program (ARP) has as its objective to advance the defence science knowledge base, to investigate novel and emerging technologies and to explore the military application of those technologies. DRDC continues to re-allocate funds to new projects. This ensures the continued relevancy of programs and research; and
  - The Defence Industrial Research Program (DIRP) is specifically aimed at promoting and assisting basic industrial R&D in technology areas that are of interest to the Canadian Forces.



The Future Forces Synthetic Environment UAV flight simulation lab.

## New Applied Research Program Projects started in 2004

### Maritime

- Underwater Data Networks and Sensors for Autonomous ISR Systems
- Integrated Ship Signature Management Testbed
- Multi-Static Anti-Submarine Warfare (ASW) with Deployable Sources
- Naval Platform Target Strength Prediction, Measurement, and Modification
- Task Group Mine Defence Concept Development
- Technology Evaluation for Rapid Environmental Assessment

### Land

- Cognitive Aspects of Project Minerva
- Urban Mobility/Counter-mobility
- Non-Lethal Weapon Research Protocols
- Combat Vehicle Signature Reduction
- Integrated Protection for Light Armoured Vehicles (LAVs)
- Advanced Passive Protection for LAVs
- Explosive Ordnance Disposal Modernization
- Sensor Delivery

### Air

- Trials and Integration Concepts for Advanced Imaging Sensors
- Airborne Integrated Multi-Band Electro-Optical Sensors for Automated (or Aided) Target Recognition (ATR)

- Air-to-Surface Sensors: Development and Operation
- Network-Centric Distributed Collaborative Planning
- Airborne Information Fusion & Management for Tactical Picture Compilation
- Advanced Combat Radar
- Future Offensive Systems Performance & Health Monitoring
- Air Vehicle Integrated Modelling and Simulation
- Neck Injury Reduction

### C4ISR

- Combat Identification
- Third and Fourth Generation Wireless Electronic Warfare
- Specific Emitter Identification
- Global Navigation Satellite Systems Protection and Exploitation
- Distributed Robust Network Infrastructure
- Adaptive Wireless Systems for Enhanced Military Spectrum Capacity
- Programmable Multi-Band Radio Frequency (RF) Front-Ends and Antennas for Software-defined Radio

### HP

- Several new projects under development for 2005.

## Exploitation Management

The regular and rapid migration of S&T products into operational systems and concepts has led to approaches such as spiral development and capability engineering. Exploitation of R&D is taken into account from the outset and continues as the R&D progresses.

*A streamlined capital acquisition and life-cycle management system that simplifies and greatly reduces the time needed to develop and field new capabilities. Tools such as synthetic environment-based acquisition may contribute to this. To achieve this, it is essential to establish collaborative capability definition, engineering and management using focused research and development, a comprehensive CD&E program, the best available synthetic environments, integrated project teams, and the rigour of systems engineering – all enabled with advanced collaborative processes and broadband networks.*

– Strategic Operating Concept



Inside the Access Lab, part of the Collaborative Capability Design, Engineering and Management Technology Demonstration Project.

An “Exploitation Guidebook” for the TDP provides the framework within which to identify, plan and maximize exploitation opportunities. The guidebook breaks the exploitation process into three steps:

- Identify stakeholders who can benefit from the results of the project;
- Identify potential exploitable results, both during project execution and after the project is completed; and
- Develop and document the exploitation plan.

Integrated project teams with representation from the operational, requirements, R&D and acquisition communities, as well as industry, are key enablers of exploitation. By engaging these communities early in new concept development, a capability engineering approach can be used for managing planning, acquisition and evolution. The Collaborative Capability Design, Engineering and Management (CapDEM) TDP is exploring the use of these methodologies and toolsets within the DND context, using C4ISR as the trial capability. Exploitation Management of Maritime TDP using some of these methods has also been initiated.

### Last Year's Key Objective

- **Develop and implement mechanism for technology exploitation and insertion by 2005.**

## Commercialization and Technology Transfer

### Last Year's Key Objective

- **Develop and implement mechanism for technology exploitation and insertion by 2005.**

Realizing the benefits of Canada's investment in research is one of the priorities of the federal government. Enhancing the flow of discoveries, inventions and new concepts from laboratories into commercial products and processes will help to bridge the gap between business and research communities. As one initiative towards bridging this gap, the regional research centres are establishing themselves as innovation hubs.

