



Defence Research and
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Defence R&D Canada — Centre for Security Science



From Concept to Capability

Collaborative Science and Technology for
Public Safety and Security

2002–2010

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Overview

With an increase in terrorist and naturally occurring extreme events, the rapid, globalized spread of infectious diseases, and other safety and security threats, the Government of Canada is committed to being more vigilant than ever in protecting Canadians at home and abroad. The Defence R&D Canada – Centre for Security Science (DRDC CSS) plays an integral role in coordinating, through its partnerships and programs, timely and relevant science and technology (S&T) activities in support of an all-hazards approach to address terrorism, criminal activities, and accidental and natural disasters.

DRDC CSS Mission

To strengthen, through investments in science and technology, Canada's ability to prevent, prepare for, respond to, and recover from accidents, natural disasters, or terrorist and criminal acts that impact the safety and security of Canadians.

DRDC CSS, a joint endeavour between the Department of National Defence and Public Safety Canada, is managed by DRDC on behalf of the two departments. The Centre partners with the S&T and public security community—industry, academia, federal, and provincial performers, as well as local responders—to produce new knowledge and enhance capability. Public safety and security S&T coordinated through DRDC CSS is a Government of Canada imperative to improve the protection of critical infrastructure and emergency preparedness and response, and enhance the anti-terrorism capacity of law enforcement agencies and the military.

Background

DRDC CSS originated from the Government of Canada's Public Security Anti-Terrorism (PSAT) initiative that provided funds for security, intelligence, and law enforcement departments and agencies to heighten border security and enhance the security of Canadians. Out of PSAT, the Chemical, Biological, Radiological-Nuclear and Explosives (CBRNE) Research and Technology Initiative (CRTI) was launched for collaborative federal S&T, providing the roots for the future centre.

CRTI was formed in the wake of the terrorist attacks of September 11, 2001, to bring together the rich pool of defence research expertise with expertise across a broad range of public safety and security domains. CRTI turned to federal government science departments and agencies to lead the initiative, in contrast with the traditional Canadian S&T approach, which is generally led by academia and private industry. The initiative was required to engage the entire Canadian innovation system, meaning that participants would have to partner in project teams with other departments and agencies, including responder agencies, as well as academia and industry.

As the nation's CBRNE capabilities improved, it was recognized that Canada needed to expand its S&T efforts into other areas. This recognition led to the creation in 2006 of DRDC CSS, one of nine DRDC research centres, which took over responsibility for CRTI. Through a whole-of-government approach, DRDC CSS works with the other DRDC research centres and over 21 federal departments and agencies. Through these networks, the Centre contributes to DRDC's vision to be known worldwide as for a leader in defence and security S&T.



DRDC CSS helps develop S&T for critical infrastructure protection

DRDC CSS manages the Public Security Science and Technology (PSST) suite of programs, including:

- CRTI was launched in 2002 as a horizontal research and development program, with an initial emphasis on CBRN capability areas, expanding over the years to include forensics, psychosocial factors, and explosives;
- The Public Security Technical Program (PSTP) was established in March 2006 and broadens the scope of safety and security S&T to address critical infrastructure protection; surveillance, intelligence, and interdiction; emergency management systems and interoperability; and
- The Canadian Police Research Centre (CPRC) has been supporting research and development (R&D) relevant to the demands of law enforcement since 1979 and became part of DRDC CSS in 2007, at which time its mandate was expanded to include fire and emergency medical services.

Through its PSST programs, DRDC CSS manages and administers research, development, and evaluation of technologies through projects funded by a Call for Proposals process, exercises, and other activities. It identifies future trends and threats, and provides support and services for all-hazards vulnerability and risk assessment, technology forecasting, and operations research. DRDC CSS also manages international agreements for collaborative S&T with the United States (US) and the United Kingdom. With its commitment to continuous improvement, DRDC CSS is consolidating its operations and integrating the management of its programs to better respond to the changing demands of today's security environment.

Governance

Given the horizontal, multi-departmental, multi-jurisdictional nature of public security and PSST programs, and the integrative role of DRDC CSS, strong and empowered governance is essential. The core governance construct for the PSST program suite is found in two enabling memoranda of understanding (MOU):

- An interdepartmental MOU signed with 21 participating federal departments establishes the mechanisms for managing and delivering horizontal S&T.
- A Department of National Defence and Public Safety Canada MOU establishes the DRDC CSS as the coordinating body for federal public security S&T responsive to policy direction from Public Safety Canada.

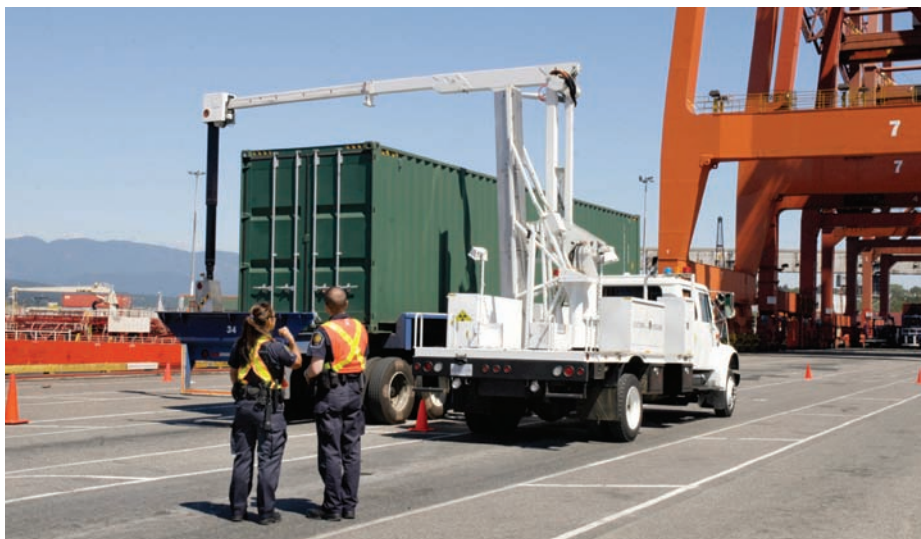
Together, these MOU's vest authority in two key governance elements:

- A Program Management Board (PMB) at the Director General (DG) level. The PMB is co-chaired by the DG, DRDC CSS, and the DG, Preparation and Recovery, Public Safety Canada.
- A Steering Committee (SC) at the Assistant Deputy Minister (ADM) level, which is co-chaired by the ADM (S&T), DRDC, and the Associate ADM, Emergency Management and National Security, Public Safety Canada.

A series of theme-based working groups, science clusters, and communities of practice report to and advise the SC and the PMB.

Through its governance oversight, DRDC CSS maintains alignment between the Government of Canada's public security policy and its operational

One of DRDC CSS's strategic outcomes is the secure flow of goods through ports



and regulatory priorities, and a balanced S&T investment portfolio. A later section of this report articulates how investment priorities are identified.

Strategic Outcomes

In consort with its partners, DRDC CSS developed a series of strategic outcomes with which all its activities are aligned:

- Canada, its citizens, allies, institutions, critical infrastructure, and socio-economic fabric have a greater **resilience to high-consequence public security events**.
- Canada has a **secure and efficient flow of people, goods, and services** across its borders and ports of entry.
- A robust national emergency management and response system is in place, providing effective, **full-spectrum protection of people, responders, and critical infrastructure from all hazards**.
- The **public is confident** that public security threats are being identified, assessed, and addressed in a way that keeps pace with the evolving nature of threats, reflects Canadian values, and maintains the integrity of the criminal justice and national security systems.

Strategic Activities

The main activity undertaken by DRDC CSS to accomplish its strategic outcomes is the funding of projects from government, industry, and academia to address national S&T knowledge and technological gaps. It uses an open, competitive Call for Proposals process and funding can cover projects from early research through to the acquisition of mature technologies. Priorities for funding are reviewed annually and updated, as appropriate, using an integrated risk assessment and capability based planning approach.

In addition to competitive project funding, DRDC CSS engages in a range of activities designed to strengthen Canada's preparedness and public security capabilities. One of the most important activities relates to the development and maintenance of a network of national and international partners and subject matter experts within the public safety and security, S&T, policy, and operational communities. These are groups of stakeholders from government, industry, and academia who share common interests in particular subject areas and who are willing to contribute their expertise and experience to enhancing Canada's ability to prevent, prepare for, respond to, and recover from incidents that impact on the safety and security of Canadians.

DRDC CSS also plays an important role in developing and refining Canada's public safety and security strategies and policies by providing invaluable S&T expertise, advice, and guidance. By including scientific and technical considerations at the beginning of the decision and development processes, DRDC CSS helps ensure that the investment of resources is made where they are truly needed.

Exercises also play a critical role in ensuring that PSST program investments are delivering effective S&T solutions to the federal, provincial, and municipal responders who are the front-line defence in the event of an emergency or disaster. The program investment models support the design and execution of a variety of tabletop and scenario-based field exercises that provide a valuable opportunity for responders to coordinate roles and responsibilities and practice techniques that may not be required in their normal day-to-day operations. By addressing complex issues of interoperability and sustainability in technology development, exercises help ensure the successful integration of new S&T capabilities and knowledge within responder and operational communities.

Other key PSST program activities that contribute to strengthening Canada's public security S&T capabilities include:

- Developing an integrated risk assessment and capability based planning approach to public safety and security;
- Evaluating public security concepts and technologies;
- Organizing workshops, discussion groups, and symposia with federal, provincial, municipal, academic, and private sector emergency management and responder communities;
- Providing support and services for all-hazards vulnerability and risk assessment, technology forecasting, and operational analysis;
- Identifying future trends and threats; and
- Participating in national and international activities to enhance safety and security.

Themes

All three PSST programs—CRTI, PSTP, and CPRC—are active in four main theme areas. The themes are inter-related and cover projects and activities for all types of responses and responders, including first responders and specialized responders, as well as those involved in coordination and decision making. The projects and activities cover all stages of research and development, from exploratory research to final deployment.

The focus for the **Defeat Chemical, Biological, Radiological-Nuclear, and Explosives (CBRNE) Threat** theme is to enable capabilities to strengthen Canada's preparedness for, prevention of, response to, and recovery from an incident involving CBRNE agents.

The S&T for **Critical Infrastructure Protection (CIP)** theme aims to improve the resilience of Canada's critical infrastructure to physical and cyber attack. S&T support is essential to ensure the robustness, reliability, and protection of physical and information technology (IT) facilities, networks, services and assets, which if disrupted or destroyed would have serious impact on the health, safety, security, economic well-being, or effective functioning of the nation.

The **Surveillance, Intelligence, and Interdiction (SII)** theme focuses on advancing and integrating Canada's public safety and security capabilities to identify and stop terrorists or criminals and their activities, particularly as they pertain to border and transportation security, through surveillance, monitoring, disruption, and interdiction. A key element of this theme includes S&T to enable forensic attribution as well as to provide for the safety and security of police, fire, and emergency medical services personnel.

The **Emergency Management Systems and Interoperability (EMSI)** theme is to improve the performance, integration, and interoperability of national and international emergency management capabilities and supporting systems (people, tools, and processes). Activities under this theme include building operational capacity and seamlessness across the national system, developing a

comprehensive process that includes the private sector and regional response communities, supporting regular national and international exercises, and working closely with allies to improve continent-wide emergency management.

Progress

PSST program investments are producing results that strengthen national capabilities in the following areas, as well as many others:

- Risk and vulnerability assessments, and capability based planning;
- S&T support to operations during major events, which includes mobile nuclear, chemical, biological, and forensic identification labs, as well as S&T reachback mechanisms;
- National first responder specialist training;
- “Dirty bomb” preparedness;
- Detecting chemical and biotoxin agents in food;
- National disease surveillance capability;
- Decontamination products and methods;
- Public safety interoperability;
- Personal protective equipment;
- Forensic tools for incident investigation (e.g., CBRNE, human remains, fire); and
- Incident management tools.

As a result of the successes of many projects and the program overall, community members and DRDC CSS staff have received awards and recognition for their contributions to the safety and security of Canada, their cross-government teamwork, and their work with international partners.



DRDC CSS supports the development of emergency response capabilities

Leveraging Investments in Security Science

Since their establishment, the programs under DRDC CSS have evolved to meet the increasing scope and complexity of public safety and security challenges. Hundreds of government, industry, and academic partners have contributed to research initiated through these federal investments. In receiving federal program funding, project partners are required to make in-kind contributions through funding, facilities, or human resources, and to engage additional partners. This horizontal engagement of partners leverages S&T capacity to enable activities that are beyond the scope of any one organization.

Equally important to the research is the dissemination of the information and knowledge created by the S&T performers. DRDC CSS and its partners produce numerous publications, presentations, reports, tools, technologies, and patents each year, ensuring that the knowledge and capabilities created are used, built upon, and transferred to the broader community of public safety and security stakeholders and practitioners. The stakeholder community, in turn, provides DRDC CSS with feedback to ensure that lessons learned in the real world are applied to improve existing capabilities and considered in the development of future S&T priorities.

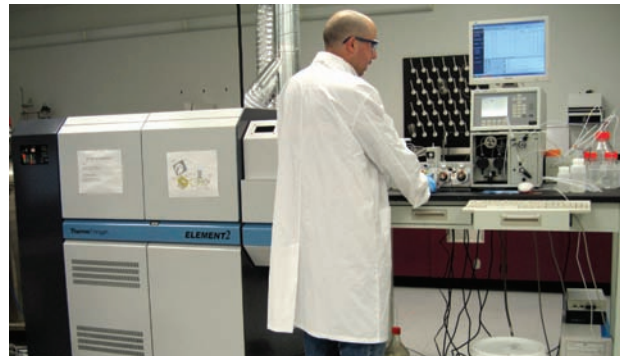
Public Safety and Security S&T Programs

To meet the challenges of the new global security environment, the public security legislative, policy, and operational landscape has become increasingly complex. By their very nature, preparedness and response efforts extend horizontally across dozens of federal departments and agencies, and vertically across all three levels of government. The role of S&T in these efforts is intrinsically linked with the roles of planners, policy makers, decision makers, and responders. Public security S&T expertise is spread across the public, industrial, and academic sectors, adding yet another layer of complexity.

The Defence R&D Canada – Centre for Security Science (DRDC CSS) programs use a collaborative, national approach based on a horizontal model that brings together existing defence research expertise with expertise in emergency and specialized response, public health, food and animal protection, domestic radiological protection, environmental response, intelligence, law enforcement, and other public safety and security fields.

CBRNE Research and Technology Initiative

The Chemical, Biological, Radiological-Nuclear, and Explosives (CBRNE) Research and Technology Initiative (CRTI) began as a \$170-million, five-year initiative to enhance Canada's capacity to deal with CBRN threats to public safety and security. It has proven to be an effective model for bringing together Canada's national S&T and public security communities, and applying their collective knowledge and capabilities towards common goals. CRTI's mandate was extended for an additional five years in December 2006, and expanded to include explosives. CRTI emphasizes partnership-building as a critical element of success, reaching beyond the federal government to first responders,



Projects supported by CRTI have developed S&T to address CBRNE threats

provincial and municipal governments, and academic, industry, and international partners.

CRTI maintains science clusters, which are communities of experts who meet regularly to discuss issues, developments, and priorities relating to their areas of expertise. The clusters are for chemical, biological, radiological-nuclear, explosives, forensics, and psychosocial factors. The clusters focus on the needs of laboratories and the operational community for addressing CBRNE threats, including terrorist and criminal acts, natural disasters, and accidents. They provide new opportunities for knowledge sharing across jurisdictions, organizations, and disciplines, and generally identify synergies and common interests to improve the efficient use of resources.

The work accomplished through the clusters helps the federal government establish priorities and identify S&T gaps and public security vulnerabilities. Each year, CRTI solicits proposals from government, industry, and academia for new projects to address these vulnerabilities. Many of the projects supported by CRTI funds have made important S&T contributions to public safety and security. The return on investment has been significant in many cases, as CRTI projects have

assisted researchers to move their technologies from the laboratory into the hands of users.

