DEFENCE R&D DÉFENSE

S&T Support to the Canadian Small Arms Replacement Program

Presentation to NDIA, International Infantry & Joint Services Small Arms Systems Symposium, Exhibition & Firing Demonstration

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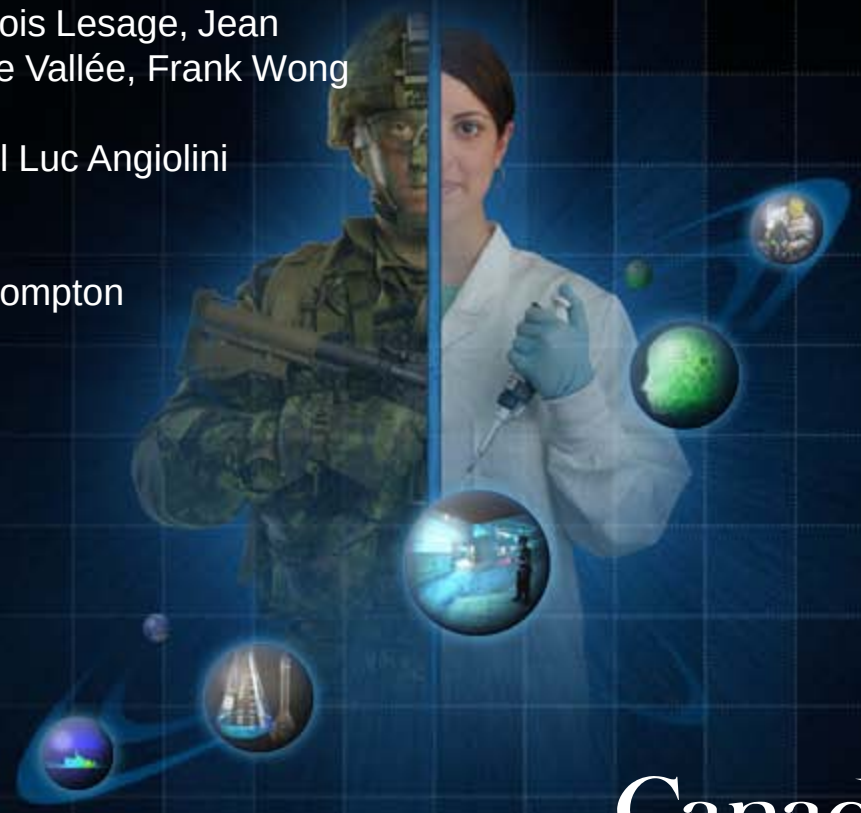
Colt Canada: Blaine Groves, Brenton Teed, Dave Compton