### Selected Business Opportunities

- **Networked underwater warfare**
- **Space-based reflective hyper-spectral image sensors**
- **Airborne networked sensing system**
- **Micro-satellite based space surveillance**
- **Modelling & Simulation/Synthetic Environments**
- **Uninhabited vehicles**
- **Forensic evidence: analytical methods, recovery methods, and equipment.**



Signing of a Research Collaborative Agreement between DRDC Toronto and Avitar Inc., Canton, Massachusetts.

Rapid transition of S&T into defence and security capability involves engaging industry early in R&D technology insertion and spiral development, and moving away from "big bang" procurement to an evolutionary approach taking into account end-to-end procurement. Commercialization and technology transfer are required for technology to be transformed into product. Through timely commercialization, a synergy can be achieved between Canada's defence and security objectives and her economic objectives. The result would be economic benefit at the national level and the creation of sustainable employment.



The management structure for the agency's R&D program is geared towards pursuing innovative ideas and maximizing the impact of investments. Half of the R&D budget is for internal R&D, with the remainder for external R&D. Many of the TDP projects are now managed by integrated project teams composed of members from the R&D community, industry, the acquisition community and the CF requirements and user community.

Because TDPs are collaborative in nature, they require some form of meaningful investment by all stakeholders.

Each research centre and the corporate office has a Business Development Office (BDO). Together, they comprise a network of senior officials whose primary focus is the development of external business opportunities to leverage the R&D program.



Innovative technology –  
A conceptual rendering of the  
Rapidly Deployable System  
monitoring coastal water.

## Connecting Nationally and Globally



NATO Research and Technology Board meeting in Istanbul, September 2004.

At the national level, public security, innovation and commercialization drive policy and activities. DRDC is a key player, responding to these drivers. The interdepartmental Assistant Deputy Minister Science and Technology (ADM S&T) Committee is leading the development of a framework for federal S&T for Cabinet approval. As well, the interdepartmental ADM S&T Integration Board is currently developing policies and a strategy for integration of federal S&T activities.

Internationally, we are in the process of developing guidelines and policies maximizing the benefits of international collaboration. We also play a key role in developing a TTCP R&D strategy for network-enabled warfare, and the Chief Executive Officer (CEO) of DRDC is leading the update of the NATO Research and Technology (R&T) Strategy accompanying the recent transformation of NATO to reflect the changed defence and security environment.

### Connecting National Security and Defence

DRDC continues to lead in national defence by connecting Canada's national security needs with the established expertise of our defence R&D

### Continuing Key Objective

- **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.**

program. The CRTI, established to strengthen Canada's preparedness for a Chemical, Biological, Radiological and Nuclear (CBRN) terrorist attack, has become a model for leveraging expertise, S&T delivery and horizontal partnering in the federal government. Its partners include 17 federal departments and agencies as well as industry, academia and emergency response organizations.

With the signing of the Agreement for Cooperation in Science and Technology for Critical Infrastructure Protection and Border



Chemical, Biological, Radiological and Nuclear Research and Technology Initiative Mobile Nuclear Laboratories offering increased protection against nuclear contamination.

## Last Year's Key Objective

- **Initiate and lead two new interdepartmental S&T initiatives by 2005.**

Security between the governments of Canada and the U.S., DRDC has once again demonstrated leadership in an S&T initiative. The agreement will allow Canada and the U.S. to leverage each other's S&T expertise to develop and adopt security measures to ensure cross-border security and the protection of critical infrastructure. Together they are setting up the PSTP, a Canada-U.S. program to integrate ongoing and future collaboration resulting from the agreement. Arrangements under the PSTP are being led by DRDC in partnership with Public Safety and Emergency Preparedness Canada (PSEPC), on behalf of Canada, while the Department of Homeland Security (DHS) has the lead for the U.S. The PSTP will bring together Canadian government departments and agencies with their U.S. counterparts to ensure efficient use of resources. The PSTP joins the CRTI in fostering collaboration among S&T organizations.