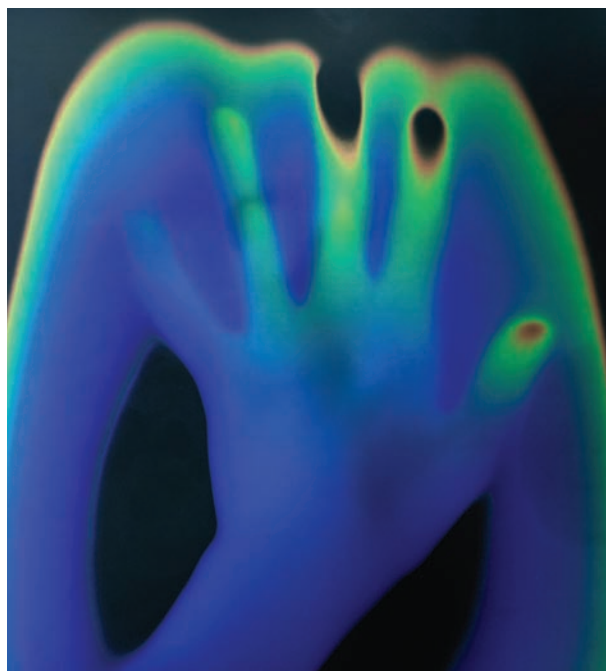
Since its inception, CRTI has also been engaged in a number of other activities to support technology acquisitions and facilitate exercises, workshops, and training to enhance emergency responders and interoperability between different agencies. Collectively, CRTI's activities have resulted in measurable gain for Canada, including CBRNE response capabilities, increased expertise, knowledge, and capabilities in Canadian S&T, and linkages among diverse science and security communities, both domestic and international.

Public Security Technical Program

The 2005 federal budget allocated \$15.5 million over five years to establish the **Public Security Technical Program (PSTP)** with a mandate to align federal, industry, and academic S&T efforts in public security and to lead collaborations in this area. The program was developed in consultation with 21 federal partner departments and agencies to stimulate collaboration, generate critical masses of expertise in public security S&T, and fund studies and projects. The program manages research, investments, networking, and other activities in three key public security domains: critical infrastructure protection; surveillance, intelligence, and interdiction; and emergency management systems and interoperability.

Building on the CRTI's science cluster model, PSTP has put in place **communities of practice** practice that bring together experts from various domains around PSTP mission areas. The communities form a network of national and international partners and subject-matter experts within the S&T, public safety, and national security communities, including responders and planning, policy, and operational professionals from all levels of government, industry, and academia.

The PSTP communities of practice are Biometrics for National Security; Border and Transportation Security; Critical Infrastructure Protection; Emergency Management Systems and



PSTP communities of practice address safety and security needs through advances in biometrics

Interoperability; and E-Security. Each community continues to grow to meet future safety and security needs, and further communities will be established. Through a Call for Proposals process, PSTP provides funding for scoping studies and social science research projects conducted within the communities.

PSTP facilitates knowledge management and collaboration across communities of practice by sharing information and intelligence through meetings, workshops, and conferences; by providing an advanced collaborative workspace through a web portal; and by partnering with industry. The communities of practice generate and share invaluable knowledge that helps the federal government establish priorities and identify vulnerabilities and risks. This work enables decision makers to determine where investments must be made to develop the capabilities to protect Canadians and Canada's infrastructures.



CPRC projects address issues of concern to first responders

Canadian Police Research Centre

The Canadian Police Research Centre (CPRC) was founded in 1979 as a partnership among the Canadian Association of Chiefs of Police (CACP), the Royal Canadian Mounted Police (RCMP), and the National Research Council of Canada (NRC). CPRC focuses on improving first responder safety and security, enhancing operational effectiveness, and developing standards, protocols, best practices, and operational evaluations. CPRC achieves these objectives by funding research, developing standards, evaluating products, transferring technology, and being a scientific advisor to its partners. In September 2007, CPRC was restructured as a formal Government of Canada program managed by DRDC CSS. It received \$25 million for five years and expanded its mandate from a focus primarily on law enforcement to encompass fire and emergency medical services.

CPRC is a strategic investor striving to ensure that the best equipment and information is available to the emergency responder community and that Canadian industry has opportunities to contribute to this specialized field. Each year, CPRC invests in projects with public safety and security partners, participates in project planning and support, and monitors project progress and the quality of deliverables.

Projects address a variety of issues of concern to the first responder community, including personal protective equipment, forensic entomology, drug detection, explosives countermeasures, decontamination, cyber-safety for children, maritime security, and communications interoperability. Many CPRC projects have resulted in innovative tools, approaches, and practices that are now used by police, firefighters, and emergency medical personnel across the country.

CPRC is uniquely situated to assist national programs intended to build the public safety and security S&T capacity of local emergency responders. It strengthens linkages between the federal science community and Canada's first responders. CPRC's work directly contributes to the Government of Canada's ability to address law enforcement priorities and to meet the recognized S&T needs of Canada's emergency responder agencies.

International Activities

DRDC CSS's international activities support Canadian public security outcomes by fostering international collaboration and leveraging S&T. DRDC CSS informs the public security S&T (PSST) community about areas of international convergence in approaches, priorities, and investments. It enables international collaboration by creating and administering the appropriate tools, such as bilateral arrangements, and by developing networks. Where possible, it leverages PSST investments by informing and facilitating international engagements aligned with Canadian strategic priorities.

DRDC CSS engages with international partners in research projects, has signed many international agreements for the development of security S&T, and is involved with several international collaborative working groups. In addition to formal agreements, DRDC CSS provides expert advice and participates in such forums as the Global Health Initiative (GHI), Science, Technology and Trade Advisory Group (STTAG), the US–Canada Bilateral Consultative Group (BCG), and the Quadilateral Conference on CBR Counter-Terrorism.

Agreements with the United States

DRDC CSS, representing the 21 federal departments and agencies that have signed the PSTP memoranda of understanding (MOU), has been managing a number of collaborative PSST arrangements with the United States (US). Signed in 2004, the US–Canada bilateral agreement for **Cooperation in Science and Technology for Critical Infrastructure Protection and Border Security** is administered by the Department of Homeland Security (DHS), Science and Technology, and DRDC CSS is the Canadian delegated authority for collaboration. Multiple working groups collaborate under this banner and information is exchanged on a regular basis. Many collaborative projects and activities have been completed or are underway and more are being initiated.

These on-going efforts have yielded a number of significant improvements for both countries, especially in the areas of border security and CBRNE prevention and response:

- CRTI led the development of Canada's position on the North American Nuclear Detection Architecture and contributed to the development of the Global Nuclear Detection Architecture Guidelines proposed by the US DHS's Domestic Nuclear Detection Office (DNDO). Extensive work in the RN domain on detection and forensics continues with DNDO.
- In collaboration with the Chemical and Biological Directorate at DHS, CRTI has contributed to the development of an all-hazards triage facility that will screen unknown hazards for CBRNE materials before they are submitted to the appropriate laboratories for further typing and forensic analysis. Prior to this project, there were no CBRNE triage facilities in Canada.
- In collaboration with the US Transport Security Administration and the US Transportation Security Laboratory, Transport Canada developed and procured building kits for improvised explosive devices (IEDs) and



Signing the US–Canada agreement for Cooperation in Science and Technology for Critical Infrastructure Protection and Border Security

infiltration kits to test security equipment. This work was coordinated and supported by CRTI.

- Transport Canada has worked collaboratively with US and Canadian industry to develop, test, and evaluate air cargo security technologies and systems. It has been involved in ongoing efforts to develop, test, and evaluate systems to improve checked baggage screening with the US Transport Security Administration and the US Transportation Security Laboratory.
- DRDC CSS has helped create the CBRN Technical Working Group for Remediation with the US DHS and the US Environmental Protection Agency. This working group facilitates information sharing between experts and government agencies in the event of a CBRN incident in Canada or the US.

DRDC CSS is also responsible for administering and managing the Canada–US **Research and Development to Combat Terrorism** MOU, which came into force in October 2009. This MOU, administered by the US Department of Defense Counter Terrorism Technical Support Office with oversight by the US State Department, Office of the Coordinator for Counterterrorism, is expected to yield significant results. The MOU covers \$100 million in collaborative activity over a ten-year period. With a requirement that the US and Canadian governments share equally all costs associated with projects, this agreement presents a significant opportunity not only to



Chiefs of associations for police, fire, and emergency medical services sign interoperability agreement

enhance domestic and international efforts to combat terrorism, but also to leverage existing investments managed through the programs administered by DRDC CSS and elsewhere in the federal government.

The focus of this relationship is on the rapid transition of S&T for use by the operational community. This S&T includes work in explosives detection and disposal, CBRN countermeasures, investigative support and forensics, personnel protection, physical security, training technology development, irregular warfare support, and other areas. Projects typically take one to two years to reach deployment and in its previous incarnation, administered through Public Safety Canada until 2008, a number of valuable projects were fast-tracked through the MOU.

Agreements with the United Kingdom

In January 2009, Canada and the United Kingdom (UK) signed an MOU on **Public Security and Safety Cooperative Science and Technology**. The signatories are DRDC and the UK Centre for the Protection of National Infrastructure (CPNI). The MOU allows Canada and the UK to engage in a broad set of collaborative public security S&T initiatives. It facilitates the sharing of lessons learned by DRDC CSS at the Vancouver 2010 Olympics with the organizers of the London 2012 Olympics. A series of bilateral meetings have provided an opportunity for Canadian and UK

delegations to gain a better understanding of each country's S&T organizational structure and programs, and their priorities; to identify potential areas for cooperation; and to discuss the way forward for implementing activities under the MOU. Two technical annexes on search and screening and on radicalization and violent extremism are underway, and DRDC CSS has sent a specialist on search and screening for major events to London.

International Interoperability

The CPRC and the Canadian Standards Association (CSA) partnered in 2005 to explore establishing a Canadian entity similar to the US Interagency Board (IAB). The IAB provides a forum for the exchange of ideas among operational, technical, and support organizations to improve national preparedness and promote interoperability and compatibility among all layers of the response community. IAB members help develop and implement performance criteria, standards, test protocols, and technical, operating, and training requirements for all-hazards incident response equipment with an emphasis on CBRNE issues.

CPRC held two consultative sessions with cross-sections of the Canadian first-responder community in 2007 to explore the concept of establishing the Science and Technology Advisory Committee (STAC) based on the model of the IAB. The STAC was formed in 2008 and one of its main activities is reviewing CPRC project funding.

CPRC's efforts to enhance responder interoperability through the Canadian Interoperability Technology Interest Group (CITIG) have been bolstered by strong ties with the US National Public Safety Telecommunications Council (NPSTC) and the US DHS's SAFECOM program. NPSTC amended its charter to accept CITIG as the first international member, resulting in direct access by CITIG members to NPSTC research, development, testing, and evaluation, guidance, tools, and templates. The US DHS SAFECOM program has welcomed CITIG as a participant on many initiatives, most notably the creation of the National Emergency Communications Plan and ventures designed to improve cross-border interoperability.

Identifying Public Safety and Security S&T Priorities

The Defence R&D Canada – Centre for Security Science (DRDC CSS) identifies investment priorities through a systematic analytical process that reveals public safety and security gaps and vulnerabilities and provides science and technology (S&T) options for addressing them. Priorities are constantly re-assessed to reflect the evolving threat environment, but once identified they guide all DRDC CSS activities, especially decisions about project funding.

Over the past eight years, DRDC CSS' Risk Portfolio has established itself as the federal leader in CBRNE and, more recently, in all-hazards risk assessments and gap analyses. Members of the Risk Portfolio draw on the technical expertise of multiple federal partners to identify the threats and hazards confronting Canada's safety and security. DRDC CSS and its S&T and intelligence partners undertake robust risk assessments on the pertinent threats and hazards. Analysts conduct capability analyses based on a set of full-spectrum scenarios, which are designed to frame the risks. Options are then generated to reduce the assessed risks and address the gaps and vulnerabilities uncovered in the capability analyses. From the options, DRDC CSS sets and articulates priorities and develops investment options.

Risk Management and Consolidated Risk Assessment

DRDC CSS's Risk Portfolio applies a systematic approach to risk analyses, which includes technology forecasting, risk and vulnerability assessments, and operational analysis, and integrates them into the capability based investment model. The Consolidated Risk Assessment (CRA), which is one of the many tools developed by DRDC CSS, is a bottom-up process that engages experts from the S&T,

operations research, law enforcement, intelligence, and responder communities across all levels of government. The process builds consensus on particular threats and their associated risks by using accepted criteria to rank them. The departure point for this process is the question, "What can be done with knowledge, expertise, and material to address risks and vulnerabilities?"

The following objectives are crucial to the CRA:

- To provide a measure of risks and corresponding gaps;
- To provide a sense of immediacy for addressing threats and corresponding gaps; and
- To serve as a key indicator in the formulation of S&T investment priorities.

The CRA ranks threat scenarios from highest to lowest risk, based on the probability of the threat actually being carried out and the impact should that happen. The technical feasibility of someone enacting the scenario is given a numerical value, as is the scenario's severity of impact for casualties, geographical scope, social disruption, and economic loss. The combination of probability and impact, when plotted on a two-dimensional matrix, produces a vulnerability rating. Intelligence experts develop an intelligence judgment that assesses the intent and capacity of terrorists to execute the threat scenario. The vulnerability rating and the intelligence judgment are plotted on a two-dimensional risk matrix to produce an overall risk rating.

Each scenario is given a priority rating, ranging from threats that can be addressed at discretion to those that must be addressed immediately. Further analysis of all scenario risk ratings and associated gaps helps to establish investment priorities, which are reflected in the Calls for Proposals issued by



Representatives from all first responder services have been involved in DRDC CSS capability based planning workshops

the DRDC CSS programs and inform decision making within the Centre and in the broader federal public security, defence, and intelligence communities.

Capability Based Planning

Capability based planning (CBP) is an approach for deriving operational requirements that can be applied to all-hazards planning. CBP aims to clearly articulate high-priority capability gaps across the entire pre- and post-incident response spectrum in the context of all-hazards. This approach does not single out program elements in organizations, equipment shortfalls, training, standards compliance, or other traditional metrics. Instead, it uses a more overarching approach based on what is possible, where the goal is reducing risk to Canadians from potential hazards.

CBP focuses on managing results while considering needs and costs. Within the public security and emergency management domain, CBP adheres to four basic principles:

- Acknowledge uncertainty by developing the broadest range of missions and scenarios possible to ensure flexibility and adaptability of response in an all-hazards context.
- Harmonize stakeholder activities to promote multi-jurisdictional perspectives, objectives, planning, and programming activities.

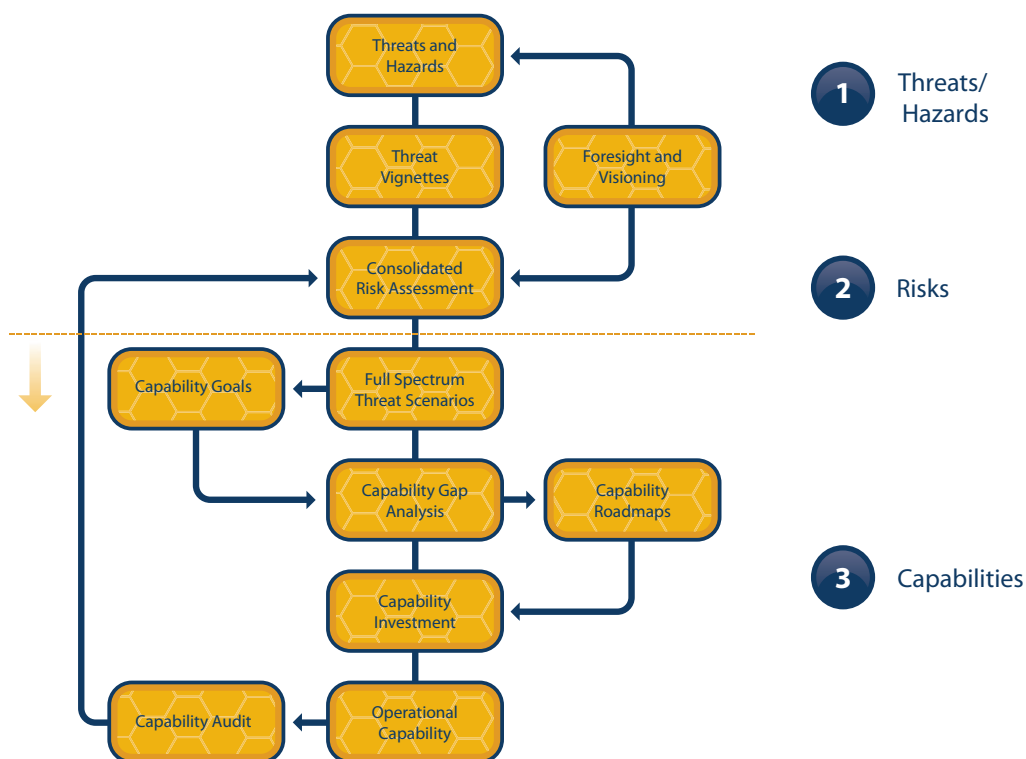
- Use the measure of risk reduction as an indicator of the success or failure of the investment of human and financial resources.
- Plan holistically by shifting the focus of requirements from materiel to overall systems (people, tools, processes).

