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# Science and Technology for Countering Terrorism at Home and Abroad – Perspectives on the Key Challenges

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Speaking Notes

## INTRODUCTION

Like many of you, my background is in defence science. However, in the past few years since the terrorist attacks of 11 September 2001, I have been working with the Canadian public safety and security community to examine how the nation's science and technology capabilities can be brought to bear on Canada's public security challenges, in particular those deriving from the terrorist threat to the nation. Today I want to share with you some of my observations on the challenges for science and technology in general - and defence S&T in particular - in today's public security context, with a focus on counter-terrorism issues.

I'll approach this in three parts. First, I'll provide some personal views on the current context for counter-terrorism S&T. I'll then present you a few examples of how S&T is being applied to the public security and counter-terrorism priorities in Canada. Finally, I'll summarize with some views, as promised, on the S&T challenges, drawing largely from recent experiences in the establishment of a new collaborative S&T program between Canada and the US in the context of our mutual homeland security. Perhaps to position your expectations, I view these challenges are more than technical, but I do think they play well into the mandate the SCI Panel.

I will begin with a few remarks regarding today's context.

## THE COMPLEXITY OF THE DEFENCE CONTEXT IS GROWING …

The world of defence, and by implication that of defence science, is very different today from what it was some 15 years ago at the end of the Cold War, or even as it was a brief time ago on 10 September 2001. As I have attempted to highlight on the slide, a new lexicon shapes the defence context. While the ability of our nation's militaries to engage in high intensity operations against competent adversaries remains an essential foundation of defence policies, this capability is increasingly juxtaposed against demands for our militaries to contribute to complex peace support operations around the world, and to the security of the nation at home. A new perspective on the threats to our nations has developed, to which our defence capabilities are expected to respond. It is no longer sufficient to assume that by preparing for high intensity conflict, our militaries will be able, by default, to succeed in these other tasks. Of course, this evolving defence context also profoundly impacts the priorities for S&T investment.

## S&T FOR COUNTER-TERRORISM: PERSPECTIVES

A primary example of this evolving context for S&T, and the one being explored in this symposium, would be its contribution to the nations' counter-terrorism capabilities. Arguably, these capabilities can be grouped into three related, yet distinctly different areas. The first is the ability of our militaries to carry

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the fight to the terrorist abroad, as characterized for example by the operations in Afghanistan in 2002. The second is countering the terrorist threat at home, the homeland security context. Finally, there is the perspective of our militaries conducting stability operations abroad, as we see in both Afghanistan and Iraq, where they are faced with the challenge of countering terrorist actions against both the civilian population and the military stabilizing force. Science and technology solutions for one area may well be applicable to another; however, such dual-use application does require that our S&T communities understand the differences among these areas as well. Some of the key differences are indicated on the slide. As but one example, while offensive operations increasingly call on military coalitions, counter-terrorism activities in the other two contexts bring multiple agencies across multiple jurisdictions into play.

My focus for the remainder of the presentation will be on the homeland security perspective.

## THE NATIONAL SECURITY SPECTRUM

In the national security context, our nation's defence capabilities reside at one end of a spectrum of national security mandates. The lead for matters of public safety and security, including counter-terrorism, is typically positioned with civil authorities distributed across multiple levels of government. Dual-use applications for Science and Technology are clearly possible across this spectrum. However, the transition of defence technologies into the homeland security domain can be complicated. Let's examine some of the factors at play.

## PUBLIC SAFETY AND EMERGENCY PREPAREDNESS FRAMEWORK

Shown here is the framework typically employed for public safety and emergency preparedness. One moves clockwise around the planning cycle from readiness through response and recovery. Counter-terrorism would be one threat to which the national system would be expected to respond. However, the system is indeed expected to address all emergencies, whether derived from terrorist or criminal activities, accidents or natural disasters. In essence, our national public safety and security systems must take an "all-hazards" approach, just as our militaries are expected to be multi-purpose. However, the planning paradigm here has some key differences from the classical military C2 paradigm, most notably due to the fact that nation's emergency response capabilities are fundamentally reactive versus the typically proactive or offensive nature of military planning.

## COUNTER-TERRORISM THROUGH THE LENS OF THE NATIONAL EMERGENCY MANAGEMENT AND CRISIS RESPONSE SYSTEM

If one looks at counter-terrorism capabilities through the lens of the national emergency management and crisis response system, a number of system attributes become apparent. Many of these have similarities with military capabilities in the context of coalition operations. One implication, therefore, is the potential to apply many of the S&T solutions for military Command and Control systems to the nation's emergency management system.

First, the system is inherently a system-of-systems, a consequence of its highly distributed nature. The system focuses very much on the capabilities of the First Responder to an emergency. Most typically, one thinks of municipal First Responders such as police or firefighters, although this does depend on the emergency being addressed. For example, the nation's veterinarians could well be the First Responders, as Canada has experienced recently as a result of Mad Cow and Avian Flu incidents. The system operates within a legislative framework that establishes authorities that those in the system can exercise, and in some instances, limits the technologies that can be used. Finally, the system must be able to address multiple consequences.