An example of this collaboration can be seen in the recently acquired Mobile Nuclear Laboratories, which provide support in the event of a radiological or nuclear incident. These labs have operators from several other government departments. This capability could be linked to the Land Force Reserve Restructure proof of concept trial for a CBRN response capability.

DRDC has been very successful in linking governments, universities and businesses into S&T endeavours. A key objective is to engage the CF in these horizontal initiatives.



Strengthening public security through technology – Facial Detection System using biometrics technology.



## Working with the United States

One of the pillars of Canada's defence strategy, as identified in *Shaping the Future of the Canadian Forces: A Strategy for 2020*, is the strengthening of our military relationship with the U.S. to ensure that Canadian and U.S. forces are interoperable and capable of combined operations in key areas.

The U.S. Department of Defense (DoD) is the largest single sponsor of technology development in the world. Access to advanced technologies from the U.S. is therefore critical in order for Canada to develop defence capabilities compatible with future U.S. forces. Cooperation in S&T at an early stage of research and concept development is a precursor to effective interoperability.

### Examples of Successful Collaborations with the United States

- **Multi-Mission Effects Vehicle Demonstration**
- **Rapidly Deployable Acoustic Surveillance Systems**
- **Networked Underwater Warfare**
- **Force Protection Against Enhanced Blast.**
- **Advanced Distributed Mission Trainer**



The CF-18 Multi-Task Trainer is a highly successful Canada-U.S. collaboration.

The special Canada-U.S. defence relationship has seen the successful development and exploitation of many technologies and systems. The unique relationship that Canada enjoys with the U.S. in defence science creates favourable conditions for Canadian industry to access U.S. defence programs. The Defence S&T Senior National Representatives forum permits regular contact between the highest-level Canadian and U.S. defence S&T executives. It also ensures that buy-in occurs at the highest levels and that collaboration targets common strategic objectives.

## Conclusion

DRDC has a heritage of excellence in defence science and a commitment to uphold its position as a leading defence S&T agency. Our continued success depends on influencing and aligning with policy and strategy, strengthening our connections with those who use the results of our work, and solidifying strategic linkages with our national and international partners. The key to our continued success is excellence in an S&T portfolio that is aligned with advances in technology, changes in the security environment and the CF agenda for transformation. To ensure continued success we will undertake a major review of our TIS and assess our international standing in our niche research areas.



Demonstrating successful collaboration – A U.S. soldier using the Multi-Mission Effects Vehicle simulator.

Innovative approaches are required for the exploitation of technology to enhance, transform and maintain operational capability, while taking into account factors such as affordability, and operational and human consequences. By drawing on the expertise of scientist at the defence research centres, DRDC is able to provide advice and input on technology trends, threats and opportunities to the creators of defence policies and strategies. As input to the transformation agenda, for example, a multi-disciplinary team of DRDC scientists undertook an investigation of transformation concepts and technologies that will aid the CF to blend existing and emerging systems and structures, to enhance capabilities relevant to future missions, roles and tasks. We have also co-sponsored a major symposium to advance the



DRDC meeting the challenges of the future –  
Deploying the Rapidly Deployable System.

concept of NEOps, and we will contribute a forward-looking S&T perspective to the evolution of the SCIP.

The challenge is to pursue S&T concepts that will lead to results which can be exploited at an affordable cost to improve defence capabilities. DRDC's strong connections to the CF client community through Overview and Advisory Groups provide the framework for decisions as to what S&T to pursue. An important and immediate outcome of our work is assistance to CF operations by means of expert support, advice and material for emerging requirements.

Realizing the benefits of Canada's investment in research is one of the priorities of the federal government. This involves enhancing the flow of discoveries, inventions and new concepts from laboratories into commercial products and processes by bridging the gap between business and research communities. Rapid transition of S&T into defence and security capability involves engaging industry early in R&D technology insertion and spiral development. DRDC is geared towards pursuing innovative ideas and maximizing the impact of investments. As one initiative, the regional research centres are establishing themselves as innovation hubs.