CBP addresses the uncertainty in the threat environment by developing a broad collection of possible scenarios to define requirements and reduce the tendency to fixate on any one threat or hazard. CBP is planning under conditions of uncertainty to provide capabilities to respond to a wide range of threats and hazards, while working in an economic framework that requires choice. It addresses the question, “What do we need to be able to do in the future?”

CBP requires the following fundamental steps:

- Achieve a reliable understanding of threats;
- Perform a risk analysis and rating of threat scenarios;
- Analyze capability gaps; and
- Set investment priorities.

The process flow for CBP for S&T investment is illustrated in the diagram on the next page.



Capability Based
Investment Model

CBP principles have been used in a number of PSST program studies and projects, including studies related to border security, telecommunications infrastructure protection, and emergency management process mapping, and in a national emergency operations centre command post exercise and technology demonstrations on mass decontamination and rapid assessment teams. Future Calls for Proposals from PSST programs will include more emphasis on applying CBP principles in setting research priorities.

Psychosocial Overview

Through projects and activities, DRDC CSS and its partners aim to better understand and develop structured processes to assist emergency and security planners, decision makers, and responders in identifying psychosocial risks, vulnerable populations, resources, and interventions at various phases of an event in order to limit negative impacts and promote resilience and adaptive responses.

The psychological, behavioural, and social impacts of terrorist events, natural disasters, and pandemics, can represent the most enduring and costly consequences for society, with major effects on public trust, economic viability, the social fabric, and citizen well-being. To prepare, plan, rescue, or assist in long-term recovery, knowledge and understanding of psychosocial factors contributes to making Canada's response plans more effective and adaptable. Because every response to a terrorist event is unique, there is an emerging realization that a response can be conducted by an array of non-traditional first responders, including local public health authorities, front-line health care providers, food inspectors, and lay responders. Adequate training of all key responders on psychosocial considerations is crucial to managing the acute and long-term effects of major high-consequence incidents.

As Canada and other countries build the capacity to prevent, mitigate, and manage CBRNE threats, it is important to recognize the range of social, psychological, emotional, spiritual, behavioural, and



DRDC CSS's Operations Research team has provided advice to support the National Strategy and Action Plan for Critical Infrastructure

cognitive factors that can affect victims and their families and communities at all phases of an event. Further, an understanding of the same social and psychological factors can contribute to preventing extremist violence by helping to understand the pathways leading to it

Operations Research

DRDC CSS's Operations Research (OR) team applies advanced scientific and analytical methods to public safety and security challenges related to complex operations. Examples include systems analysis of critical infrastructure to identify sources of vulnerability owing to complex dependencies; assessments of operational requirements and of exercises; research into barriers to effective multi-agency coordination, cooperation, and collaboration; and psychosocial issues. Research findings provide valuable information that can be considered by decision makers when addressing complex operational problems.

The contributions of the OR team are crucial in the CRA and capability based investment model processes. The OR team made important contributions to operational S&T for security support at the Vancouver 2010 Winter Games through the provision of scientific advice to operational planning staff in Vancouver, as well as support during the Games.

In addition, the OR team assessed the Integrated Security Unit's (ISU) dependencies on critical infrastructure (CI) services needed to support security operations so that the ISU could coordinate with CI service providers for both planning and operations during the Games. Following the Games, the OR team provided the analytical components for an After Event Report requested by the Privy Council Office.

Current OR work includes the following initiatives:

- Collaborative work with key allied nations on methods for improving CI resilience and for modelling complex CI dependencies;
- A follow-on collaborative partnership with Emergency Management BC on the issues of risk assessment and CI;
- Understanding the fundamental factors that lead to violent radicalization;
- Modelling of information sharing amongst agencies responsible for harbour security;
- Requirements analysis in support of the Canadian Police Research Centre (CPRC);
- Research into barriers to effective inter-agency coordination, cooperation, and collaboration;
- Development of a web-based framework to support the RCMP's planning for major security events;
- Analyses of cyber-exercises (e.g., Cyber Storm III); and
- Advice on risk assessment tools for the implementation of the National Strategy and Action Plan for CI.

The OR team networks with fellow researchers across the federal government and other groups involved in public security to leverage knowledge and expertise. Those involved include professionals with backgrounds in physical sciences and engineering, mathematics and statistics, information science, economics, sociology, and political science. The team has particularly close ties with the DRDC – Centre for Operational Research and Analysis.

Investing in Public Safety and Security S&T

The Defence R&D Canada – Centre for Security Science (DRDC CSS) programs seek out, fund, and promote science and technology (S&T) that addresses priorities identified through the consolidated risk assessment (CRA) and capability based investment model processes discussed in the previous section. The S&T can be at any stage of its maturity, from research and development through to technology acceleration and acquisition. There is also funding for scoping studies and social science research projects. The hundreds of projects supported through the PSST program suite have made concrete contributions to public safety and security S&T and many technologies developed through projects have been made operational.

The PSST programs issue Calls for Proposals and, based on identified priorities, select projects through an open, competitive process. A complete list of projects for all three PSST programs is provided in Annex B. A selection of projects that highlights specific capabilities is discussed below.

A Better Helmet to Protect Against Bomb Blasts

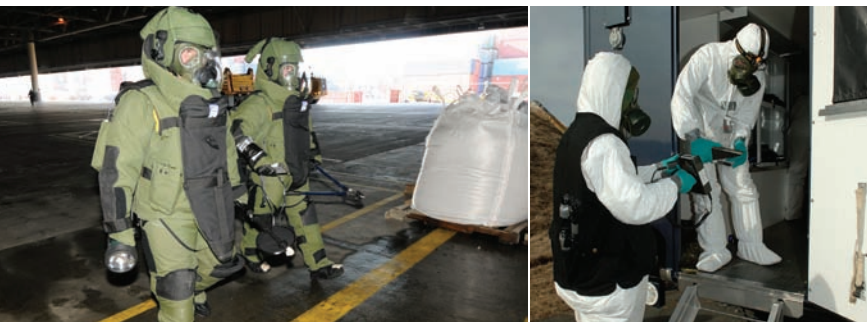
After several years of research and design supported partly by funds administered through CRTI, Allen-Vanguard successfully engineered a bomb disposal helmet, the Med-Eng EOD 9A, which protects technicians from blast, chemical and biological (CB) agents, and electromagnetic interference. Allen-Vanguard designed the helmet to support two interchangeable visors: an explosive ordnance disposal (EOD) visor for standard bomb disposal operations and a CB visor that accommodates a respiratory system for use when an improvised explosive device (IED) is suspected of containing CB agents.

The 9A is the world's first Electronic Countermeasures (ECM) Class A Helmet for bomb disposal operations. As such, it provides technicians with the critical ability to maintain full use of the helmet's electronic systems while deploying ECM to prevent detonation of a radio-controlled IED. The helmet suppresses unwanted signals to avoid setting off electronically sensitive IEDs.

Allen-Vanguard partnered with the RCMP, DRDC Suffield, and the Royal Military College to conduct extensive, full-scale blast and simulated CB agent testing, as well as performance and reliability tests, on the new helmet. The tests demonstrated that the helmet provides effective protection against blasts and stops the penetration of CB agents. A wrist-mounted control unit enables the wearer to control the helmet's electronic functions. Immediate demand for the new helmet was so high that the company faced a backlog of orders from leading bomb disposal and Counter-IED units in Canada, the United States (US), and abroad. The helmet is a component of the most widely used EOD suit in 120 countries.

When to Replace Body Armour

Law enforcement officers are legitimately concerned about when to replace body armour. Replacing it at the end of the typical five-year warranty period might offer assurances of safety, but if it could be demonstrated that body armour remains effective even after the warranty period, the life cycle cost of armour could be reduced. In response to needs expressed by the Canadian Association of Chiefs of Police (CACCP) and the Ontario Association of Chiefs of Police (OACP), CPRC developed a project to investigate the degradation of ballistic armour material and life expectancy of soft body armour, including questions surrounding the manufacturer's warranty period and replacement time.



Many CRTI and CPRC projects have contributed to the development of personal protective equipment

CPRC worked in collaboration with DRDC Valcartier to design and implement a testing program to study the performance of armour retired from Canadian police forces. The initial activities for the project included a background investigation of vest warranty information, a report on similar work by the United States (US) National Institute of Justice, a review of statistical elements for meaningful results, estimates on the availability of used garments from the Canadian Forces to support this study, and a work plan and budget proposal for the development of a scientific approach towards replacement of body armour.

The project team tested 150 sets of decommissioned body armour and found that age does not appear to correlate with ballistic performance. The researchers speculated that it is the initial design and construction of the body armour panels, and not their age, that are the leading factors in determining the effectiveness of the armour. These findings are considered preliminary and the 150 samples upon which these observations were made are not necessarily representative of current in-service armour. Additional testing on a larger sample size will be conducted to ensure a sufficient database of results to meaningfully support conclusions.

The outcome of the on-going testing and evaluation will be an Aged Armour Replacement Protocol that will enable police services to determine, in a scientific manner, whether the aged armour they have in service is still safe for continued use.

Medical Countermeasures Against Ricin

Ricin, which is one of the most lethal substances known to humankind and a potential catastrophic bioterrorist agent, is easy to obtain and prepare, and can be manufactured in large quantities. A single castor bean contains enough ricin to kill as many as 10 people and around the world over a million tons of castor beans are processed for oil and animal feed every year. Originally, the only medical countermeasure available to deal with ricin poisoning was a sheep antibody developed in the United Kingdom (UK). However, the stock remains limited, available only in the UK, and contains animal proteins.

CRTI provided funding that enabled Twinstrand Therapeutics and Cangene Corporation to partner with DRDC Suffield to address this gap. Together, they developed an antibody therapy that was able to rescue mice up to 16 hours after ricin poisoning. The partners then secured CRTI funding to enable them to concentrate, purify, and prepare antibodies that could potentially be used in emergency kits.

“When we first started this project, we were told it was pointless. The experts believed nothing could be done minutes after casualties were poisoned with ricin. We couldn’t study the toxin because it was no longer available. It was definitely high-risk and CRTI deserves a lot of credit for trusting our capabilities and backing us.

“This project was really remarkable, not only from a CBRNE perspective, but in terms of the teamwork and value added. We now have the capabilities, we now have new insight, and I don’t know what value you can put on that.”

Dr. John Cherwonogrodzky,
Defence Scientist, DRDC
Suffield

DRDC Suffield helped develop CASCAD® decontamination foam



The project was notable for the partnership and synergy, as well as for the significant in-kind contributions by partners of over \$1 million each. Cangene went on to buy Twinstrand and build a new partnership with Canada West BioSciences and DRDC Suffield through a new CRTI project to further develop the anti-ricin countermeasures. This project produced the first ever medical therapy to protect first responders entering a high-consequence public safety and security event involving ricin toxin or to treat casualties shortly after exposure.

Dr. John Cherwonogrodzky, the project manager, said that the partners were “stunned” by their new discoveries. They found “mouse monoclonal antibodies ... that are more active than anything reported and better than animal anti-serum. Unexpected subtle differences between mouse and human antibody sequences appear to have a huge impact on activity.” They also found a new method of vaccination that takes effect in days rather than months. “None of this would have been possible without CRTI support.”

Decontamination Foam for Responders

The Canadian Aqueous System for Chemical/Biological Agent Decontamination was originally developed at DRDC Suffield and is marketed by licensee Allen-Vanguard Corporation as the CASCAD® decontamination foam. Through a CRTI project, the two organizations worked together to adapt this military-strength decontamination foam for use in domestic emergencies. This foam was later modified to create a combined blast-suppressant and CB decontaminant that also mitigates radiological agents.

Allen-Vanguard engineers developed formulations to extend the foam’s shelf life, make it easier to transport, and make it more resistant to cold. They also improved the mixing procedure and the equipment used to apply the foam. Allen-Vanguard then developed a light, portable decontamination system (LPODS) for delivery of the CASCAD foam.

As part of a pilot initiative funded through the CRTI and facilitated by the CPRC, LPODS have been delivered to four fire services located in New Westminster, Calgary, Regina, and Montreal for on-going testing and evaluation in an operational setting. The four fire departments also contributed to the development of the first version of a universal standard operating procedure and an Operation and Maintenance (O&M) training package.

Through the course of this pilot, the services will be creating scenarios to simulate potential CBRN incidents that could occur in their cities. For example, le Service de sécurité incendie de Montréal is testing how the system could be used while responding to a threat in the metro station. Every six months, lessons learned will be communicated to CPRC in order for improvements to be made to the hardware or the standard operating procedures and O&M packages.

Recovery of Human Remains from Fatal Fires

The recovery of human remains from the scene of a fatal fire serves several purposes. From an ethical standpoint, recovering a human body for burial provides closure for the family and society looks to the fire investigator to provide this service. Legally, the Ontario’s Coroner’s Act stipulates that human remains must be recovered from the fire scene and examined by a coroner for cause and



Burning farmhouse used in forensic investigation study

manner of death. Human remains from a fire can also provide evidence critical to the investigation.

The completeness of the recovered remains can affect the determination of the cause of death. For example, missing a body part with a defensive wound could alter the determination of the cause of death, especially if there are no other indicators of violence. An inability to accurately diagnose the cause of death could allow a perpetrator to escape prosecution. Such forensic considerations place great responsibility on the shoulders of the fire investigator.

Through CPRC funding, the Ontario Fire Marshall's Office used archaeological recovery methods to develop new forensic investigation techniques for use in arson investigations. The project has helped fire investigators to understand the value of archaeological methods at fatal fire scenes. The project has also provided insight into the skills required to use these methods. Application of the findings of this project will make fire investigators more effective in retrieving forensic evidence.

Rapid, Sensitive Tests to Detect Agroterrorism Threats

Researchers at the Canadian Food Inspection Agency (CFIA), the National Research Council (NRC), and the Public Health Agency of Canada (PHAC) have collaborated to develop a suite of rapid tests to diagnose high-threat animal viruses. These tests significantly increase Canada's capacity and capability to prevent a large-scale animal disease outbreak and, if necessary, respond to and manage the long-term consequences of such an incident.

CFIA categorizes foot-and-mouth disease, avian influenza, swine fever, and the Nipah virus as the top four high-risk foreign animal disease agents that could be used to threaten Canada's agricultural sector. An outbreak of any one of these diseases could be catastrophic to Canada's economy, crippling it for months and even years.

Researchers used CRTI funding to develop a series of antigen and antibody screening tools. Over the course of the four-year, \$6-million initiative, the project teams produced 18 diagnostic tests that are mobile and suitable for use in the field as well as in laboratories. They can be automated to handle large numbers of samples and can accommodate electronic data collection and transmission. The researchers developed and implemented a first responder laboratory training course for veterinarians at the CFIA in Winnipeg. They also produced training materials and equipment that is now operational.

"It's not enough to build the technologies, we have to put the technology in the hands of people who will use it and find ways of having them move the information to people who could use it properly."

**Dr. Shane Renwick, Director,
Animal Health Science
Foresight, CFIA**

Using Data to Fight Disease

Rapid identification of outbreaks can enable health authorities to contain a potentially dangerous situation before it's too late. Syndromic surveillance is the use of real-time data gathering and analysis to identify disease outbreaks, both from natural causes and from those that could be the result of bioterrorism. CRTI has sponsored a range of projects that

have advanced the ability to use technology to manage and respond to animal and human disease outbreaks.