GD-OTS Canada: André Bernier

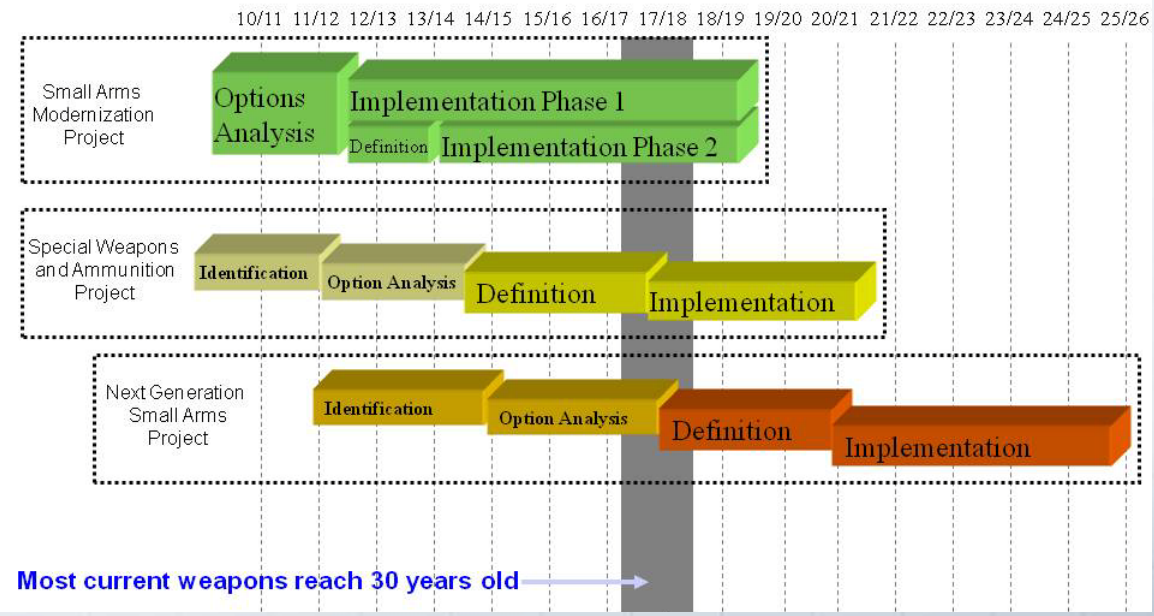
Indianapolis, IN, May 23-26, 2011



Small Arms Replacement Program

Three Separate Projects

- Small Arms Modernization (Options Analysis Approved)
  - Replace pistol, HMG, Ranger rifle, M203, enhance current assault wpns, provide lighter weight ammunition and improved weapon sights, sharpshooter capability, baseline weapon accessories
- Special Weapons and Ammunition
  - PDW, foreign wpns, boarding party wpns, combat shotgun/breaching
- Next Generation Small Arms
  - Replacement of assault weapons & machineguns



Major S&T Activities Supporting Small Arms Replacement Program

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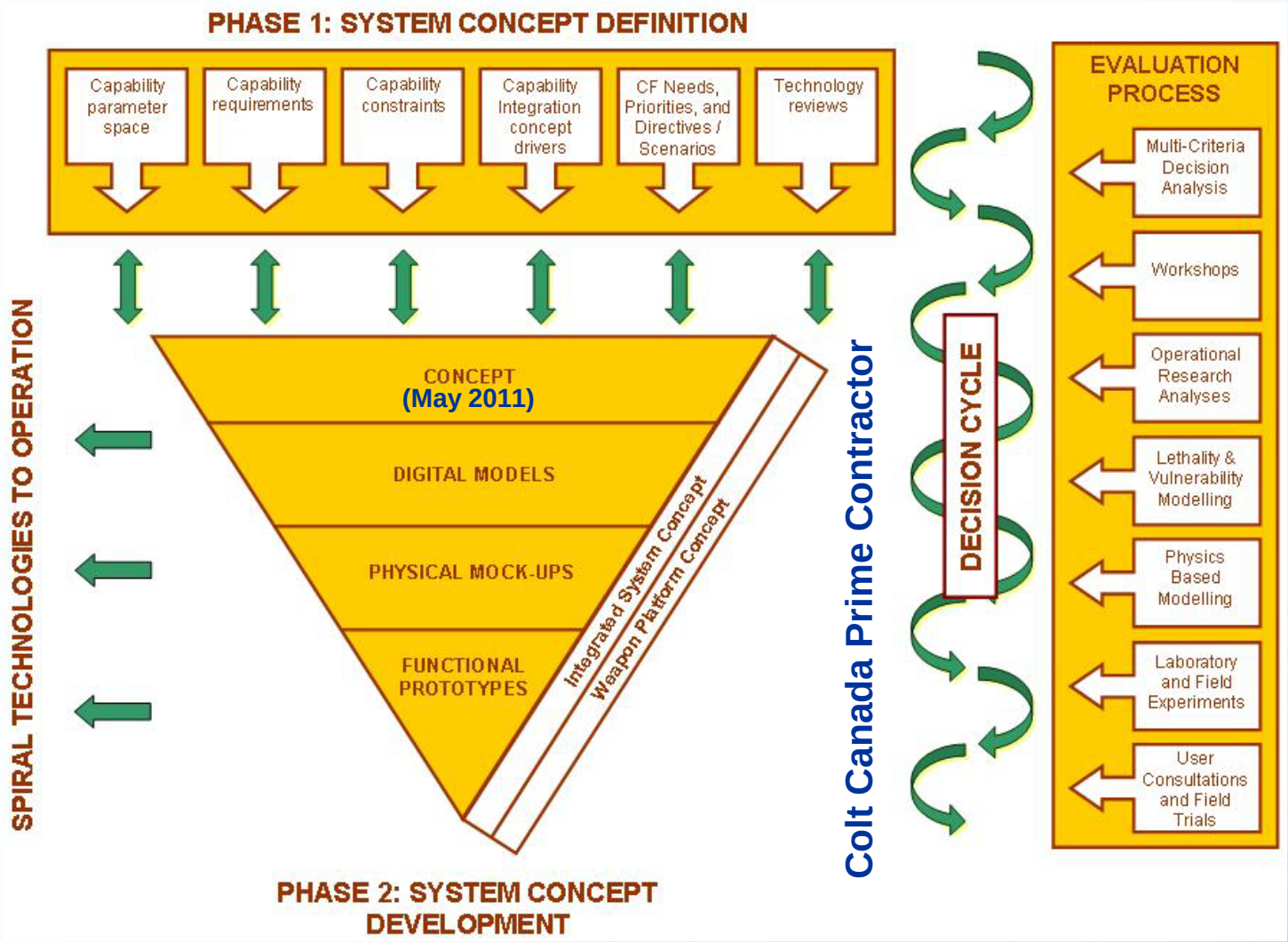
Statement of Operational Requirements (SOR) Development Effort