## CHARACTERISTICS OF HIGH-CONSEQUENCE PUBLIC SAFETY AND SECURITY EVENTS

High-consequence public safety and security events, such as those that would derive from terrorist attacks, exhibit some core characteristics. The event will inevitably engage multiple jurisdictions, cutting across the authorities and responsibilities of multiple agencies. A natural progression from crisis to consequence management will likely not occur, but may move through multiple crisis phases, largely influenced by the manner in which the public reacts to the event. The impacts of the event would also be multiple and simultaneous, potentially including human casualties, economic, political, environmental, public confidence, and national infrastructure consequences. Canada's experience in 2003 with the SARS outbreak in Toronto and Vancouver was a case study of the issues at play. The outbreak was, of course, derived from natural causes, but had it been an act of terrorism, the response required of the national emergency management system would have been largely the same.

## CANADIAN FEDERAL PUBLIC SAFETY AND SECURITY STRATEGY

Now I will turn briefly to some examples of how science and technology is being applied to public safety and counter-terrorism priorities in Canada.

The federal government's public safety and security strategy is aimed at ensuring a robust national emergency management capability, recognizing this capability is distributed across federal, provincial, territorial and municipal jurisdictions. The government has targeted a number of national strategies and systems that it has committed to champion. Key examples include the creation of a new national Public Health Agency to better prepare the nation for major health challenges to Canadians, a Government Operations Centre to support decision makers throughout the emergency management system, and targeted technology investments to improve security of the nation's borders.

Science and Technology underpins virtually all of these initiatives. Let me provide a few examples of new S&T investments.

## MARITIME SECURITY TECHNOLOGY INVESTMENTS

In terms of S&T for border security, one example is the plan to implement a network of high-frequency surface wave radars developed by Defence R&D Canada and Raytheon Canada along Canada's east and west coasts. The systems will provide detection and tracking of ships in Canada's coastal waters out to some 400 km.

## COUNTER-TERRORISM TECHNOLOGY CENTRE

A second example has been the creation of the Counter-Terrorism Technology Centre, co-located with DRDC's Chemical and Biological Defence research centre, DRDC Suffield. The CTTC, as part of the national CBRN strategy, provides specialized high-end training, including live-agent training to civilian First Responders and the military. Upwards of 1000 personnel have received training in 2004. The centre is also a CBRN national reference laboratory to support police forensics, and is intended ultimately to provide equipment evaluation for CBRN equipment suppliers.

## CBRN RESEARCH AND TECHNOLOGY INITIATIVE

Finally, I highlight the CBRN Research and Technology Initiative, or CRTI.

## CRTI MANDATE

The CRTI was created by the federal government shortly after 11 September 11 2001. Its purpose is to invest in S&T that enhances the nation's capabilities to prevent, prepare for and respond to terrorist attacks using weapons of mass destruction targeted either directly against Canadians, or indirectly by attacking our critical infrastructure, the food and water supply or the agro-system.

## NEW APPROACH TO FEDERAL S&T IN CANADA

The CRTI is also a new approach for national S&T, that recognizes the leadership role expected of government science in addressing national priorities, but also the need to link government, industry, academia and international performers. The initiative has enabled the formation of clusters of federal and provincial laboratories – one each for the chemical, biological and R/N threat – that are prepared to provide a rapid-response support to the country's First Responders in the event of an incident. Finally, the initiative provides funding for research projects that are chosen for their ability to address the most critical priorities. To date, CRTI is funding some 55 projects with a total value in excess of $200M.

## NEW MODEL

Here is a simplified description of the CRTI business model. A series of investment priorities have been identified by considering the highest risks to the nation and the gaps both in operational and science capabilities to address these risks. On the right side of the model, proposals are sought from partnerships of public and private S&T performers for projects that will provide solutions, whether they be efforts to accelerate technology already in the pipeline, or research into the tougher science challenges. On the left, investments are also made into the lab clusters to enhance their response capabilities.

## CONSOLIDATED RISK ASSESSMENT

Central to the model is the approach to risk assessment and priority setting. The risk assessment has two steps. First, as shown here is the development of a number of scenarios for possible ways in which terrorists could use CBRN hazards. The risk associated with each scenario is first evaluated scientifically based on an assessment of the feasibility of the scenario and the extent of the consequences.

## INTELLIGENCE JUDGMENT

Secondly, this assessment is married with a judgment provided by Canada's intelligence community of the plausibility that terrorists are considering such scenarios. Those scenarios assessed as having both a high vulnerability and immediate risk than become the highest priority for mitigation through the initiative's research investments.

## CANADA-US PUBLIC SECURITY TECHNICAL PROGRAM: COLLABORATION FOCUS

Finally, I will turn to some observations on the key S&T challenges. These observations draw substantially on the recent collaboration between Canada and US government scientists to implement a new cooperative S&T program, known as the Public Security Technical Program.