PHAC led a four-year project to develop the Canadian Network for Public Health Intelligence (CNPHI), which is a web-based system that enables the real-time surveillance, intelligence exchange, and response to critical public health events. It is the first tool of its kind to enable federal, provincial, and regional health authorities to share this information in a secure manner and it is used by more than 90 per cent of Canadian public health authorities. CNPHI was used early in the 2008 listeriosis outbreak to issue an alert to public health units across Canada.

Another project that is contributing to Canada's national syndromic surveillance capabilities is the Advanced Syndromic Surveillance and Emergency Triage (ASSET) project. Led by a team at the University of Ottawa Heart Institute, the ASSET project has included the deployment of another CRTI project output, the Early CBRN Attack Detection by Computerized Medical Record Surveillance (ECADS) real-time outbreak and disease surveillance (RODS) system, in Ottawa. An earlier system developed by the NRC with CRTI funds provided the foundation for ASSET-RODS, which can be adapted for use in any community and interface with CNPHI. ASSET-RODS enables municipal and regional authorities to monitor health events at the local level.

Similarly, detecting animal disease threats through the integration of human and animal health intelligence can minimize their consequences for human health, the food supply, and the economy. A team of researchers led by CFIA has developed the Canadian Animal Health Surveillance Network (CAHSN), an early warning system to detect animal disease threats. This network enables the national integration and sharing of provincial and local data, and was used in the 2009 avian flu outbreak. CAHSN continues to evolve by working with labs and animal health surveillance experts across Canada and with CNPHI.

These surveillance networks became crucial in fighting the H1N1 pandemic influenza in 2009. CNPHI was deployed in Mexico as an integrated real-time surveillance system to facilitate the dissemination of strategic intelligence. This provided much-needed assistance in the coordination of public health responses to the spread of the virus in one of the most afflicted countries. The ASSET tool was used in Ottawa hospitals and ECADS was used by health units across Canada.



Satellite used as part of virtual radar constellation

The benefits of being able to promptly identify an outbreak through the analysis of pre-diagnosis data made instantly available are countless. These systems continue to monitor public health across Canada, looking for patterns that could indicate a new outbreak, information that will help authorities initiate a response to keep Canadians healthy.

Arctic Surveillance Using a Virtual Radar Constellation

The Canadian Arctic presents many challenges for surveillance and protection. Reduced pack ice in the Northwest Passage could increase the number of ships passing through Canadian waters and introduce new threats, such as smuggling and terrorist incursions. PSTP collaborated with the Norwegian Defence Research Establishment,



Screen capture from
Accipiter radar system

DRDC Ottawa, and the firm C-CORE to address capability gaps in Arctic intelligence and surveillance. The Government-Related Initiatives Program (GRIP) of the Canadian Space Agency provided core funding for the project, with contributions from PSTP.

The project coordinated the abilities of three recently launched radar satellites, treating them as a virtual constellation to explore the benefits of their advanced technologies. Computer programmers developed algorithms to extract information about infrastructure, terrain, and movement from data collected by the satellite constellation. Case studies by government agencies validated the research and assessed the suitability of new image products and maps generated from the satellite data.

The project is using the satellite data for target detection and classification, and for change detection to enable the improved surveillance of vehicle and ship movement. The data also provided information on changes in permafrost and the infrastructure of oil and gas, nuclear, and dam facilities. The case studies, with selected sites from Newfoundland, Nunavut, and the Northwest Territories, are based on clients' needs for critical infrastructure monitoring.

Enabling Surveillance on the Great Lakes Border

Protecting the borders between Canada and the US is a critical security operation for both countries. One of the greatest border challenges involves monitoring the 3,700 kilometre Great Lakes-St. Lawrence Seaway system, which is made up of waterways with a surface area of nearly a quarter of a million square kilometers. Innovative S&T solutions are needed to support authorities in addressing this challenge, but technology alone cannot solve the issue. S&T experts must work in collaboration with border enforcement and intelligence practitioners to develop solutions that truly respond to the needs of border authorities.

PSTP funded a study of Great Lakes border security in preparation for enhancing security along this section of border. The study sought to identify technology issues pertaining to the protection of the interior marine boundary and to investigate suitable S&T solutions. The study brought together experts from the RCMP, Accipiter Radar Technologies Inc., and OIC Marine Security Operations Centre to examine the feasibility and operational effectiveness of radar surveillance networks to support border enforcement and interdiction on the Great Lakes and St. Lawrence River. This was achieved through existing fixed and mobile radar assets, which were used to deploy radar surveillance capabilities in the designated areas.

The intent of the study was to gather data for analysis and development of recommendations, and to see whether the technology would improve and enhance Canada's ability to monitor the Great Lakes and St. Lawrence River. In an unexpected turn of events, the study reached beyond this original purpose and demonstrated real impact in an operational setting.

Multi-mission radars contributed to the maritime domain awareness in the Great Lakes to support the Toronto Police Service and the RCMP during the G20 Summit meeting in 2010. The radar capabilities helped monitor vessel traffic across Lake Ontario, documenting their routes of travel from their points of departure to where they arrived throughout the G20 Summit in Toronto. The system also provided early detection and increased awareness of maritime traffic, as well as enhanced port and harbour security throughout the summit.

The data collected throughout the study and the feedback from operational users will be analyzed to validate and document the results. For the first time in Canadian history, Canada has a persistent surveillance capability on part of the Great Lakes border and the benefits of this have been clearly demonstrated. Although the current system is in place temporarily as part of the study, authorities have seen how this type of capability can help them to better protect Canada's borders and are looking at how to make it more permanent.

Protecting Critical Telecommunications Infrastructure

A CBRNE attack on telecommunications infrastructure could impede the ability to effectively respond to an emergency. Through funding contributions, PSTP partnered with Bell Canada and Industry Canada to conduct a simulation-based assessment of Bell's response capabilities. The assessment provided the foundation for developing an emergency response concept for the Canadian telecommunications industry, which PSTP pursued through the same partnership, with Bell Canada acting as the representative of the Canadian Telecommunication Emergency Planning Association.



Telecommunications is a crucial part of critical infrastructure

The study used a capability based planning (CBP) approach to set operational requirements for a hazardous materials (HAZMAT) response capability and defined a series of design concepts and options. The researchers then surveyed industry experts to investigate the options and define the requirements. They developed architectures for each option in its current and targeted states. The study concluded with a capability gap analysis and a feasibility study.

The analysis identified gaps with each option and showed that a made-in-Canada service concept was best suited to the needs of the Canadian telecommunications industry. From recommendations in the study report, this concept was further developed to ensure that a response capability can be established, implemented, and maintained. The concept was then tested through an exercise also funded by PSTP. Industry Canada was the lead department and the partners were BC Hazmat, CAE Professional Services, Bell, and Telus.

The exercise evaluated the feasibility of pairing telecom service technicians with experienced HAZMAT technicians to conduct critical telecom maintenance tasks within a telecom critical infrastructure site that has been contaminated with chemical or biological hazardous materials. Telecom technicians received training in the proper donning of personal protective equipment prior to the field exercise. A post-exercise debrief was conducted and participant feedback gathered for a report, which included lessons learned and best practices.



RCMP trainees at a simulation shooting range

Psychological Risk Manager

The need to make psychosocial knowledge available to the responder community and to non-specialists has been clearly articulated by first responders and planners across Canada. This need for psychosocial knowledge applies to communicating with the public, dealing with the media, coordinating between units, pre-event training, anticipating public and worker reactions, and building public confidence.

The goal of the Psychological Risk Manager (PRiMer) project is to use technology and multimedia to train and transfer a knowledge base to responders and planners to assist in preparation for and response to CBRNE threats or attacks. PRiMer builds on previous work that yielded the Psychosocial Risk Assessment and Management (P-RAM) framework, a CBRNE-adapted integrative framework combining threat characteristics with evidence-based psychosocial effects and factors involved in preparedness, response, and recovery. PRiMer synthesizes the theoretical and research findings into a user-friendly, non-specialist knowledge base.

The PRiMer training includes a media rich, web-based self-study guide, a facilitator guide, and participant materials for the PRiMer workshop, workshop activities, and a web-based suite of decision support tools. PRiMer training is also meant to apply to joint civilian- and military-security missions, group behaviours, collective decisions, and shared leadership in joint operations.

The training package also incorporates psychosocial factors into response plans and preparation guidance, both for the public and for various types of responders. This addition improves plans, ensures the appropriateness of response to public demands, increases public confidence in authorities, supports compliance, and augments resilience. PRiMer training of various stakeholders will serve to enhance planning and preparedness in Canada, as well as to improve all-hazard crisis response.

The Use of Simulation Technology in Police Training

Unlike most professions, police officers cannot rely on “on-the-job” training when it comes to some of the dangerous aspects of their job, such as apprehending an armed suspect, responding to an active shooter, or operating emergency vehicles. Unfortunately, reproducing these high-stress situations in a training environment can be difficult, expensive, and dangerous.

Technologies such as shooting and driving simulators offer a solution to this issue by providing opportunities for staging mock scenarios, such as proceeding through intersections, driving in fog or icy road conditions, or using firearms in low light situations. Simulation provides high-arousal training in a safe environment, which allows trainees to learn the skills to respond appropriately while under the stress and realism of deadly situations.

While simulation technology has been in use for some time, little is known about its effectiveness or appropriate use. The CPRC has joined forces with the RCMP Training Depot, the US Federal Law Enforcement Training Center, and the University of Regina to determine the optimal use of simulation technologies in police training. The study aims to determine the optimal amount, type, and combination of simulation and live training needed to achieve the desired skills.

The RCMP is monitoring trainee progress, in both simulated and live environments, to understand and compare how the two types of training methods differ in terms of how quickly and effectively skills acquisition and retention can be achieved. To date, 4,000 police cadets and long-service officers have been observed and preliminary results indicate that simulation technology is a powerful training tool at certain stages of training. In addition, the study has demonstrated areas of significant savings where training time can be reduced and there is less cost associated with physical assets such as ammunition, and range and vehicle maintenance.

The study will continue to follow the performance of police trainees as they progress in their career. This will ensure that a significant data set is generated, which can be used to better understand skill retention and in-service re-qualification needs.

Improving the Interoperability of First Responders

Historically, police, fire, and emergency medical responders have depended upon their own standalone radio communication systems. Unfortunately, these systems are rarely compatible across jurisdictions or with other agencies within the community.

There are approximately 100,000 public safety emergency responders in Canada working for 1,800 provincial and municipal law enforcement agencies, 2,600 fire departments, and more than 600 rescue departments. At times, these agencies must also interact with federal law enforcement agencies and with those from provincial/territorial and federal emergency management, transportation, and public utilities who all need to talk to one another during critical incidents.



Responders from all services and jurisdictions need to be able to communicate with each other

The Canadian Interoperability Technology Interest Group (CITIG) was created in 2007 to improve Canadian public safety and security communications interoperability. Led by the CPRC, it is a responder-driven, federally funded activity that brings together 450 volunteer members from the responder community, all orders of government, non-governmental organizations, associations, academia, and industry.

CITIG was formalized when the CPRC and the Canadian Association of Chiefs of Police (CACP) joined forces with the Canadian Association of Fire Chiefs (CAFC) and Emergency Medical Services Chiefs of Canada (EMSCC) to work together to improve public safety and security interoperability.

CITIG has been very successful since its inception and has significantly increased awareness about interoperability challenges and helped provide useful tools for practitioners and policy-makers to overcome these challenges. It has promoted the effective use of resources, particularly through the sharing of best practices to adapt international work to Canadian needs. CITIG has also enhanced communications within and cooperation among responder agencies and between many levels of government, both in Canada and internationally.

Creating Public Safety and Security S&T Capacity

Defence R&D Canada – Centre for Security Science (DRDC CSS) programs engage in a number of knowledge transfer and learning activities that aim to create awareness and improve mutual understanding between responders, planners, policy makers, and the science and technology (S&T) community. These activities include exercises and workshops, which provide opportunities for individual, team, and collective organizational learning.

Exercises

DRDC CSS funds, designs, and participates in a range of activities, from tabletop exercises to international, multi-jurisdictional full-scale field exercises. Exercises play a critical role in ensuring that Public Security Science and Technology (PSST) investments are delivering effective S&T solutions to the federal, provincial, and municipal responders who are the front-line defence in the event of an emergency or disaster. They provide opportunities for officials from multiple levels of government and across sectors to gain experience working together, to coordinate interoperability between jurisdictions, and to hone their skills.

Exercises supported by PSST programs are mutually beneficial in that they provide S&T personnel with knowledge of responder challenges and requirements, while helping responders and planners to determine how S&T can assist them in coordinating a safer and more effective response. Exercises also provide the responders and S&T participants an opportunity to test protocols and equipment in the field and identify knowledge gaps and system vulnerabilities.

The exercises build upon lessons learned and provide an opportunity for the federal, provincial, and municipal responder communities to share experiences, develop best practices, and identify

further areas where S&T can be applied. They further provide opportunities to learn lessons by incorporating After Action Reviews during and after the events. Lessons learned are captured in After Action Reports and incorporated into future exercise design and operational plans.

All activities are conducted under strict protocols and procedures that ensure the safety of the participants, the surrounding communities, and the environment. The exercises described below are a representative sample of the broad range of events supported over the past eight years.

Explosives Exercises

The programs in the public security S&T (PSST) suite have supported a wide range of exercises to test responses to incidents involving the use of explosives. The Public Security Technical Program (PSTP) funded a four-day multi-modal explosives training exercise in May 2006. Organized by the RCMP's Canadian Bomb Data Centre, the exercise was designed to prepare responders to conduct post-blast investigations of incidents that occur across multiple sites and target multiple modes of transportation, similar to the terrorist attacks carried out on transit systems in Madrid, Spain, and London, England.

The scenario involved explosions on a bus and a train. Participants in the training in Temagami, Ontario, included municipal law enforcement agents from Ottawa, Toronto, York Region, Windsor, and London, as well as representatives from the RCMP, the Sûreté du Québec, the Ontario Provincial Police, and the US Defense Intelligence Agency.

Since the creation of the Explosives Cluster in 2006, the Chemical, Biological, Radiological-Nuclear, and Explosives (CBRNE) Research and

Explosives Cluster conducts post-blast exercise



Technology Initiative (CRTI) has made great strides in networking members of the community to foster innovation and the exchange of expertise. In May 2007, CRTI sponsored and the RCMP led a series of post-blast training exercises to prepare emergency responders and law enforcement agencies to deal with terrorist explosions. The exercises presented more than 200 post-blast investigators from the RCMP, the Department of National Defence (DND), the Ottawa Police, and local emergency services with various scenarios to enable them to practice forensics investigation procedures.

In the first exercise, a bomb hidden in a laptop computer was detonated in the cargo bay of a decommissioned, pressurized Boeing 727. This event simulated a high-risk security environment and exercised participants in responding to an aircraft explosion and collecting evidence.

The second exercise involved two scenarios, a VIP motorcade that was destroyed with 100 pounds of explosives and a military vehicle blown up by a roadside bomb. Responders tested new scene-survey and forensic technologies, as well as wireless communications to stream video from the field to a command post.

The third exercise had three scenarios. The first involved a suitcase bomb on a public transit vehicle; the second used explosives and fertilizer to blow up a cube van; and the third featured a tractor trailer armed with explosives, but neutralized using a large barrel disrupter.

Biological Incident Exercise

For three days in October 2007, a team of federal S&T experts, along with members of operational and first responder communities from all levels of government, participated in the largest multi-jurisdictional bioterrorism field exercise ever staged in Canada. The Biological Incident Exercise (Bi-Ex-West), held in Delta, British Columbia, provided a valuable learning experience to assist in the development of a more efficient and coordinated response to an emergency situation involving a zoonotic agent (i.e., a disease that can be transmitted from animals to humans).

The field exercise built on two tabletop exercises held previously at the Justice Institute of British Columbia. It was designed to enhance the capability of members of the Biological Science Cluster to respond to terrorist events and enabled the participants to use their experience while preparing them to operate together, across jurisdictions. The field exercise focused on handling samples on-site, transporting samples to the National Centre for Foreign Animal Diseases laboratory in Winnipeg, and conducting forensic analysis and investigation of the incident.