- Objectives
  - Assist in the development of science-based operational requirements for CF man portable future direct fire capability (FDFC)
- Components
  - Soldier Integrated Precision Effects System (SIPES) Technology Demonstration Project to explore new technologies and system integration issues (***financed***)
  - Small Arms SOR Development Program (***adhoc financing***)
    - Applied Research Projects (ARP) to build up knowledge and technology base
    - Engineering Development Models (EDM) to integrate the results of SIPES, ARP, and SSTRM in TRL 8 level systems

Soldier Systems Technology Road Map (SSTRM)

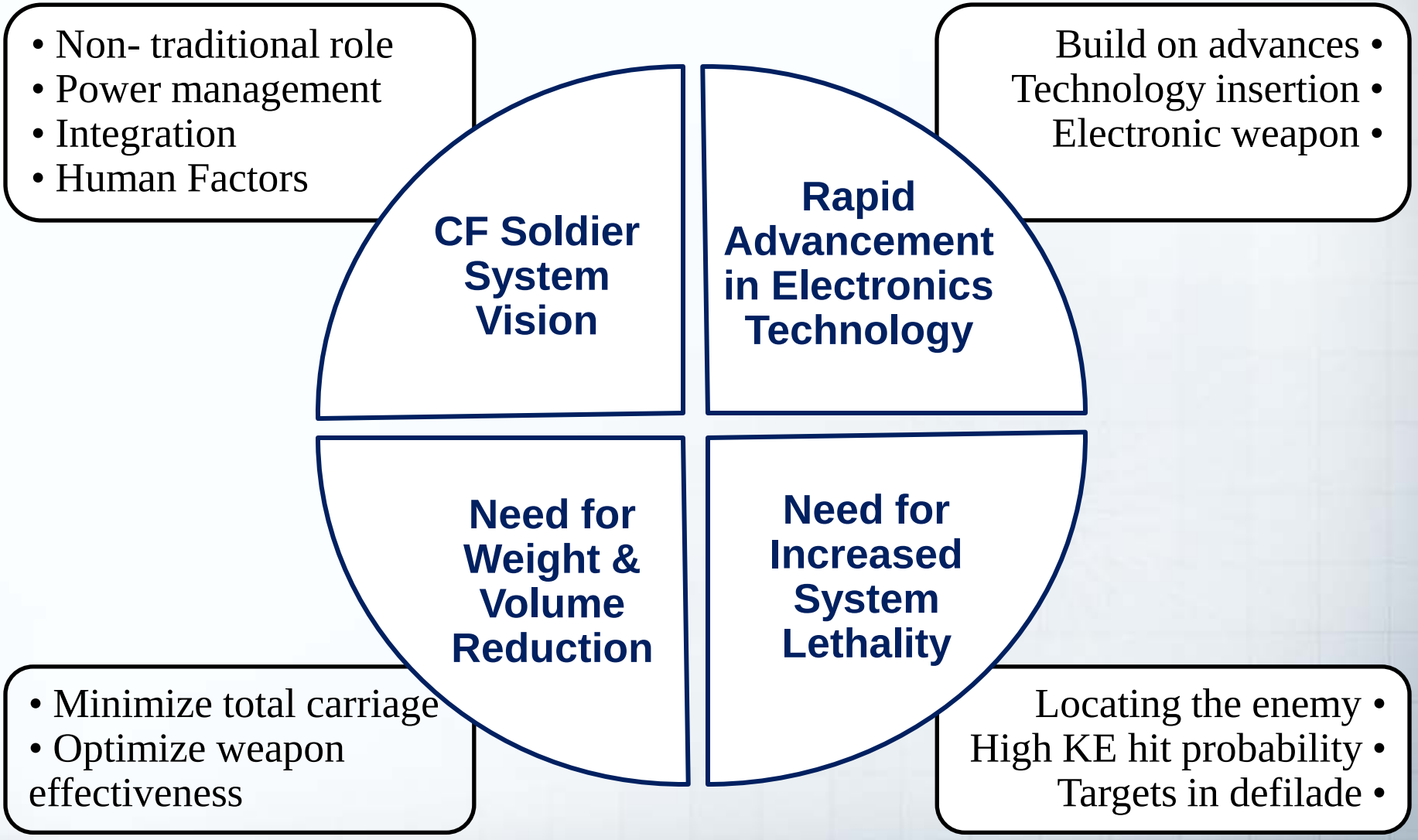
- Objectives
  - To develop a comprehensive technology roadmap (TRM) that will support the Canadian Forces soldier modernization effort using Industry Canada TRM framework: a fair and transparent process open to all stakeholders (***financed***)
  - Much larger than soldier weapons