At the national level, DRDC is a key player in public security, innovation and commercialization. DRDC has been very successful in linking governments, universities and businesses in S&T endeavours. As part of our strategy for making a difference, DRDC will engage the national innovation system for North American security through such partnerships as CRTI and PSTP.

DRDC is well connected internationally as a key player in TTCP and NATO RTO, and through bilateral and multilateral collaborations. The special Canada-U.S. defence S&T relationship has seen the successful development and exploitation of many technologies and systems.

In order to meet the challenges of the future, DRDC recognizes the need to work in partnerships today. While DRDC's reputation grows internationally, we will ensure that we maintain our proven reputation as a national S&T leader. Communications are vital in our role of demonstrating what the future holds and how to prepare for that future. DRDC is building the bridges today to meet with success tomorrow.

## Technology Investment Strategy

The 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 in-house R&D. We draw on Canadian industry, universities, other national partners and our allies to leverage the additional capabilities we need to carry out a defence R&D program based on Service-Level Agreements (SLAs) with DND and CF.

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. A review and assessment of the TIS and its implementation is planned for 2005.

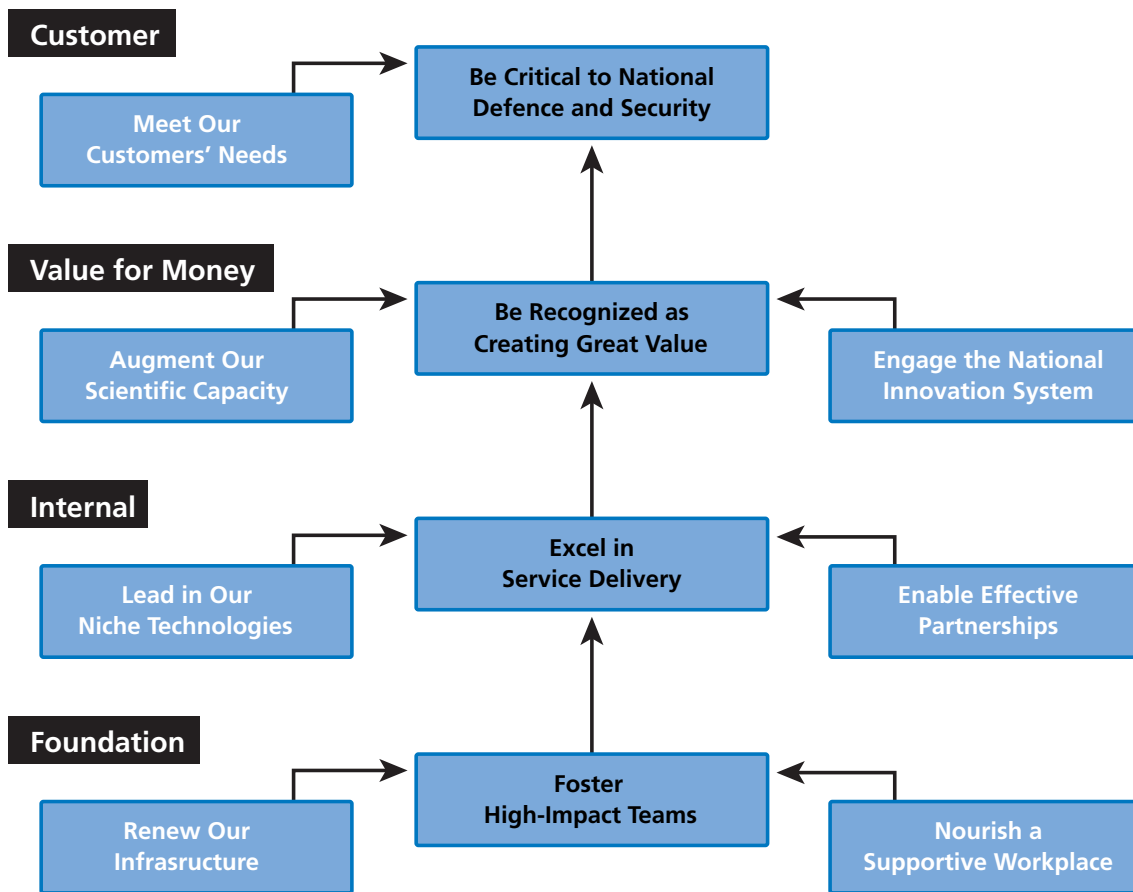
### TIS R&D Activities

- Command and Control Information Systems Performance and Experimentation
- Information and Knowledge Management
- Communications
- Human Factors Engineering and 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