Federal participants came from the Canadian Food Inspection Agency (CFIA), the Department of National Defence, the Public Health Agency of

"Bi-Ex-West is an example of various levels of government working together to protect the safety of Canadians. The personal contacts established and lessons learned during this exercise are critical to improving all aspects of emergency preparedness."

Dr. Paul Kitching, Director, National Centre for Foreign Animal Disease, CFIA



Bi-Ex-West built on tabletop exercises to become the largest multi-jurisdictional bioterrorism field exercise ever staged in Canada

Canada (PHAC), Public Safety Canada, and the RCMP. Provincial participants included the British Columbia (BC) Ambulance Service, the BC Centre for Disease Control, the Ministry of Agriculture and Lands, the Provincial Emergency Program, the Fraser Health Authority, and the Vancouver Coastal Health Authority. Staff from the Corporation of Delta and volunteers from Delta's Emergency Social Services and Amateur Radio Society also took part.

Exercise Integrated Response

Following the Francophonie Summit in Quebec City in October 2008, CRTI sponsored and led Exercise Integrated Response (ExIR-08). ExIR-08 was an interdepartmental, multi-jurisdictional national-level counter-terrorism field exercise designed to increase knowledge and provide an opportunity for information exchange. It involved the National CBRN Response Team working closely with the S&T community. As with its predecessor, ExIT-08, the exercise was based on realistic scenarios using both sealed and unsealed radioactive sources.

ExIT-08 and ExIR-08 involved scenarios designed to test responders' ability to characterize and render safe chemical, biological, and radiological threats. Scenarios provide the most realistic threat environment possible while still meeting safety and environmental standards and the responders' training goals. These radiological scenarios are the most challenging to be implemented in full-scale exercises in Canada and have provided valuable insight for developers of similar exercises in the future. They were designed to test and evaluate an across-government CBRNE set of response guidelines, equipment, capabilities, and S&T support to operations.

Exercise Initial Thunder

In February 2008, CRTI conducted Exercise Initial Thunder (ExIT-08), the largest and most realistic multi-jurisdictional CBRNE counter-terrorism exercise ever held in Canada to that point. Over 250 participants demonstrated the tools, knowledge, and expertise that the federal S&T community could contribute to assist responders in emergency situations involving CBRNE threats. Exercises like ExIT-08 provide participants with a valuable learning experience to assist in the development of a more efficient and coordinated response to major emergency situations.

"These exercises are useful at the operational level in helping us become better acquainted with the new counterterrorism technologies that are being introduced, such as radiation portals. While we train as a team in responding to hazardous materials, for example, the critical test is seeing how we and our partners in police and ambulance complement each other in a situation as complex as this one."

Tim Armstrong, Chief of Special Operations, Vancouver Fire Department, on ExIT-08

Federal participants came from Atomic Energy of Canada Limited, Canada Border Services Agency, Canadian Nuclear Safety Commission, DND, Environment Canada, Health Canada, Natural Resources Canada, PHAC, Public Safety Canada, the RCMP, and Transport Canada. Provincial and municipal participants included the BC Centre for Disease Control, BC Ambulance Services, BC Provincial Emergency Program, Vancouver Fire and Rescue Service, and the Vancouver Police Department.

ExIT-08 was one of a series of federal exercises conducted to evaluate tools, systems, and procedures developed through CRTI investments, following on Exercise As Is in 2003, Exercise Follow-On in 2005, and Exercise Maritime Response in 2006. It also focused on interdiction and prevention, and critical infrastructure protection. Over the course of ExIT-08, teams of responders worked through a number of scenarios designed to demonstrate the value and effectiveness of S&T solutions.

The first segment of ExIT-08 took place in the Port of Vancouver and involved the detection of an illegal shipment of radiological materials, the explosion of the material, and the triage and transport of casualties who had been exposed to radiation. The second segment of the exercise was staged at Canadian Forces Base (CFB) Esquimalt. The scenarios during this segment involved the apprehension of CBRNE materials and their correct handling for forensic purposes.

Participation in CAPEX

Every two years, Canada, Australia, the United Kingdom (UK), and the US, member countries of the Technical Response Group (TRG) of the Chemical Biological Radiological (CBR) Quadripartite, participate in a capability exercise (CAPEX). CAPEX is a field exercise that provides participant groups with an opportunity to respond to a number of simulated CBRNE events. Recent exercises were held in Australia in November 2008 and the UK in March 2011. Scenarios included a biological attack on an embassy, unexploded dirty bombs, a chemical attack on a train, and a variety of configurations of explosives.

Canada was represented by the Joint National CBRNE Response Team, made up of RCMP explosives and forensics technicians, members of the Canadian Forces, and biological experts from PHAC, and supported by chemical experts from DRDC Suffield and Environment Canada and radiological experts from Health Canada and DND. One of the objectives for the Canadian team was to test the value of having scientific experts embedded in the team to provide on-site advice. To this end, the team was sponsored by the CRTI.



During Exercise Initial Thunder teams of responders addressed scenarios designed to demonstrate the value of S&T solutions

DRDC CSS staff contributed to after action reviews and prepared final reports that captured recommendations for process improvement. Through the reviews, it is evident that responder communities recognize the important role of S&T and support the involvement of science advisors in future events.

Agriculture and Agri-Food Canada National Emergency Operations Centre Exercise

PSTP and Agriculture and Agri-Food Canada (AAFC) conducted a three-day exercise in February 2009 to test AAFC's ability to activate and operate their National Emergency Operations Centre. As part of a study, PSTP helped fund and design the exercise, as well as participating in it. PSTP and AAFC staff used a capability based planning (CBP) approach to design, implement, and evaluate the exercise. The scenario built on a 2007 tabletop exercise called Global Grippe that was designed to investigate the impact of an influenza pandemic on the food supply management cycle.

The exercise tested AAFC's emergency management and response processes in relation to the internal impacts of an influenza pandemic, such as increased absenteeism, and involved members of several AAFC centres across Canada, including laboratories located in BC and Alberta, as well as their national headquarters. AAFC was also able to identify, quantify, and prioritize gaps in their internal capability, while PSTP used the exercise to identify capability gaps that could be filled through the application of S&T.

The National Emergency Operations Centre's ability to manage an internally focused emergency was measured with tools that included the Public Safety Architecture Framework from Public Safety Canada, and the Exercise and Evaluation Program and Target Capabilities List of the US Department of Homeland Security. This approach demonstrated that PSTP could apply the principles of CBP within a civilian emergency management context, using a standardized methodology, to meet end-user requirements through the application of people, processes, and tools. The exercise reinforced the need for building the experience of emergency operations centre teams under realistic and controlled circumstances.

Workshops

Workshops are an important means for communities and stakeholders to exchange information, problem solve, and learn new skills. They bring experts from across sectors and organizations together for the purpose of finding solutions to public safety and security problems that can be addressed by S&T responses. The following examples are indicative of the diversity of workshops held by DRDC CSS programs and the usefulness of the results.

Capability Based Planning Workshops

Since June 2007, DRDC CSS has been holding workshops with police, fire, and emergency medical services teams across Canada to apply CBP principles to determine the capabilities required to prevent, prepare for, respond to, and recover from hazardous events. One aspect of the approach

includes adapting components of the National Incident Management System (NIMS) developed by the United States (US) Department of Homeland Security (DHS) to Canadian conditions. The workshops provide an opportunity for DRDC CSS to familiarize emergency responders with the concept of CBP and its benefits, and gather input on how it can be modified to reflect the Canadian reality.

Through the workshops, DRDC CSS has adapted from NIMS an inventory of Resource Types and a Target Capabilities List (TCL) for the Canadian context. Resource Typing is a system to define and inventory the personnel and teams that might be needed as resources in an emergency response.

The TCL defines the capabilities that might be needed to respond to an emergency and ensures the quality and completeness of effort from the Resource Types.

DRDC CSS conducted series of pilot projects at the local and provincial levels to validate and adapt CBP, and to gain insight on the effects of implementing CBP. The pilot projects illustrated that the CBP approach provides significant benefit to response readiness evaluation and response planning. Each pilot project also used the TCL to perform gap analyses, enabling local emergency response organizations to identify and address gaps in their capabilities. The pilot projects and workshops were also useful for introducing new partners to DRDC CSS.

Staff members of DRDC CSS, in cooperation with approximately 250 stakeholders and partners from federal, provincial/territorial, and municipal organizations, as well as non-government organizations (NGOs), academia, and the private sector have completed the first draft of tools for public security using the CBP approach. The initial toolset includes a draft set of Resource Typing documents and the Target Capabilities List (TCL)—Canada for use in further development of a complete formal structure for capability inventory capture and associated capability gap analysis.



CPRC and associations for police, fire, and emergency medical services joined together to promote interoperability

CITIG Workshops to Enhance Communications Interoperability

Since its inception in 2007, the Canadian Interoperability Technology Interest Group (CITIG) has made significant strides in raising awareness about one of the most important issues facing emergency responders today: the interoperability of public safety organizations.

Public Safety Canada's Canadian Communications Interoperability Plan (CCIP) defines a national vision to improve daily communications interoperability among emergency responders. It was developed through consultation with municipal, provincial, and national champions for enhanced communications interoperability. This plan has been supported through the engagement of the Canadian Council of Emergency Management Officials (CCEMO) and the Senior Officials Responsible for Emergency Management (SOREM).

Over the years, CPRC and CITIG have initiated a series of workshops, including national voice interoperability workshops, a cross-border interoperability workshop, two vendor outreach forums, and a successful program of regional forums designed to raise awareness amongst, and prompt action by, communications interoperability stakeholders. Approximately 1,500 people have participated in the range of workshops, forums, and national meetings held under the auspices of

CITIG. These workshops have provided excellent forums to gather input in support of the CCIP.

Improving communications interoperability is a priority for DRDC CSS, Public Safety Canada, Industry Canada, and federal, provincial, local, and international partners. CPRC will continue to work with its partners through CITIG to address this priority and enhance the safety and security of emergency responders across Canada.

Blast Vulnerability Workshop

In October 2008, the CRTI Explosives Cluster sponsored a one-day workshop designed to inform government officials on how they could obtain quality service at a reasonable cost when sourcing blast vulnerability assessment and mitigation expertise for government facilities. While there is significant expertise in this area within the federal government, it is fragmented across multiple departments with different mandates and differing levels of ability to provide services. Outside the government, there is a mix of companies with varying degrees of capability.

The workshop included presentations by Natural Resources Canada's Canadian Explosive Research Laboratory, the RCMP's Physical Security section and Public Works and Government Services Canada's Risk Management Advisory Services. It provided participants with an overview of the potential effects of explosives on buildings and people, common methods of risk assessment and mitigation for explosives, advice on important considerations when sourcing blast-vulnerability expertise, and a list of potential services within the federal government and private sector.

Improving the Safety of Coroners, Medical Examiners, and Pathologists

In January 2009, a CRTI-sponsored workshop in Vancouver brought together experts from Canada, the US, the UK, Belgium, and Brazil to share first-hand experience in handling CBRN contaminated bodies. The objective was to increase awareness about CBRN events resulting in contaminated fatalities, as well as provide a forum for subject matter experts to begin outlining guidelines or protocols for



PSTP Nanotechnology Workshop

CBRN fatality events and establish general training requirements for secondary responders.

This workshop was planned as a result of lessons learned from Bi-Ex-West, which . That exercise had revealed that Canada did not have national procedures, protocols, or standards for handling fatalities contaminated by CBRN agents. It also showed that although resources and training were increasingly made available to first responders to respond to CBRN incidents, secondary responders like coroners, medical examiners, and pathologists remained largely unprepared to respond to deal with these types of incidents.

The workshop covered a number of important issues including training and equipment, body storage, decontamination and body washing, final disposition of the body, and forensic analysis. These discussions and resulting recommendations are contributing to ongoing efforts across Canada on fatality management. The workshop is indicative of the broader DRDC CSS effort to foster dialogue and collaboration among agencies that play a role in protecting Canadians in the event of a CBRNE incident. Since the event, coroners in British Columbia and other parts of Canada have continued to work on a capability based approach to this issue. The information gleaned during the workshop also helped individual organizations to develop plans and capacity.

PSTP Stakeholders and S&T Workshops

One of the most important roles of DRDC CSS is to develop and maintain a network of national and international partners and subject matter experts within the S&T, public safety, and national security domains through science clusters and communities of practice. These are groups of stakeholders from government, industry and academia who share common interests in one particular subject and who are willing to contribute their expertise and experience to enhancing Canada's ability to prevent, prepare for, respond to, and recover from incidents impacting on the safety and security of Canadians.

In 2008, PSTP sponsored a series of full-day workshops bringing together partners and stakeholders to acquaint them with the program and get their input for the way forward for PSTP. The workshops were focussed on visual analytics, the PSTP strategy, biometrics, and nanotechnologies. Workshop participants included representatives from a variety of federal government departments, as well as private sector subject-matter experts.

One of the main goals was to provide the initial stimulus for the formation of communities of practice in these areas. Participants were introduced to the program and to their colleagues in the various fields. They were presented with the funding opportunities made available through PSTP.

Discussions at the workshops addressed the linkages among S&T, existing capabilities and mandates, and the gaps that needed to be addressed. Participants were asked to assist in prioritizing the gaps, defining how progress towards addressing the gaps could be met, and tracing out a capability roadmap.

The workshops helped to establish the credibility of the PSTP program with key partners from all areas of the security S&T community, including policy makers, researchers, managers, and operators. Most importantly, the workshops provided the opportunity to initiate new relationships that are continuing to be nurtured through the PSTP communities of practice.

Operation Maple Leaf included a large vehicle bomb disruption exercise



Advanced CBRNE Training Program

Suicide bombs, large vehicle bombs, and radio-controlled explosive devices are the weapons of choice for today's terrorists. Responders are faced with the dangerous responsibility of handling these devices and it is essential that explosives technicians are provided with the best and most advanced skills training available. The Advanced Technical CBRNE Training Program, also known as Operation Maple Leaf, aims to provide technical skills and ensure that responders are better equipped to counteract CBRNE threats. The project is funded through CRTI.

Operation Maple Leaf comprises four new courses for explosives technicians: Advanced Electronics and Hand Dismantle Techniques, Live Applications and Technology Transfer Exercises, Remote Control and Electronic Countermeasures, and Live Agent CBRNE Training for Explosives Technicians. Participants develop advanced skills by constructing sophisticated devices for training purposes, reconstructing improvised explosive devices, and learning techniques for rendering safe a variety of devices, including body bombs and booby trap devices.

Canada is recognized as a leader in improvised explosive devices (IED) countermeasures and explosives ordinance disposal. For example, when Colombian security forces lost several explosive ordinance disposal (EOD) operators as a result of the detonation of an IED, the Colombian government sent police and military EOD operators to Canada to participate in the specialized training courses. Explosives technicians from around the world have traveled to Canada to participate in Operation Maple Leaf, including technicians from the US, Brazil, Belgium, Sweden, South Africa, Germany, Finland, Australia, and Denmark.

These courses were developed in partnership with the Canadian Police College, DRDC Suffield, Hardpoint Defence and Security Technology Inc., the Ontario Provincial Police, the Ottawa Police Service, and the Niagara Regional Police Service. Student feedback demonstrates that the courses have met the needs of operational technicians and provided them with the skills and knowledge they require to better respond to incidents involving CBRNE explosives.

Workshops on In-custody Deaths

Every year, people die throughout Canada while in custodial settings: forensic hospitals, police lock-ups, provincial jails, and federal penitentiaries. Currently, there is no formal mechanism in place for sharing information, conducting research, and documenting best practices to aid in the prevention of in-custody deaths. CPRC has been helping to organize a Canadian forum to raise awareness about deaths in custody and to prevent them from happening assist in the development of better procedures.

In mid-2008, in part fuelled by CPRC-funded research on restraints, conducted energy devices, and sudden and unexpected deaths, CPRC was approached by representatives of the Office of the Correctional Investigator (OCI), the ombudsman for federal offenders, to look at creating a mechanism to address the broader issue of in-custody deaths in Canada. The OCI presented the UK Forum for Preventing Deaths in Custody, formed in 2005, as a potential model for Canada. CPRC hosted four workshops with stakeholders to decide if the UK's approach could be adapted for use in Canada. CPRC has also looked consulted with organizations in Australia and the US.