SIPES Technical Strategy



March 2014

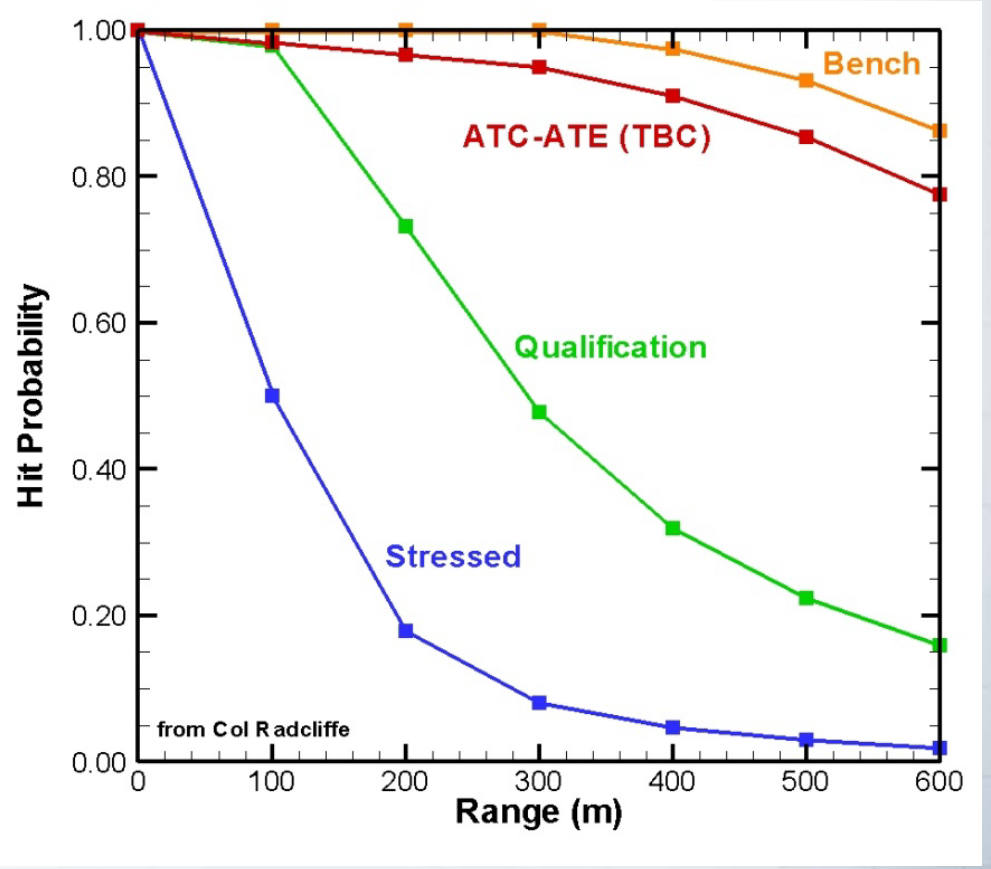
Integrated IC Weapon System Vision: Key Ideas Influencing the and Their Implications