The PSTP is mandated to pursue S&T that enhances our mutual national capabilities to mitigate high-consequence public safety and security events. The program has four key areas of investigation. First is

to counter the CBRNE hazard, whether derived from terrorist or criminal activities, accidents or natural disasters. Second is the protection of the nation's physical and cyber-infrastructure. Third is the nations' ability to disrupt or interdict terrorist or criminal activity through coordinated intelligence, policing, border and transportation security. Finally, the program applies S&T to advancing the effectiveness of the national emergency management system, including its enabling standards.

## CHALLENGES IN PUBLIC SAFETY AND SECURITY S&T DELIVERY

Among the key challenges facing our S&T communities in addressing these areas is the relationship that needs to be established with the First Responder and other operational customers.

In particular, we need to identify who are the decision makers, what decisions they make, and how technology assists them in decision-making. We must be better at anticipating threats and vulnerabilities in order to allow a shift from reactive to proactive S&T delivery. We should be able to inform, enable and respond to national public safety and security strategies that establish future direction in timeframes well beyond today. At the same time, we must provide direct S&T operational support today. Finally, we must deliver to users the technical capabilities that anticipate and address the most critical gaps in operational effectiveness.

## FOCUSING THE S&T INVESTMENT: SCENARIO-BASED RISK ASSESSMENT AND GAP ANALYSIS

In terms of anticipating the most critical gaps, we have adopted an all-hazards scenario-based methodology for risk assessment and gap analysis. A couple of examples of the scenario (or perhaps more appropriately, the vignette) are shown in the bottom of the slide. As I have noted earlier, while terrorism is a substantial concern, the national emergency management system must be capable of addressing a wide range of threats.

## PUBLIC SAFETY AND SECURITY: CROSS-CUTTING S&T ISSUES

We have identified four cross-cutting S&T issues, many of which I am sure will resonate with the defence science community. First is the challenge of situational awareness by decision makers across the emergency management system. You will see that many of the challenges are common to the challenges in realizing the promise of network-enabled operations for the military.

Second is developing a system-of-systems perspective, in the context of better understanding interdependencies, and in supporting the ability to conceive, design, model, acquire and evolve national capabilities.

Third is exploiting the potential of modeling and simulation, not only to enable the delivery of S&T, but also to support decision makers.

Finally is the issue of interoperability across the system-of-systems and applying S&T to removing bottlenecks.

## CANADA – US PUBLIC SECURITY TECHNICAL PROGRAM: COLLABORATION PRIORITIES

Against this backdrop, this slide provides an overview of the current priorities for S&T collaboration that Canada and the US have jointly identified in each of the PSTP's investigation areas. I would expect that

many of these will resonate with priorities identified across the NATO nations, and I will be interested in learning of the solutions being discussed in the course of this symposium.

## S&T FOR COUNTER-TERRORISM: SUMMARY

I can summarize with two points. First, in addressing the public safety and terrorism threats to the NATO nations I believe that the defence science community has much to offer. However, it is prudent to first invest the effort to ensure we intimately understand the requirement and the customer. Secondly, I believe that significant opportunities exist for S&T to inform, enable and respond to the needs of the national public safety emergency management and crisis response system. In this regard, I see your SCI symposium as both timely and relevant, and wish you the best for a productive meeting.


# Science and Technology for Countering Terrorism at Home and Abroad – Perspectives on the Key Challenges

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Defence Research and Development Canada