A core group of approximately 20 individuals, with representatives from federal and provincial corrections, police, forensic mental health, and criminal justice oversight agencies, initially steered the effort. That group was expanded in October 2009 when its findings were featured in a plenary session during the Canadian Congress on Criminal Justice (CCCJ) in Halifax. During the sessions, proponents of a Canadian version of the forum discussed the need for and the role of this collaboration. They shared initial research on the scope of the problem and presented plans for next steps. The forum has agreed on goals that include raising awareness, establishing common definitions, researching best practices, identifying knowledge gaps, and compiling an inventory of experts.

Deaths in custody are an important issue in Canadian policing, correctional, and psychiatric facilities. Their occurrence often points to gaps in mental health and criminal justice services as well as a breach of obligation to provide safe and secure custody. The forum is making an important contribution to building national awareness, understanding, and capacity to address the problem.

Support for Major Events

By 2007, planners for the Vancouver 2010 Winter Olympics and Paralympics (V2010) realized that safety and security preparations for the Games were unprecedented in their complexity and would require the coordinated effort of many partners. The main partners, the RCMP, the Canadian Forces, and the Province of British Columbia (BC), recognized that they needed S&T advice and solutions to address some of the more challenging issues. DRDC CSS was well positioned to respond to these requirements and able to leverage the knowledge, relationships, and communities from the PSST suite of programs as well as from within the other DRDC research centres. In late 2007, DRDC set up the Major Events Consolidated Security Solutions (MECSS) project to accomplish two objectives:

1. Assist the functional authorities in reducing the security risk associated with V2010 through the coordinated application of S&T; and
2. Contribute to the establishment of an enduring major event security architecture that could be applied to future major events in Canada.

The 2010 Winter Games provided the opportunity to integrate and deploy public security S&T that PSST had helped to develop in the previous decade. MECSS leveraged the trusted relationships established over the years through previous large-scale exercises and training events. The value of the scientific and technical support to security authorities led to the continuation of the project to provide support to the RCMP during the G8 and G20 Summits in June 2010.

"You often hear the term 'whole-of-government approach' for special events, so over the past couple of years—using the Olympics as a catalyst—we have been able to use scientific reachback in a far more meaningful way; we have brought these experts on board from different departments in government, either from physics or biology or chemistry. They have formed this scientific cluster and they have invested a considerable amount of time and finances, in conjunction with CRTI and the Centre for Security Science."

Inspector Scott Sheppard,
Officer in Charge, Explosives
Disposal and Technologies
Section, RCMP

V2010

The MECSS Project coordinated a number of activities to assist authorities in the application of S&T to counter security risks for V2010. DRDC employees were embedded as scientific advisors with the RCMP in Ottawa and in the Integrated Security Unit (ISU) in Richmond, BC, in the Province of BC's Integrated Public Safety Unit, and the Canadian Force's Joint Task Force Games. DRDC scientists made major contributions to planning and operations in key areas such as command and control, blast effects, vehicle and personnel screening, critical infrastructure protection, CBRNE, exercises, and marine surveillance.



Preparations for the 2010 Olympic Games in Vancouver

Well before the flame was lit in Vancouver, CRTI and PSTP participated in the V2010 Integrated Exercise Program. The program was designed to ensure that municipal, regional, provincial, and federal organizations were prepared to respond in a coordinated manner to any emergency that could occur during the Games. The PCO-directed Integrated Exercise Program consisted of three complementary exercises of increasing scope, complexity, and participation. Exercises Bronze and Silver occurred in November 2008 and February 2009, respectively. Exercise Gold, a full-scale operational exercise to confirm readiness for the Games, was held in November 2009. CRTI played a large leadership role in designing and coordinating the CBRNE-based scenarios that were integrated into Exercise Gold. In addition, DRDC CSS supported, through planning and evaluation, other exercises, including numerous table top exercises, the ISU's Pegasus Guardian series, and a parallel series of military exercises.

The MECSS project enabled DRDC CSS to leverage national S&T resources to strengthen the Government of Canada's major events security architecture. An enduring legacy has been the development of a Web 2.0-based Major Events Planning Framework developed for the RCMP,

which captures planning lessons from previous events for re-use in future requirements. This tool is scheduled to be released in the summer of 2011 to support whole-of-government planning efforts across Canada.

A second legacy has been the knowledge base that was created during the preparations. This Canadian S&T knowledge has been sought after by allies who are planning similar mass gatherings and resulted in DRDC CSS leading the After Event Report on whole-of-government security planning for V2010 at the request of the Privy Council Office. Perhaps, however, one of the most tangible legacies is that of mobile laboratory support to CBRNE responders in what has come to be called Science Town.

Mobile Laboratory Capabilities

A mobile laboratory initiative is exactly the type of collaborative effort expected in a horizontal program. Through pan-cluster efforts, CRTI has supported the transition of S&T from the few specialized laboratories scattered across the country into a deployable on-site operational capability in the form of mobile CBRNE and forensic laboratories.



Mobile nuclear laboratory interior

Beginning in 2003, through CRTI's technology acquisitions process, four mobile nuclear laboratories were assembled to provide a national technical capability to respond to radiological nuclear emergencies. These labs were continually upgraded until 2009, when a fifth mobile nuclear laboratory was acquired to fill a gap in national coverage on the prairies, as well as to take advantage of new technological developments in portable instruments.

The labs were designed to provide on-site technical and scientific support in response to unplanned radiological or nuclear (RN) events in Canada. They have been deployed in a variety of scenarios and exercises, including special events security for the 2008 Quebec City Francophonie Summit; CRTI training exercises at DRDC Ottawa and DRDC Suffield; support for provincial emergency exercises; a decontamination project at Canadian Forces Base Comox; and an international gamma-spectroscopy comparison sponsored by the International Atomic Energy Agency in Austria.

CRTI acquisitions supplied PHAC's Microbiology Emergency Response Team and Environment Canada with laboratory equipment to enhance their deployable microbiology and chemical response laboratories, which were already active in responding to health and environmental emergencies, nationally and internationally. In 2009, CRTI supported the acquisition of additional mobile laboratories for PHAC, DRDC Suffield, and RCMP Forensics.

The mobile laboratories, while they are designed to be activated in emergency situations or pre-deployed before major events, also have non-emergency uses such as training and exercises, support for data acquisition and analysis for ongoing CRTI projects, and site decommissioning, clean-up, and restoration.

During an incident, the mobile laboratories provide critical support to police and military investigators. Using the labs, investigators avoid the need to transport samples, thereby losing critical time for incident management activities like medical countermeasures, site decontamination, public health investigations, and quarantine implementation. The labs improve the safety and security of response team operations and allow in-depth analyses to be performed on-site.



Mobile nuclear labs as part of Science Town

Science Town

The S&T CBRNE community has been working closely with the National CBRNE Response Team led by the RCMP with support from the Canadian Forces. The National Team has recognized the benefits of on-scene S&T advice and analytics through national and international exercises. Security requirements for V2010, and the G8 and G20 Summits provided the opportunities to trial responder and S&T partnerships in real operations.

Science Town, a group of CBRNE and forensics laboratories, was co-located with the National CBRNE Response Team in Whistler and Vancouver leading up to and during V2010. With CRTI funding and support, Science Town brought together laboratories and expertise from DRDC, Environment Canada, PHAC, Health Canada, Natural Resources Canada, and the Director General Nuclear Safety (Department of National Defence). The scientific teams played a significant preventative role in monitoring for CBRNE hazards and analyzing samples. The on-scene scientific and technical advice was instrumental in ensuring

that suspicious but benign incidents were not misinterpreted or escalated. In addition to the on-site support provided by the laboratories, both the National CBRNE Response Team and the lab teams had around-the-clock access to a network of S&T experts located across Canada for reachback assistance in the form of advice and analysis.

The success of Science Town during V2010 led to its deployment for the G8 and G20. Discussions at the federal level are ongoing to establish more formal protocols for the deployment of S&T resources in support of the National CBRNE Response Team.

Some of the capabilities developed through MECSS will be sustained as a “whole-of-government” approach in the development of a Major Events Planning Framework and the continued formalization of Science Town. As well, advice and support is being provided to other countries who are preparing for their own major events. MECSS is a prime example of how DRDC CSS has been able to satisfy operational requirements with technical capability.

Expanding Canada's Public Safety and Security S&T Knowledge Base

It is a goal of Defence Research and Development Canada – Centre for Security Science (DRDC CSS) to establish conditions that facilitate the growth of an ever-expanding public safety and security science and technology (S&T) knowledge base. This knowledge base is generated by projects funded through DRDC CSS programs, as well as through training, exercises, workshops, and symposia. It is shared through other activities supported by DRDC CSS, including the production and publication of knowledge products, networking through communities of practice and science clusters, and sponsoring or participating in national and international events.

DRDC CSS facilitates knowledge management and collaboration across each science cluster and community of practice through a number of mechanisms:

- By sharing value-added information and intelligence via meetings, workshops, and conferences;
- By providing an advanced collaborative workspace through a web portal; and
- By establishing an open, fair, and transparent call for proposals for S&T projects.

Members of science clusters and communities of practice can undertake lab visits to learn about the capabilities and capacities of each other's laboratories and participate in multi-jurisdictional exercises, which allow them to test new S&T and practice interoperability among members, as well as across communities and levels of government and with other response groups.

The work that is accomplished through the science clusters and communities of practice provides invaluable knowledge that helps the federal government to establish priorities, and identify



DRDC CSS captures and disseminates knowledge produced by partners

vulnerabilities and risks, which in turn helps decision makers determine where investments must be made for Canada to develop the right capabilities to protect its people and infrastructures.

Public Security S&T Knowledge Management and Communications

As a condition of funding, project proponents are required to report on the progress of their research. The DRDC CSS knowledge management (KM) team captures the reports, as well as other knowledge products generated by the programs, such as after-action reports on exercises and workshops. These reports contribute to knowledge products developed within DRDC CSS, including quad charts, fact sheets, success stories, articles, and the DRDC CSS website.

By sharing and promoting public security S&T (PSST) innovations, DRDC CSS helps to spur response from researchers and emergency responders. This response influences the CRA and the capability based investment model and renews

the knowledge cycle. The DRDC CSS knowledge base remains open at all stages of the cycle to the surrounding PSST environment. Activities sponsored by DRDC CSS programs is deployed in that environment whenever it has reached sufficient maturity.

The DRDC CSS KM team also assists project proponents, portfolio managers, science clusters, and communities of practice to produce knowledge products to inform and educate partners and the public about the Government of Canada's S&T security goals, the S&T it supports, and its successes. The horizontal relationship of federal partners through the PSST program suite ensures that the dissemination of its knowledge products has ripple effects throughout the whole of government and influences policy and decision makers within the context of public security.

The KM team develops tools to facilitate networking among S&T partners and to disseminate knowledge products to safety and security stakeholders. These tools include DRDC CSS's public website, an information portal for stakeholders, and an online secure workspace for collaboration among members of the communities of practice and science clusters.

National Public Safety and Security Strategies and Policies

DRDC CSS plays an important role in developing and refining Canada's public safety and security strategies and policies by providing S&T expertise, advice, and guidance. It also provides strategic guidance and direction through policy interpretation and priority formulation.

DRDC CSS and its partners help shape Government of Canada public safety and security policies and strategies to combat multiple public security threats. They contribute to the development of various national plans led by Public Safety Canada, including the National CBRNE Strategy, the National Cyber Security Strategy, the National Strategy and Action Plan for Critical Infrastructure, and the Canadian Communications Interoperability Plan.

By including S&T considerations at the beginning of the decision and development processes, the Government of Canada is ensuring that the investment of resources is made where they are truly needed to enhance Canada's ability to prevent, prepare for, respond to, and recover from incidents that have an impact on the safety and security of Canadians.

Equipment Standards and Recommended Equipment List

In March 2011, the Canadian Standards Association (CSA) and Public Works and Government Services Canada's Canadian General Standards Board published the first Canadian standard for protection of first responders from CBRNE events. The new standard is the culmination of two CRTI projects and the product of nearly a decade of efforts by more than 100 stakeholders. It ensures that all Canadian responders are sufficiently protected by providing guidance of the following elements of CBRN personal protective equipment: selection, use, and care; capabilities and limitations; requirements for whole-body protection to ensure that the individual components work together for maximum protection and responder performance.

"I believe the CRTI model, which strongly encourages collaboration, ensured that all relevant stakeholders were represented in the project team and created vital linkages and partnerships that otherwise would not have existed. The [personal protective equipment] standard would not have been possible without the support of the CRTI."

Dr. Eva Dickson, Department of Chemistry and Chemical Engineering, Royal Military College, and Chair of Technical Committee

With project funding from CRTI, the CPRC led a partnership with the CSA, Public Safety Canada, and the chiefs and members associations of Canadian police, fire, and emergency medical services to develop a list of recommended equipment for emergency responders facing CBRNE threats. To build the list, the CPRC formed a committee that brought together experts from the police, fire, and emergency medical services, along with representatives from standards and training



The right personal protective equipment is essential to the safety of responders

institutions, and subject-matter experts in public safety and security S&T. The work of the committee was accomplished using recognized international standards development practices.

The recommended equipment list identifies the equipment that responders need for different types of CBRNE threats. Response agencies can then compare the list with their resources and identify gaps that need to be filled. They can prioritize allocation of resources to reduce the risk for their responders and plan for training. The list can also be used by the S&T community to identify CBRNE technology that needs to be developed, tested, and evaluated.

As a result of meetings of CPRC and CSA representatives with officials from the InterAgency Board for Equipment Standardization and Interoperability (IAB) in the United States (US), Canadian responders can now gain access to the IAB's Responder Knowledge Base by applying through the CPRC. The knowledge base is a source of information on products, standards, certifications, and equipment-related information, including a standardized equipment list.

Public Security S&T Summer Symposia

Each year, DRDC CSS sponsors a Public Security S&T Summer Symposium that offers participants a forum to learn about the latest developments and advances in research projects sponsored by the Chemical, Biological, Radiological-Nuclear, and Explosives (CBRNE) Research and Technology Initiative (CRTI) and the Public Security Technical Program (PSTP). It provides project proponents the opportunity to showcase their work and receive feedback on it from the broader public security and S&T communities.

Since the first symposium in 2003, the series has evolved and expanded. Earlier symposia were held to provide CRTI project proponents the opportunity to report on the progress of their research. Expert panels were added and representative from operations and policy invited to participate. Technology demonstrations and a day devoted strictly to first responders have become standard features of the event. In recent years, attendance has exceeded expectations.

Each symposium is organized around a different theme. The event has evolved to provide an excellent opportunity for participants to hear national and international experts speak on current issues in security and counter-terrorism. CRTI and PSTP communities of practice hold meetings to discuss their work and trends in their areas. Responder Day provides a forum for presentations and discussions focused on the needs of operational responders from across the country.

The symposium is preceded by publication of a proceedings document that contains abstracts on all active CRTI and PSTP projects. The DRDC CSS annual symposium is the Canadian forum of choice for the S&T and public security communities to exchange ideas and share their expertise with colleagues who are dedicated to ensuring that Canada has the tools and knowledge it needs to protect Canadians.

The Way Forward

Over the last five years, Defence R&D Canada – Centre for Security Science (DRDC CSS) has established itself as the federal authority for managing timely and relevant science and technology (S&T) research in support of an all-hazards approach to natural and accidental disasters, and terrorist and criminal acts.

Since their inception, the public security S&T (PSST) programs have followed an evolutionary path keeping pace with the changing safety and security landscape, both at home and globally. They are continuing on this path with an emerging vision that will build on successes through a single, harmonized multi-departmental approach to public safety and security S&T. This approach will ensure that the programs' S&T expertise is more effectively leveraged to inform Canada's public safety and security policy, operational, and regulatory priorities.