Integrated IC Weapon System Vision: Electronic Ignition and ATC / ATE

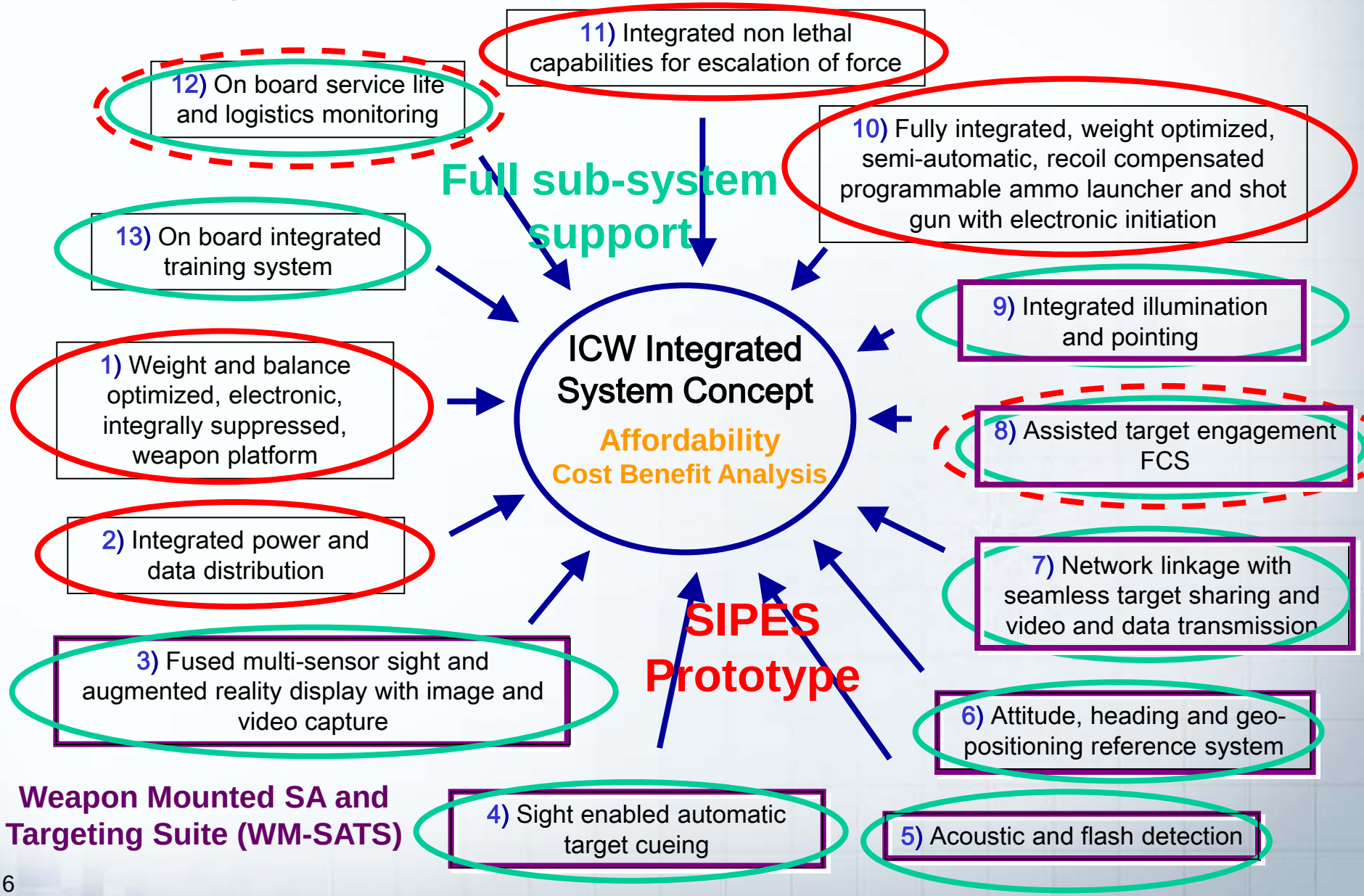
A Revolutionary Combination

- Every soldier becomes a sharpshooter
- All lethal shots can be head shots
- Suppression is no longer about volume of fire
- Reduces risk of non-lethal shots being lethal