Recherche et développement pour la défense Canada

Canada

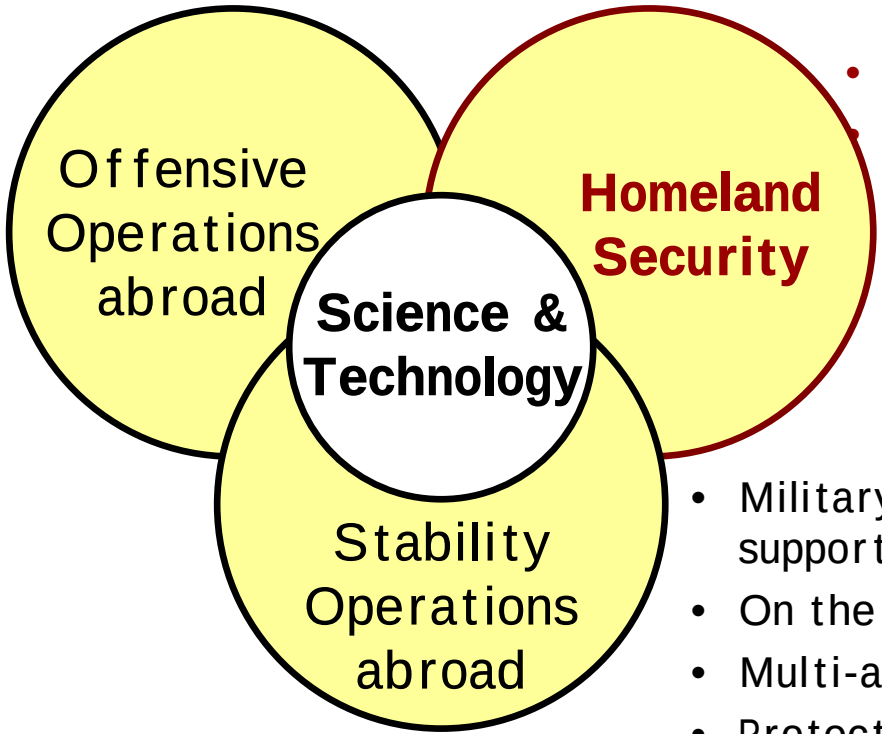
# Context

# The Complexity of the Defence Context is Growing …

- Failed States / Non-State Actors
- Operations in Complex Terrain
- War on Terrorism
- Stability Operations
- Asymmetric Threats
- Suicide Bomber
- Homeland Security
- Defence, Diplomacy and Development linkages
- Defence Transformation versus Sustainability Imperatives
- Etc…

# S&T for Counter-Terrorism: Perspectives

- Military in the lead
- On the offence
- Coalition
- Protection of the force
- Rules of Engagement

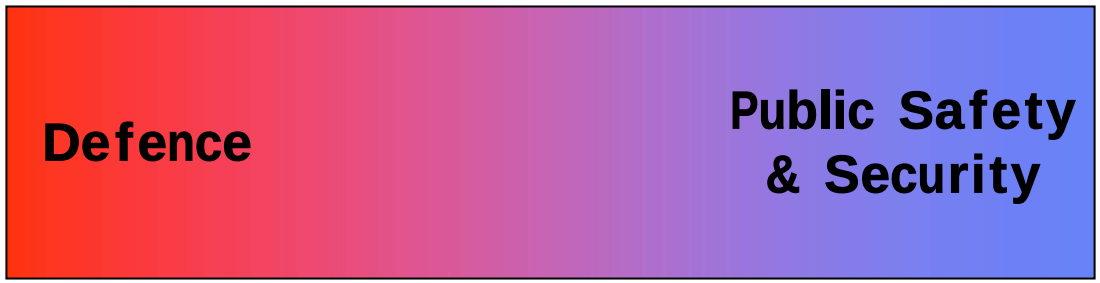



- Military in a support role
- On the defence
- Multi-agency / multi-jurisdictional
- Protection of the public
- Legislative framework

- Military in both lead and support roles
- On the defence
- Multi-agency & Coalition
- Protection of the public and the force
- ROE & Legislative framework