To underpin this integrated approach, the Assistant Deputy Minister (ADM) co-chairs of the PSTP Steering Committee will provide annual direction through a strategic planning guidance document that will be developed through a series of environmental scans, performance assessments, workshops, and consultations across public safety and security communities. Key elements of this planning guidance and direction are as follows:

- A set of well-articulated management imperatives with their roots in government policy.
- A set of so-called “hard problems” that help frame the policy and operational drivers into issues where S&T can help, including problems that require innovative and integrative solutions because of their overarching nature, and doctrinal and policy decisions that can be informed or enabled by S&T.
- A set of potential disruptive concepts and technologies that create opportunities for socio-economic advancement by providing



DRDC CSS will continue to manage S&T research to support an all-hazards approach to emergency management

a decisive advantage for public safety and security to enhance capabilities, but may also have the potential to increase the threat by enabling adversaries. The strategic conceptual and technical assessment of these will assist in determining how they need to be positioned within public security communities.

One of the key management imperatives of DRDC CSS in collaboration with Public Safety Canada will be to more effectively bring S&T to bear on established federal, provincial, and municipal public safety and security policy development and implementation. Moreover, the strengthening and



CPRC is partnering with Innovation Place in Regina

facilitation of linkages and integrated planning capabilities between the defence, security, and safety communities will be critical to success.

While aligning program investments to enable policy development and implementation will take on a higher priority than in the past, it will continue to be essential to mobilize and sustain the S&T community, and to find ways to effectively transition investments to end-user communities. The establishment of the CPRC's headquarters in Regina responds in part to this imperative. While CPRC will continue to report through and use DRDC CSS corporate services in Ottawa, the move to Regina will provide the CPRC significant opportunities for collaboration with organizations such as the RCMP's National Training Depot, the Regina Police College, and, especially, the University of Regina and its research park, Innovation Place. The Regina Police possess a flexible police force that could be an ideal component in the development of the CPRC's "Living Lab" concept. The Living Lab offers the opportunity to test technologies and procedures in the real world, using existing facilities and expertise in Regina's responder community.

There is an enduring requirement for the program to support the Canada-US safety and security posture and so it is important to ensure the alignment of program objectives with the federal government's international policies and commitments. DRDC CSS will work to institutionalize the structure and resources necessary to deliver support to domestic safety and security operations, and respond and adapt to global risks and threats. This work will include supporting, facilitating, and participating in activities such as highly complex safety and security exercises; operational planning across a complex and dynamic domestic landscape; and

deployment operations such as those initiated for the 2010 Winter Games and the G8 and G20 Summits to provide S&T reachback and mobile laboratory support.

Determining Canada's longer term PSST priorities and adapting them to respond to future risks and threats will depend primarily on DRDC CSS's foresight, visioning, and risk management capabilities. For example, the development of an all-hazards risk assessment tool, which DRDC CSS is leading with Public Safety Canada, will provide a common framework for multi-departmental planning and interoperability to prevent, prepare for, respond to, and recover from a disruptive event, be it a natural or accidental disaster, or terrorist or criminal act. The framework will address the interconnected nature of Canada's risk environment and provide a means to consolidate risk assessments currently being carried out by different federal institutions into a whole-of-government view. It will also support the prioritization of risks at a federal level, while enhancing decision-making processes within the Government of Canada. Furthermore, DRDC CSS will strive to develop common capabilities across government, such as coordinated risk management, communications, and intelligence and information sharing.

Through these efforts, DRDC CSS together with Public Safety Canada and in coordination with its partners will help to ensure that federal S&T investments respond to the needs of Canada's immediate and long-term public safety and security realities and challenges, and that responders, planners, policy makers, and decision makers are equipped with the best knowledge, S&T, tools, practices, and resources available to protect the safety and security of Canada's people and infrastructure.

Annex A – List of Projects

Investments made through the Public Security Science and Technology (PSST) suite of programs have resulted in the development of science and technology (S&T) solutions that have had significant impact on Canada's ability to prevent, prepare for, respond to, and recover from threats to public security and safety caused by accidents, natural disasters, or terrorist and criminal acts. Strong synergies created through collaboration among the federal S&T community and academia, industry, responder organizations, and other levels of government enabled the development of effective security capabilities and strategies.

Program Funding

Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Research and Technology Initiative (CRTI)	Budget 2001: \$175 M over 5 years
Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Research and Technology Initiative (CRTI)	Budget 2006: \$175 M over 5 years
Public Security Technical Program (PSTP)	Budget 2005: \$15.5 M over 5 years
Public Security Technical Program (PSTP)	Budget 2010: \$3.09 M over 2 years
Canadian Police Research Centre (CPRC)	Budget 2007: \$25 M over 5 years

Public Security Technology Acquisitions

One of the ways by which DRDC CSS has supported the development of increased national S&T capacity is through the acquisition of existing technology for science-based departments and agencies. These technologies are used in day-to-day activities and are available in case of a CBRNE event. The mobile laboratory capability used at the Vancouver 2010 Winter Games is one of the most recognized examples of this initiative. However, the range of projects covers the entire CBRNE spectrum, providing support for the development of S&T in the federal research laboratory setting as well as increased operational capabilities in agencies responsible for the security of Canadians.

Public Security Science and Technology Research Projects and Studies

The following table summarizes the range of investments made by DRDC CSS and partners through S&T research projects and studies. CRTI projects date from 2002–2009, PSTP projects from 2008–2009, and CPRC projects from 2007–2009.

Defeat CBRNE Threat: Biological	
CRTI 01-0006RD	Induction of innate and specific immunity at mucosal surfaces
CRTI 01-0011TA	Hand Held Real Time Biological Detector

CRTI 01-0064RD	New technologies for surveillance of bio-warfare agents and identification of engineered virulence genes
CRTI 01-0087RD	Therapeutic antibody therapy for Ebola virus
CRTI 01-0091RD	Development of monoclonal antibodies for treatment and detection of bioterrorism agents
CRTI 01-0154RD	Rapid DNA based diagnostic tests to identify five bacterial bio-threat agents
CRTI 01-0196RD	Development of rapid detection field tests for veterinary first responders to address agro-terrorism with animal pathogens
CRTI 02-0021RD	Direct detection and identification of bio-weapons nucleic acids based on cationic polymers
CRTI 02-0035RD	Canadian Network for Public Health Intelligence
CRTI 02-0041TA	Deployable CBRN monitoring network
CRTI 02-0066RD	Risk analysis preparedness and management of bioterrorism of animal and zoonotic disease
CRTI 02-0069RD	Molecular epidemiology of bio-threat agents
CRTI 02-0091TA	Clostridium botulinum genomic DNA microarray
CRTI 03-0005RD	Sensor technology for the rapid detection and identification of pathogens used as bio-weapons
CRTI 03-0021TD	Assay development and production team for the development, validation, production, and distribution of assays
CRTI 03-0060RD	Protective markers for anthrax serodiagnosis
CRTI 04-0004RD	Canadian Animal Health Surveillance Network
CRTI 04-0045RD	Development of collections, reference DNA databases and detection systems to counter bioterrorism against agriculture and forestry
CRTI 04-0052RD	On-site composting for bio-containment and safe disposal of infectious animal carcasses and manure in the event of a bioterrorist attack
CRTI 05-0078RD	Development of live replicating viruses as vaccines and therapies for viral hemorrhagic fever viruses
CRTI 05-0090TA	Adaptation of recently developed DNA microarrays to nanochip microarray technology for detection of agro-terrorism agents
CRTI 05-0106TA	Development of fieldable nucleic acid detection techniques for category 1 and 2 biological agents
CRTI 06-0138RD	Development of Canadian diagnostic capability for Rift Valley fever virus
CRTI 06-0187TD	Portable biological agent detection system
CRTI 06-0218RD	Pre-clinical development of a nasal adenovirus-based vaccine against Ebola virus
CRTI 06-0301TD	Development of nasal spray formulated antiviral drug against avian influenza virus
CRTI 07-0135RD	Building resilience and rural health system capability for pre disaster planning and preparedness
CRTI 07-0109RD	Development and application of foresight and future visioning to support capability based planning for animal disease emergency management in Canada

CRTI 07-0234RD	Mitigating dissemination of bioterrorism agents in Canadian food systems
CRTI 07-0132TA	Portable electronic microarrays for agro-bioterrorism: detection and typing of high consequence agents
CRTI 08-0176RD	Enhancing resilience among high risk populations to maximize disaster preparedness
CRTI 08-0190RD	Data fusion solutions for monitoring CBRNE threats
CRTI 08-0203RD	Science and technology solutions to mitigate vulnerabilities in Canada's food supply
CRTI 08-0112TA	Human monoclonal antibodies against ricin
CRTI 08-0122TD	Validation of decontamination processes in the agri-food context
CRTI 08-0181TD	Detection and identification assay validation program for bio-threat agents
Defeat CBRNE Threat: Chemical	
CRTI 01-0004TA	Development of MEMS-based biological agent sensing technology
CRTI 01-0019TA	Real-time confirmatory bio detection and identification
CRTI 01-0029RD	Protecting the first responder against CB threats
CRTI 01-0060TA	Rapid triage management workbench
CRTI 01-0100TA	Systems Level Simulant Test Chamber for CB Personal Protective Ensembles and Equipment
CRTI 01-0120RD	Development of two dimensional molecular imprinting techniques for use in sensing and screening devices
CRTI 01-0131TA	HI-6 nerve agent antidote system
CRTI 01-0161TA	CBRN blast protective helmet
CRTI 02-0007TA	Medical countermeasures against ricin
CRTI 02-0043TA	Accelerated consequences management
CRTI 02-0053TA	Simulation based decision aid for the optimization of detection protection and decontamination systems with team structure and procedures
CRTI 02-0067RD	Restoration of facilities and areas after a CBRN attack
CRTI 02-0080RD	Psychological risk assessment and management tools to enhance response to CBRN attacks and threats in Canada
CRTI 02-0093TA	Advanced polymer research for application to personnel protective clothing
CRTI 03-0009RD	Caring about healthcare workers as first responders: enhancing capacity for gender-based support mechanisms in emergency preparedness planning
CRTI 03-0013TD	Early CBRN attack detection by computerized record surveillance
CRTI 03-0019TD	Real-time bio-surveillance and response readiness
CRTI 03-0023TD	Portable and collapsible chem/bio isolators
CRTI 04-0018RD	Development of standards for chemical and biological decontamination of buildings and structures affected by terrorism
CRTI 04-0019TD	Field demonstration of advanced CBRN decontamination technologies
CRTI 04-0022RD	Rapid separation and identification of chemical and biological warfare agents and consumer matrices using FAIMS technology
CRTI 04-0082TA	RF- and ECM-compatible CB-blast protective helmet

CRTI 05-0016RD	Development of Canadian standard for protection of first responders from CBRN events
CRTI 05-0069RD	Development of PEGylated granulocyte-macrophage colony stimulating factor for acute radiation syndrome
CRTI 05-0092TA	Integrated personal cooling for chemical-biological protective undergarments
CRTI 06-0169TA	Universal surface decontamination formulation
CRTI 06-0170RD	Organophosphorus agent decontamination.
CRTI 06-0192TD	CBRN respiratory fit-testing program development
CRTI 06-0234TA	Advanced syndromic surveillance and emergency triage
CRTI 06-0255TA	Medical and casualty management command post and temporary treatment centre
CRTI 06-0259TD	Psychosocial risk manager: computer-based pre-event training
CRTI 06-0299TA	Polymer nanocomposite barrier fabric for first responder protection and containment operations
CRTI 07-0150TD	Casualty care continuum from event scene to emergency department
CRTI 08-0180TD	Establish an integrated national CBRNE training system for health, psychosocial, and communication responders
CRTI 08-0233TD	An HI-6 based intravenous product for nerve-agent post-treatment
CRTI 08-0234TD	Modeling the effects of public/animal health emergencies on laboratories
Defeat CBRNE Threat: Forensics	
CRTI 04-0030TD	Nuclear forensics response capabilities and interoperability
CRTI 04-0047TD	Chemical, biological, radiological, and nuclear incident database
CRTI 04-0112TD	Container intrusive sampling system
CRTI 05-0053TA	Deployable RN incident area network: wireless mesh topology
CRTI 05-0058TD	Unified interoperability solution set to support CONOPS framework development and municipal-provincial-federal collaboration to CBRN response
CRTI 05-0121RD	Evidence based risk assessment of improvised chemical-biological weapons
CRTI 05-0122TD	CBRN crime scene modeler
CRTI 05-0123TD	All-hazards sample receiving storage
CRTI 06-0202TD	Short-range biospectra: a device for the surveillance of bioaerosol in large indoor, semi-enclosed, and outdoor spaces
CRTI 06-0275TD	Integrated two-way radio radiation sensors
CRTI 06-0317TD	Crime scene support tool for police, hazmat and EMS
CRTI 06-0318TD	Higher education cooperative for hazardous materials and equipment tracking
CRTI 06-0319TD	Guidelines for combined air demand and heat strain management of first responders
CRTI 07-0148TD	Decontamination and mitigation techniques for chemical, biological, and explosive agents and the effect on forensic evidence
CRTI 07-0216TA	Fast CBRNE crime scene modeler
CRTI 07-0193RD	A Compton gamma imager for criminal and national security investigation

CRTI 07-0219RD	Microbial forensics project
CRTI 08-0105RD	The development of a Canadian CBRNE recommended equipment list
CRTI 08-0116RD	Forensic attribution of CBRNE materials: a chemical fingerprint database
CRTI 08-0192TD	Emergency resource inventory network
CRTI 08-0197TD	Capability-based planning validation project / CBRNE rapid assessment team
CRTI 08-0226TD	Capability-based planning validation project / CBRN mass decontamination
Defeat CBRNE Threat: Radiological and Nuclear	
CRTI 01-0027RD	Biological dosimetry and markers of nuclear and radiological exposures
CRTI 01-0052TA	Rapid carbon-14 analysis accelerator mass spectrometry
CRTI 01-0072RD	Nanodosimeters based on optically stimulated luminescence
CRTI 01-0080TA	Information management and decision support system for RN
CRTI 01-0085TA	Evaluation of GM-CSF for acute radiation syndrome
CRTI 01-0105TA	Mobile real time national
CRTI 01-0133RD	New technologies for the rapid assessment of radioactive contamination
CRTI 01-0203RD	Standoff detection of radiation
CRTI 01-0204RD	Bubble detector film
CRTI 02-0024RD	Probabilistic risk assessment for radiological dispersal devices
CRTI 02-0041RD	Real-time determination of area of influence of CBRN releases
CRTI 02-0045RD	Forensic optically stimulated luminescence
CRTI 02-0057TA	Canadian radiation alert/expert system for critical infrastructure monitoring
CRTI 02-0093RD	Advanced emergency response system for CBRN Hazard prediction and assessment in urban environment
CRTI 03-0017TA	Development of a directional gamma ray probe.
CRTI 03-0018RD	Experimental characterization of risk for radiological dispersion devices
CRTI 03-0018TD	Airport radiological counterterrorism sensor network
CRTI 03-0025TA	Defender nuclear detection web
CRTI 04-0029RD	Development of an electronic neutron dosimeter
CRTI 04-0127TD	Canadian Health Integrated Response Platform
CRTI 05-0006TA	Optically stimulated luminescence radiation sensor for long-dwell detection in transit applications
CRTI 05-0014RD	Experimental and theoretical development of a resuspension database to assist decision makers during radiological dispersal device events
CRTI 05-0043RD	Economic impact of radiological terrorism events
CRTI 05-0108TD	National nuclear emergency laboratory network and interoperability
CRTI 06-0146RD	Rapid identification of radiologically-exposed individuals for medical casualty management
CRTI 06-0156RD	Radiological dispersal device contamination interactions with urban surfaces
CRTI 06-0163TD	Real-time collaboration enhancement for the ARGOS risk assessment system
CRTI 06-0186RD	Novel DNA-based radiological dosimetry technology