## Our Strategy Map

DRDC has embarked on an initiative to articulate its strategy and to put in place a system to facilitate the management and execution of that strategy. The DRDC Strategy Map, closely aligned with the DND/CF Strategy map, is built upon four perspectives: Customer, Value for Money, Internal and Foundation. Each perspective is associated with two or three strategic objectives, areas in which DRDC must excel to fulfil its mandate.

The Strategy Map forms the basis of DRDC's performance management framework with performance indicators for each strategic objective. Through it, the relevance and health of the organization is monitored on a regular basis.



## Acronyms and Abbreviations

<b>ADM S&amp;T</b>	Assistant Deputy Minister Science and Technology	<b>ISR</b>	Intelligence, Surveillance and Reconnaissance
<b>ARP</b>	Applied Research Program	<b>JIMP</b>	Joint, Interagency, Multinational and Public
<b>ASW</b>	Anti-Submarine Warfare	<b>LAVs</b>	Light Armoured Vehicles
<b>ATR</b>	Automated Target Recognition	<b>LCM</b>	Life Cycle Management
<b>BDO</b>	Business Development Officer	<b>MEMS</b>	Micro-Electro-Mechanical Systems
<b>C2</b>	Command and Control	<b>MRSG</b>	Maritime Research Steering Group
<b>C2IS</b>	Command, Control, Intelligence and Surveillance	<b>NATO</b>	North Atlantic Treaty Organization
<b>C4ISR</b>	Command, Control, Computers, Communications, Intelligence, Surveillance and Reconnaissance	<b>NBC</b>	Nuclear, Biological and Chemical
<b>CapDEM</b>	Collaborative Capability Design, Engineering and Management	<b>NEOps</b>	Network Enabled Operations
<b>CBRN</b>	Chemical, Biological, Radiological and Nuclear	<b>OR</b>	Operational Research
<b>CD&amp;E</b>	Concept Development and Experimentation	<b>ORA</b>	Operational Research and Analysis
<b>CDS</b>	Chief of the Defence Staff	<b>PSEPC</b>	Public Safety and Emergency Preparedness Canada
<b>CEO</b>	Chief Executive Officer	<b>PSTP</b>	Public Security Technical Program
<b>CF</b>	Canadian Forces	<b>R&amp;D</b>	Research and Development
<b>CORA</b>	Centre for Operational Research and Analysis	<b>R&amp;T</b>	Research and Technology
<b>CRTI</b>	Chemical, Biological, Radiological and Nuclear Research and Technology Initiative	<b>RF</b>	Radio Frequency
<b>DCDS</b>	Deputy Chief of the Defence Staff	<b>RTO</b>	The NATO Research and Technology Organization
<b>DHS</b>	Department of Homeland Security (U.S.)	<b>S&amp;T</b>	Science and Technology
<b>DIRP</b>	Defence Industrial Research Program	<b>SA Air</b>	Scientific Adviser to the Chief of Air Staff
<b>DND</b>	Department of National Defence	<b>SCIP</b>	Strategic Capabilities Investment Plan
<b>DoD</b>	Department of Defense (U.S.)	<b>SLAs</b>	Service Level Agreements
<b>DRDC</b>	Defence Research and Development Canada	<b>SOC</b>	Strategic Operating Concept
<b>EBO</b>	Effects Based Operations	<b>TAWG</b>	Technology Assessment Working Group
<b>EO</b>	Electro-Optical	<b>TDP</b>	Technology Demonstration Program
<b>IR</b>	Infrared	<b>TIF</b>	Technology Investment Fund
		<b>TIS</b>	Technology Investment Strategy
		<b>TTCP</b>	The Technical Cooperation Program
		<b>UAV</b>	Uninhabited Aerial Vehicle
		<b>U.S.</b>	United States of America
		<b>VCDS</b>	Vice Chief of the Defence Staff