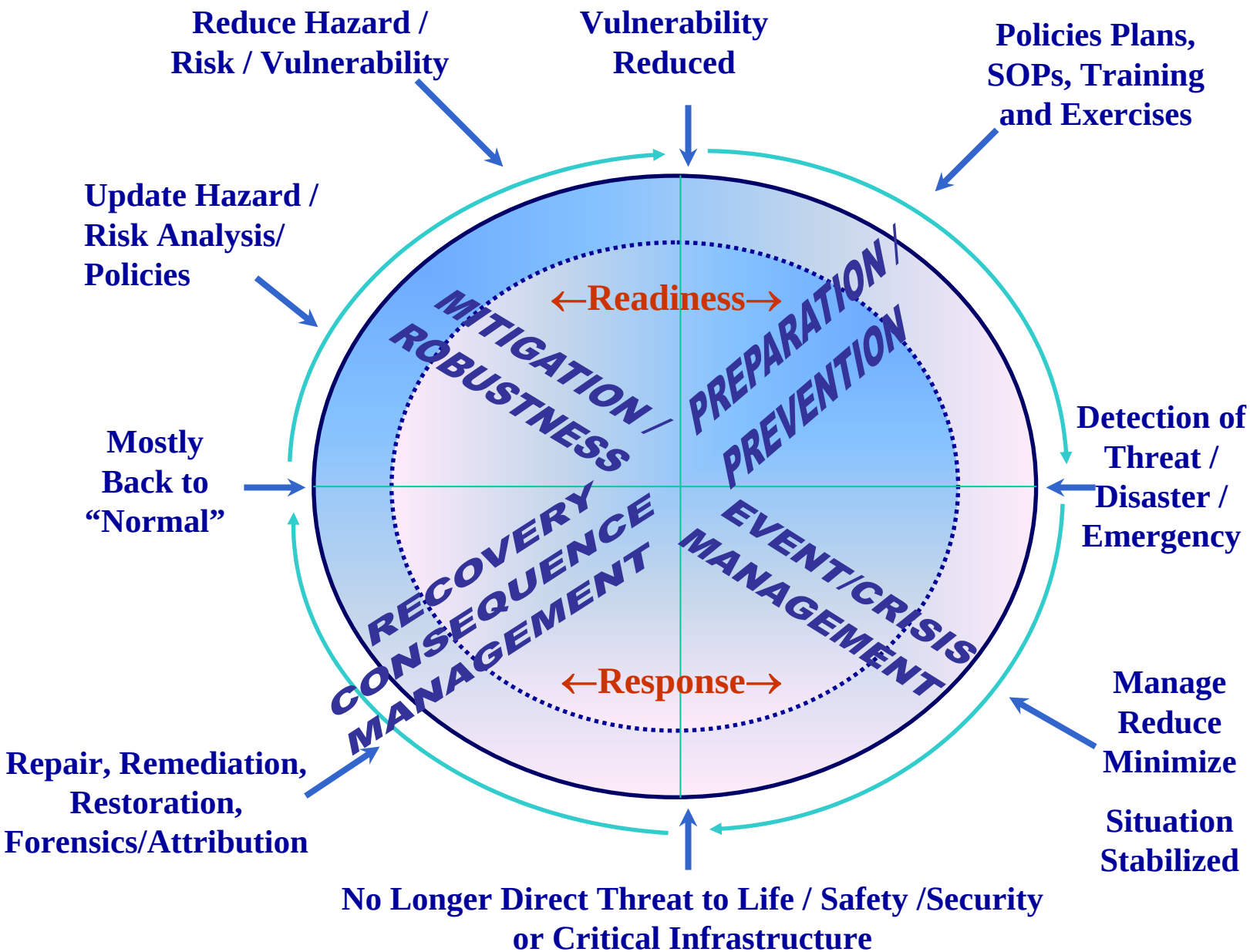
# The National Security Spectrum

Security Mandate Spectrum




Science and Technology
Dual-Use Opportunities

# Public Safety and Emergency Preparedness Framework



# Counter-Terrorism through the Lens of the National Emergency Management and Crisis Response System

## System Attributes:

- System-of-systems
- All-hazards approach
- First-responder focused
- Legislative framework
- Multi-jurisdictional
- Multi-agency
- Distributed management and accountabilities
- Addresses multi-dimensional consequences

# Characteristics of High-Consequence Public Safety and Security Events

Characteristics exhibited simultaneously, very likely internationally:

- The event simultaneously exercises all levels of government and cuts across authorities and responsibilities (inherently inter-agency).
- Crisis management and consequence management are intertwined.
- The event has high impact across multiple dimensions: casualties/ economic/ political/ environmental/ public confidence/ national infrastructure

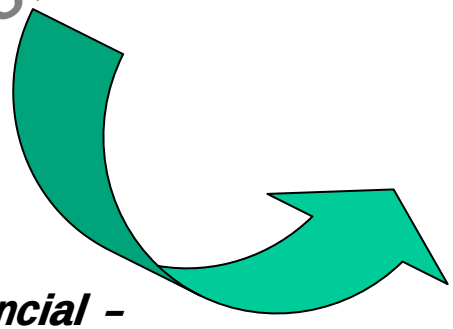
# Canadian Public Safety and Security S&T Initiatives

# Canadian Federal Public Safety and Security Strategy

Objective: Enhance public safety, national security and emergency preparedness through a robust emergency management system, encompassing

- Detection
- Mitigation
- Preparedness
- Response
- Recovery

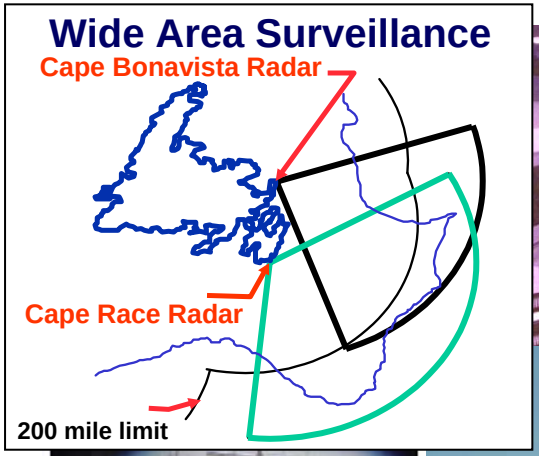
Science and Technology



***Federal – Provincial – Territorial - Municipal coordination***

Key Initiatives

- National Security Policy
- Canada Public Health Agency
- Government Operations Center
- National Exercise Plan
- National CBRN Strategy
- Cyber Incident Communication System
- National Disaster Mitigation Strategy
- Maritime, Air, Land Border Security Enhancements




# Maritime Security Technology Investments

## High Frequency Surface Wave Radar

- Operationalize 2 Defence R&D Canada Technology Demonstration sites in Newfoundland
- Implement 5 additional radars on Canada's east and west coasts