CRTI 06-0188TA	Portable optically stimulated luminescence system for forensics and retrospective dosimetry
CRTI 06-0230RD	Rapid methods for emergency radiobioassay
CRTI 07-0196TD	Towards an operational urban modeling system for CBRN emergency response and preparedness
CRTI 07-0103RD	Full-scale radiological dispersal device experiments and models
CRTI 07-0190TA	Extension of electronic neutron dosimeter to detect gamma rays
CRTI 07-0113TD	Direct alpha spectrometry for forensic samples
CRTI 07-0104TD	Multi-spectral imaging system for the detection of radiological contamination
CRTI 07-0186RD	Optimization of MEDICAL DECORportion for time of use and improved bio-effects
CRTI 08-0214RD	Special nuclear material detection via computed muon radiography
CRTI 08-0222RD	Stand-off radiation detection by air radiolysis
CRTI 08-0208TA	Special nuclear materials and radiological detection, locating, and tracking
CRTI 08-0173TD	Nuclear forensic lab interoperability and criminal investigation
CRTI 08-0225TD	Radiological-nuclear response criteria
CRTI 08-0241TD	Field techniques for emergency radio-bioassay
Defeat CBRNE Threat: Explosives	
CRTI 06-0150TD	Integrated blast risk assessment for improved preparedness and response
CRTI 06-0159TA	Advanced technical CBRNE training program for explosives cluster members
CRTI 06-0171TA	Explosives storage magazine large opening door design
CRTI 06-0204RD	Improvised explosive assessment tool
CRTI 06-0236TA	Improvised explosive device—CBRN database explosives incident expansion project
CRTI 06-0252RD	Protocols for modelling explosive threats in urban environments
CRTI 07-0179RD	Explosives vapors stand-off detector—multi-option differential detection and imaging Fourier spectrometer
CRTI 07-0121RD	Lightweight composite armour for improvised explosive devices protection: A single-walled nanotube solution
CRTI 07-0176TD	National standard for design and assessment of buildings against blasts
CRTI 07-0123TA	Blast dosimetry and CBRNE sensors integrated into explosive ordinance device personal protective equipment
CRTI 07-0153RD	Consolidated assessment of threats for the transport of combustible liquid/ gaseous fuels
CRTI 07-0217TA	Explosive and radiological transit security
CRTI 08-0142RD	Immersive haptic tele-robotic system for improvised explosive device disposal
CRTI 08-0200RD	Defeat of improvised explosive devices using electron pulse generators
CRTI 08-0104TA	Non-invasive sampling and analysis of explosives in air and sea cargo containers
CRTI 08-0131TD	Commercial explosive identification tool

Surveillance, Intelligence, and Interdiction	
PSTP 08-0103BTS	Evaluation of wide-area, covert, radar networks for improved surveillance, intelligence, and interdiction against watercraft and low-flying aircraft
PSTP 08-0119BTS	The impact of emerging maritime information and sensor systems on northern situational awareness
PSTP 02-300BTS	Sensor Interaction for Small Ship Tracking and Awareness in Harbour
PSTP 02-341BTS	Asymmetric Threat Mitigation in the Great Lakes, St. Lawrence Seaway and Maritime Ports and Inshore Waters
Critical Infrastructure Protection	
PSTP 08-0100CIP	Integrated evaluation of critical infrastructure interdependencies for major event planning
PSTP 08-0120CIP	A scenario-based approach to protecting telecommunications critical infrastructure in British Columbia: Ensuring business continuity during a major hazardous materials event
PSTP 02-318CIP	CI Interdependencies Modelling Study
Biometrics	
PSTP 08-0109BIOM	Data exchange and interoperability through stand-off biometric techniques
PSTP 08-0110BIOM	Biometric border security evaluation framework
PSTP 02-336BIOM	Assessing Vulnerability of Biometric Technologies for Identity Management Applications
PSTP 02-351BIOM	Biometric Data Safeguarding Technologies — Analysis and Best Practices
E-Security	
PSTP 08-0107eSec	Combating robot networks and their controllers
PSTP 08-0115eSec	Automated risk management system
PSTP 02-305eSec	S&T Study Priorities e-Security for CIP #3
PSTP 02-347eSec	Study on Cyber Security and Threat Evaluation in SCADA Systems
Emergency Management Systems and Interoperability	
PSTP 08-0130EMSI	Emerging public safety interoperability frameworks, standards, and architectures
PSTP 08-0135EMSI	New approaches to enhancing interoperability for horizontal information exchange across crisis support organizations
PSTP 02-324EMSI	Emergency Management Systems and Interoperability
PSTP 02-327EMSI	National Common Alerting and Notification Protocol
PSTP 02-342EMSI	MASAS Standard Access Methodology

Canadian Police Research Centre	
CPRC 2007-001	Methods of recovery of human remains in fatal fires
CPRC 2007-002	Alternative fabric trouser
CPRC 2007-003	Program and management support (CREAB,N95)
CPRC 2007-005	Blow fly thresholds
CPRC 2007-006	Simulation study using technology to enhance skills acquisition and retention
CPRC 2008-001	Restraint- preventing sudden in-custody death
CPRC 2008-002	Assessing communications capabilities during major events communications in 4 four major Canadian cities
CPRC 2008-003	The effect of arson or explosion on latent fingerprints
CPRC 2008-004	English-French use of force lexicon
CPRC 2008-005	Development of an aged armour replacement protocol and testing
CPRC 2008-006	Web-based first responders trauma resilience tool
CPRC 2008-008	Personal protective equipment used during contagious disease outbreak.
CPRC 2008-009	Nystagmus sensor prototyping
CPRC 2008-011	Evaluation of canine ballistic and slash resistant vests
CPRC 2008-013	Forensic determination of human regionalism
CPRC 2008-016	Taser XREP evaluation
CPRC 2008-017	Draganfly unmanned aerial vehicles- (mini-UAVs)
CPRC 2008-020	Closed-circuit TV Toronto Police Services evaluation
CPRC 2008-021	Frontline protective services OnScene 2008
CPRC 2008-022	Maritime provinces interoperability
CPRC 2008-023	Canadian communications interoperability plan
CPRC 2008-024	Classification of police resource by type
CPRC 2008-025	Unmanned aerial vehicle operators course
CPRC 2009-002	Remote detection of clandestine cannabis grow ops
CPRC 91022	Reduction of firefighter risk in basement fires
CPRC 91067	Enhancing forensic entomology applications in Canada using molecular tools
CPRC 91001	3-D facial reconstruction: using ultrasound technology to aid in positive identification of missing peoples of Canadian Aboriginal ancestry
CPRC 91010	Taphonomic patterns: Brush fires and heavy muscle decomposition on bone
CPRC 91070	UVA application in Canadian police services
CPRC 91034	Improved physical models and software for bloodstain pattern analysis
CPRC 91050	Hazardous environment operations course
CPRC 91071	Clandestine drug lab simulation and training
CPRC 91058	In-vivo current density imaging for neuromuscular incapacitation devices
CPRC 91043	Canadian strategy on missing persons and unidentified remains

CPRC 91047	Ottawa Paramedic Service communication centre workload analysis and predictive modelling
CPRC 91007	Towards a national fire incident database
CPRC 91076	Gap analysis for Emergency Medical Services (EMS), science and technology research opportunities
CPRC 91025	Introduction to evidence based research for tri-sector personnel
CPRC 91073	National benchmarking study of Canadian public safety voice radio systems
CPRC 91052	National benchmarking study of Canadian public safety voice radio systems
CPRC 91019	Regional emergency communication interoperability strategy and governance for the lower mainland region of British Columbia
CPRC 91016	Joint emergency services advisory operation group regional interoperability strategic plan
CPRC 91072	Tri-services capability assessment

Annex B – Financial Overview of Investments in Public Security Science and Technology

The Defence R&D Canada – Centre for Security Science (DRDC CSS) provides a focal point for Canadian science and technology (S&T) researchers working to enhance public security capabilities. DRDC CSS helps build networks, science clusters, and communities of practice with these researchers across a broad range of themes.

Part of the DRDC CSS achievement is to identify public security S&T priorities and fund projects that address those priorities. Each project is led by one of the 21 federal departments that have signed a Memorandum of Understanding (MOU) with DRDC CSS and involves partners who may come from federal, provincial, and municipal departments and agencies, academia, non-governmental organizations, and the private sector.

Through the projects it manages, DRDC CSS leverages the expertise, knowledge, and talent of researchers and scientists in a shared vision to accomplish important goals. As part of their commitment to the project, partners contribute in-kind cash, expertise, and resources. PSST programs also invest with partners to acquire technology to enhance public security capacity. The financial overview in the table below highlights PSST investment dollars and partner in-kind contributions.¹

Research Focus	Projects	CSS Investment	In-kind Investment	Total Investment
CBRNE Research and Technology Initiative				
Biological	36	\$69,617,548.00	\$67,906,481.00	\$137,524,029.00
Chemical	36	\$60,611,908.00	\$65,711,969.00	\$126,323,877.00
Forensic	22	\$33,518,290.00	\$23,696,799.00	\$57,215,089.00
Explosive	16	\$24,059,669.00	\$21,989,981.00	\$46,049,650.00
Radiological Nuclear	42	\$59,255,348.00	\$65,715,715.00	\$124,971,063.00
Total	152	\$244,562,763.00	\$243,234,762.00	\$487,797,525.00

¹ Financial data represents the project approved funding as detailed in the signed charters and Letters of Agreement (LOAs) for each project.

Research Focus	Projects	CSS Investment	In-kind Investment	Total Investment
Public Security Technical Program				
Border and Transportation Security	4	\$794,395.00	\$741,761.00	\$1,536,156.00
Critical Infrastructure Protection	3	\$598,310.00	\$255,039.00	\$853,349.00
Biometrics	4	\$799,527.00	\$1,147,839.00	\$1,947,366.00
E-security	4	\$777,836.00	\$1,376,767.00	\$2,154,603.00
Emergency Management and Systems Interoperability	6	\$1,199,542.00	\$745,485.00	\$1,945,027.00
Total	21	\$4,169,610.00	\$4,266,891.00	\$8,436,501.00
Canadian Police Research Centre				
	45	\$4,280,241.00	\$3,893,987.00	\$8,174,228.00
Total PSST Research Investment				
	217	\$253,012,614.00	\$251,395,640.00	\$504,408,254.00
Total PSST Technology Acquisitions Investment				
	200+	\$48,093,984.00	\$90,366,554.00	\$138,460,538.00

Annex C – Public Security Science and Technology Partners

Federal

The Defence R&D Canada – Centre for Security Science (DRDC CSS) has achieved success by building partnerships through cross-organizational programs comprised of 21 lead federal government departments and agencies. Each partner has signed a Memorandum of Understanding (MOU) with DRDC CSS and leads projects funded through the Public Security Science and Technology (PSST) suite of programs.

Agriculture and Agri-Food Canada	Atomic Energy of Canada Limited
Canada Border Services Agency	Canadian Food Inspection Agency
Canadian Nuclear Safety Commission	Canadian Security Intelligence Service
Communications Security Establishment	Defence Research and Development Canada
Environment Canada	Fisheries and Oceans Canada
Health Canada	Industry Canada
National Research Council	Natural Resources Canada
Privy Council Office	Public Health Agency of Canada
Public Safety Canada	Public Works and Government Services Canada
Royal Canadian Mounted Police	Transport Canada
Treasury Board Secretariat	

Other Partners

Through project and study charters, MOUs, and cooperative working agreements, DRDC CSS has partnered with almost a 1,000 national and international agencies to create a national and international network to develop and share expertise and knowledge.

Sector	Number
Provincial-Territorial	68
Municipal	69
Not for Profit	54
Academia	87
Industry	503
International	206
Total	987

Provincial, Territorial, and Municipal

Organizations from almost every province and territory have been involved in PSST projects. These partners have included organizations involved with public safety and emergency response, fire and law enforcement, health and social services, conservation and environment, education and training, fisheries and agriculture, and electricity and energy.

At the regional and municipal layer of government, DRDC CSS has partnered with hospitals and paramedics, police and fire departments, public works and hazardous materials departments, and airports and transit authorities. Organizations from over 15 different cities and regions have been involved in projects funded through the PSST suite of programs.

Not-for-profit Organizations, Non-government Organizations, and Universities

More than 50 not-for-profit and non-government organizations (NGOs), including professional associations, research institutes and health associations, and farm and food producer councils have been involved in PSST projects and activities. Laboratories and training centres in colleges and universities from across North America and abroad have also partnered with DRDC CSS.

Industry

The industrial sector has had the broadest representation on PSST projects, with over 500 companies having been a partner at one time or another. The industries involved include aeronautical and space, pharmaceutical and biosciences, personal protective equipment and security, computer hardware and software, photonics and energy, petroleum and chemicals, communications and defence, robotics and nanotechnology, and geomatics and materials.

International

DRDC CSS partners with government organizations outside of Canada at the municipal, state, and national levels to share best practices, evaluate project results, and ensure that Canadian initiatives perform at world-class levels. These partners include the North Atlantic Treaty Organization (NATO) nations, AUSCANUKUS (Australia, Canada, United Kingdom, United States), and countries involved in the Global Partnership Program.²

These partnerships include leading academic institutions, international organizations, and industrial partners and private sector partners working collaboratively to compare research results, test equipment, and transition S&T project results in world markets.

² For more information on the Global Partnership Program, see Foreign Affairs and International Trade Canada, http://www.international.gc.ca/gpp-ppm/background_apercu.aspx?lang=eng.

Annex D – Abbreviations

A	
AAFC	Agriculture and Agri-Food Canada
ADM	Assistant Deputy Minister
ASSET	Advanced Syndromic Surveillance and Emergency Triage
B	
Bi-Ex-West	Biological Incident Exercise
C	
CACP	Canadian Association of Chiefs of Police
CAFC	Canadian Association of Fire Chiefs
CAHSN	Canadian Animal Health Surveillance Network
CAPEX	capability exercise
CASCAD	Canadian Aqueous System for Chemical/Biological Agent Decontamination
CBP	capability based planning
CBRNE	chemical, biological, radiological, nuclear, and explosives
CCCJ	Canadian Congress on Criminal Justice
CCIP	Canadian Communications Interoperability Plan
CFB	Canadian Forces Base
CFIA	Canadian Food Inspection Agency
CI	critical infrastructure
CIP	critical infrastructure protection
CITIG	Canadian Interoperability Technology Interest Group
CPNI	Centre for the Protection of National Infrastructure (UK)
CPRC	Canadian Police Research Centre
CRA	consolidated risk assessment
CRTI	CBRNE Research and Technology Initiative
CSA	Canadian Standards Association or Canadian Space Agency
CSS	Centre for Security Science, DRDC
CTTC	Counter-terrorism Technology Centre
D	
DG	Director General
DHS	Department of Homeland Security (US)
DND	Department of National Defence

DNDO	Domestic Nuclear Detection Office (US, DHS)
DRDC	Defence Research and Development Canada
E – F	
ECADS	Early CBRN Attack Detection by Computerized Medical Record Surveillance
ECM	electronic countermeasures
EMSCC	Emergency Medical Services Chiefs of Canada
EMSI	Emergency Management and Systems Interoperability
EOD	explosive ordnance disposal
ExIR-08	Exercise Integrated Response 2008
ExIT-08	Exercise Initial Thunder 2008
G	
GHI	Global Health Initiatives
GRIP	Government-related Initiatives Program, CSA
H	
HAZMAT	hazardous materials
I	
IAB	InterAgency Board for Equipment Standardization and Interoperability (US)
IED	improvised explosive device
ISU	Integrated Security Unit, RCMP
IT	information technology
J – K	
KM	knowledge management
L – M	
MECCS	Major Events Coordinated Security Solutions
MOU	Memorandum of Understanding
N	
NGO	non-government organization
NIMS	National Incident Management System
NPSTC	National Public Safety Telecommunications Council (US)
NRC	National Research Council Canada
O	
OACP	Ontario Association of Chiefs of Police
OCI	Office of the Correctional Investigator
OR	Operations Research
P	
PHAC	Public Health Agency of Canada
PMB	Program Management Board

PSAT	Public Security and Anti-terrorism
PSST	Public Security Science and Technology
PSTP	Public Security Technical Program

Q – R

R&D	research and development
RCMP	Royal Canadian Mounted Police
RODS	Real-time Outbreak Detection and Surveillance

S

S&T	science and technology
SC	steering committee
SII	Surveillance, Intelligence, and Interdiction
SOREM	Senior Officials Responsible for Emergency Management
STAC	Science and Technology Advisory Committee
STTAG	Science, Technology and Trade Advisory Group

T

TCL	Target Capability List
TRG	Technical Response Group

U

UK	United Kingdom
US	United States

V

V2010	Vancouver 2010 Winter Olympics and Paralympics
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W – X – Y – Z