ATC / ATE: Automatic Target Cueing / Assisted Target Engagement

SIPES Integrated IC Weapon System Vision: A Working Conceptual Framework



Concept Development: Process

Objective

- To develop a single physical layout (preliminary design concept) for the SIPES prototype based on the Integrated Weapons System Vision
- Ensure a common mental model of team

Process

- Concept Development Workshop
  - Canadian Forces personnel, Industry and DRDC
  - Proposed four layouts for future CAD design and rapid prototyping
- Evaluation of Preliminary Design Concepts
  - CAD modelling and rapid prototyping
  - Human Factors focus group based evaluation
- Preliminary Concept Review

Concept Development: Concepts

Option	A	B1	B2	C	D
Designation	Integrated Conventional	Hybrid Conventional	Hybrid Conventional	Hybrid Bullpup	Modular Bullpup
Grenade Launcher	Over	Over	Under	Over	Over
Full Capability	No	Yes	Yes	Yes	Yes
Configurability	None	Partial	Partial	Partial	Full
Acceptability*	Greatest	Greatest	Greatest	Least	Least
Length	Medium	Medium	Longest	Shortest	Shortest
Weight	Lightest	Medium	Medium	Medium	Heaviest
Balance	Medium	Medium	Worst	Best	Best
Power / Data Efficiency	Highest	Highest	Highest	Highest	Lowest

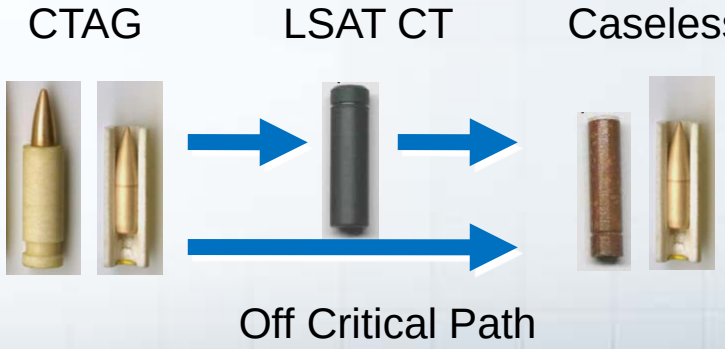
* Culture, Training, …

20 inch barrel for optimal muzzle velocity

Secondary effects module (shotgun, programmable ammunition of different calibers) for all options is based on Metal Storm technology

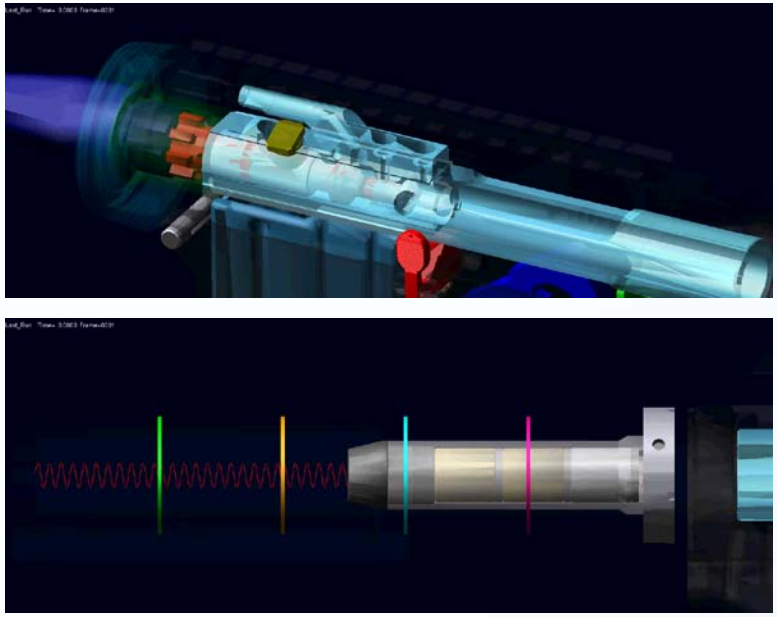
KE Ammunition and Weapon Mechanism

- Caseless electronically ignited ammunition has been removed from the critical path
- **LSAT CT ammunition** has been selected
  - Baseline will be with percussion primer
  - Potentially an electronic primer version in small quantity
- Weapon initiation mechanism
  - For demonstration purposes, baseline will be **electromechanical** with no mechanical backup
  - A **completely electronic** version will be designed and potentially built
    - Swap out electromechanical mechanism for electrode
- Weapon mechanism
  - LSAT ammunition provides potential of both aft and forward feed