## Technology Demonstration Objectives:

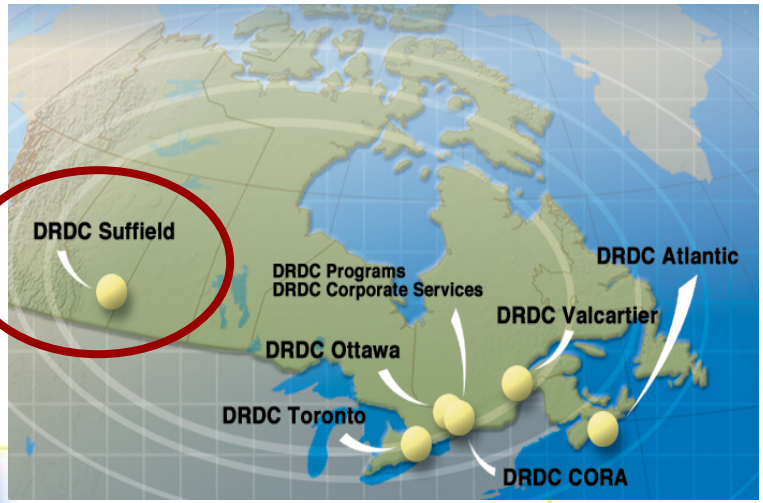
- Prove HFSWR technology by demonstrating its capability in a coastal surveillance role
- Assess the operational utility of the technology with Navy and Maritime Security communities
- Identify and progress the resolution of technical issues affecting system technical and operational performance.

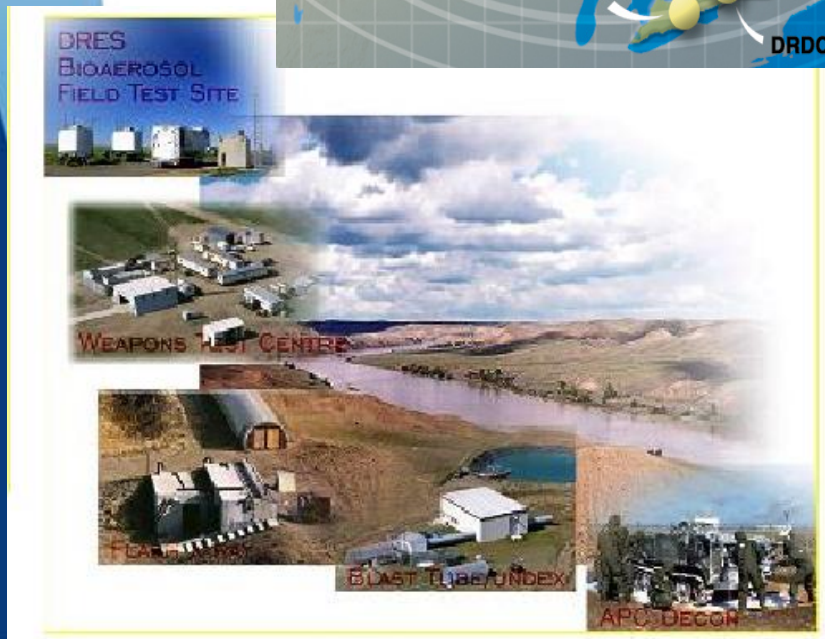
## Key outcomes:

- Demonstrated ability to detect and track ships and aircraft at ranges up to 400 km
- Identified and addressed technical and operational factors influencing performance
- Demonstration sites at Cape Race and Cape Bonavista, Newfoundland being transitioned to operational use
- Established a viable industrial capability

# Counter-Terrorism Technology Centre

Co-located with DRDC Suffield




Centre of Excellence for:

- CBR live-agent First Responders' training
- CB forensics support to national emergencies
- CBR equipment evaluation and testing

CRTI-IRTC

# CBRN Research and Technology Initiative

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WWW.CRTI.DRDC-RDDC.GC.CA

Canada

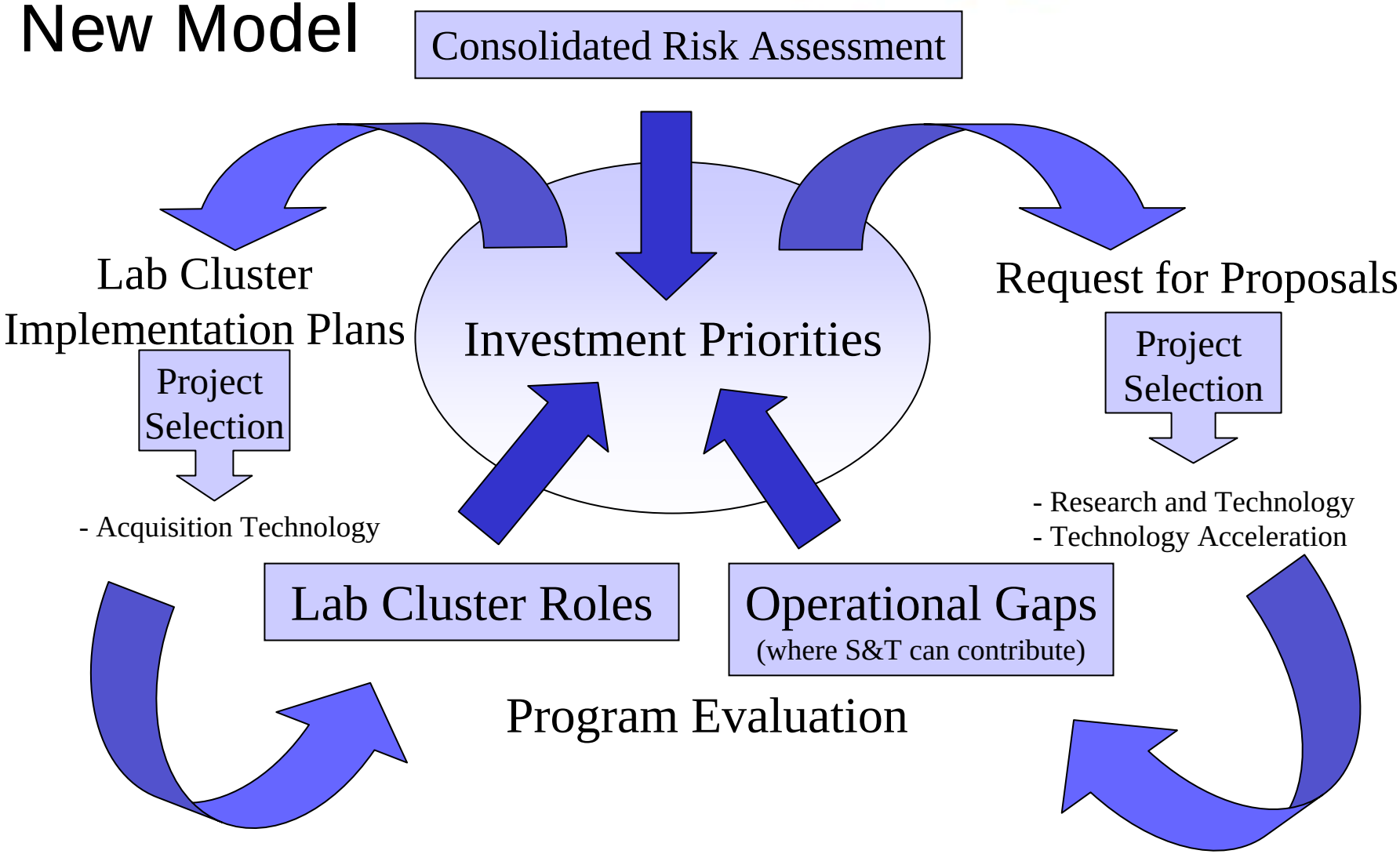

# CRTI Mandate

- $170M new funds over 5 years
- Launched May 2002
- **Mission**: to strengthen Canada's preparedness for, prevention of, and response to a CBRN terrorist attack through new investments in science, research, and technology capacity
- **Scope**: CBRN terrorist threats against people in urban areas and enclosed spaces, food, water, agro-systems, and critical infrastructure


# New Approach to Federal S&T in Canada

- Leadership from the federal science community to address national priorities
- Lab Clusters linking to operational communities for improved response
- Single competitive program linking federal S&T, academia, industry, and allies
- Competitive project selection with outcomes targeting broad response communities

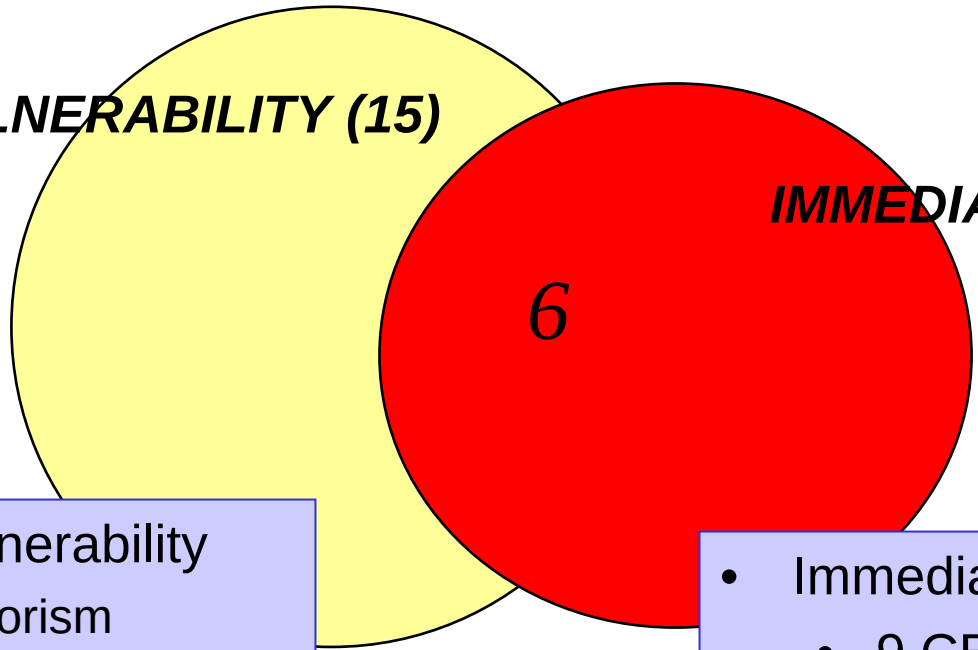
# New Model


Consolidated Risk Assessment
Lab Cluster Implementation Plans
Project Selection
- Acquisition Technology
Investment Priorities
Request for Proposals
Project Selection
- Research and Technology
- Technology Acceleration
Lab Cluster Roles
Operational Gaps
(where S&T can contribute)
Program Evaluation

# Consolidated Risk Assessment
## *53 Scenarios*

| | Target | | | | | |
|---|---|---|---|---|---|---|
| Hazard | People (Cities/ Enclosed Spaces) | Critical Infrastructure | Food/Consumer Products/Water | | Agro-System & Environment | |
| | | | Food Consumer Products | Water | Animals | Plants |
| Biological | 8 | 2 | 1 | 1 | 4 | 4 |
| Chemical | 11 | 2 | 2 | | 2 | 1 |
| Radio-Nuclear | 10 | | 5 | | | |

# Intelligence Judgment




- Extreme Vulnerability
  - 2 CB Terrorism
  - 6 Agro-terrorism
  - 7 R/N

- Immediate Risk
  - 9 CB Terrorism
  - 2 agro-terrorism
  - 3 R/N

# Public Safety and Security Science and Technology Challenges

# Canada-US Public Security Technical Program: Collaboration Focus

## CBRNE

Capabilities to prevent, prepare for and respond to CBRNE threats to public security, whether derived from terrorist or criminal activity, natural causes or accidents.

## Critical Infrastructure Protection (CIP)

The robustness, reliability and protection of physical and IT facilities, networks, services and assets, which if disrupted or destroyed would have a serious impact on the health, safety, security, economic well-being or effective functioning of the nation.

## Disruption and Interdiction (DI)

The ability to identify and stop terrorists/criminals and their activities, including surveillance, monitoring, disruption and interdiction of their activities as pertaining to border and transportation security.

## Systems Integration, Standards, and Analysis (SISA)

The performance, integration and interoperability of national and international public security and emergency management capabilities and supporting systems, including the enabling standards, and vulnerability and systems analyses.

# Challenges in Public Safety and Security S&T Delivery

The S&T Community must:

- identify who are the decision makers, what decisions they make, and how technology assists them in decision-making
- anticipate threats and vulnerabilities in order to allow a shift from reactive to proactive S&T delivery
- inform, enable and respond to national public safety and security strategies that establish future direction
- provide direct S&T operational support
- deliver to users the technical capabilities that anticipate and address the most critical gaps in operational effectiveness

# Focusing the S&T Investment: Scenario-Based Risk Assessment and Gap Analysis

| | Terrorism/ Crime | Accident | Natural Causes |
|---|---|---|---|
| CBRNE | | | |
| Critical Infrastructure | | | |
| Disruption and Interdiction | | | |
| Emerging Threats | | | |

| e .g. CBRNE | | | |
|---|---|---|---|
| Non-contagious pathogen release (Anthrax) | X | X | X |
| Toxic Industrial Material (open air wide area release) | X | X | |

# Public Safety and Security Cross-Cutting S&T Issues - 1

- Situational Awareness
  - addressing the data, communications and information management challenges
  - adaptation to the needs of the decision maker
  - understanding the human dynamic
  - enabling distributed decision making and coordinated action

- System-of-Systems Perspective
  - understanding the interdependencies of international, national and local capabilities
  - supporting the ability to conceive, design, model, acquire and evolve national capabilities

# Public Safety and Security Cross-Cutting S&T Issues - 2

- Modeling and Simulation
  - M&S to support the ability to identify, develop and implement S&T solutions
  - M&S to support decision makers from strategy to emergency management operations

- Interoperability
  - identifying the interoperability bottlenecks at the level of the emergency management system-of-systems
  - delivering improvements to standards, protocols and operating procedures

# Canada – US Public Security Technical Program: Collaboration Priorities

Collaboratively deliver S&T solutions that advance our national capabilities to prepare for, prevent, respond to and recover from high-consequence public safety and security events

## CBRNE

- S&T interoperability for operational reach-back
- Technologies for early event and critical point detection
- Immediate Consequence Management techniques for chemical hazards
- Methodologies and protocols for recovery and long-term consequence management

## Critical Infrastructure Protection

- CIP decision-support systems
- Standardized vulnerability and risk assessment
- New design architectures and retrofits
- Secure network architecture and management
- Cyber event management
- Network analysis and modeling

## Disruption and Interdiction

- Reduction of vulnerability of people, conveyances and cargo
- Officer safety
- Knowledge discovery and dissemination for domain awareness & surveillance
- Detection and alert to suspicious events
- Determination of intent
- Disruption of human threats through course-of-action selection
- Seamless communications interoperability during DI
- Effective targeting and intervention

## Systems Integration, Standards & Analysis

- Future Public Safety and Security integrated capabilities
- National risk and vulnerability assessment capabilities
- Methodologies for Public Security decision making
- Interoperability of bi-national capabilities
- Integration and uptake of PSTP technologies

# S&T for Counter-Terrorism: Summary

- The defence S&T community has much to offer – however, it must also ensure it understands the requirement and the customer

- Significant opportunities exist for S&T to inform, enable and respond to the needs of the national public safety emergency management and crisis response system

DEFENCE R&D DÉFENSE

# Discussion