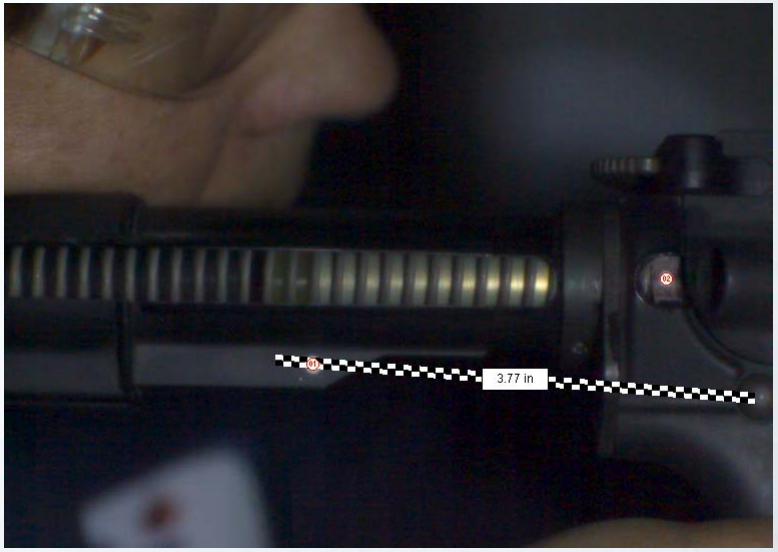


Weapon Mechanical Characterization

Modelling



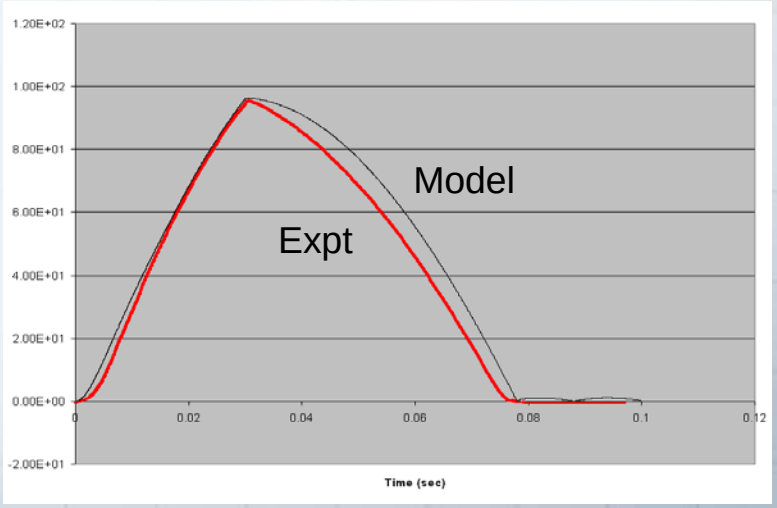
Experimental



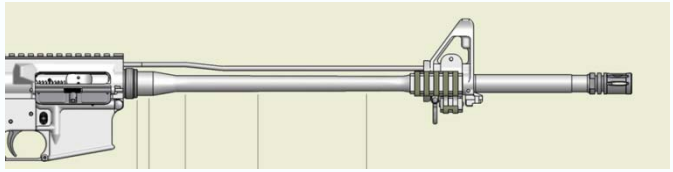
High speed video taken of the C7A2 bolt, bolt carrier and buffer body to acquire time-varying position and speed data.

Spring constants and energy dissipation factors estimated.

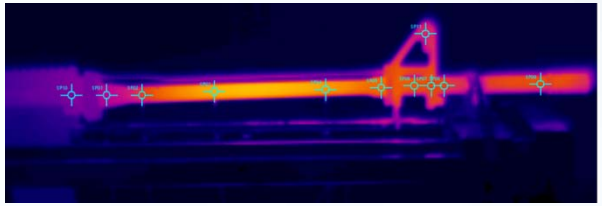
Experimental and analytical results compared to confirm validity of modeling technique.



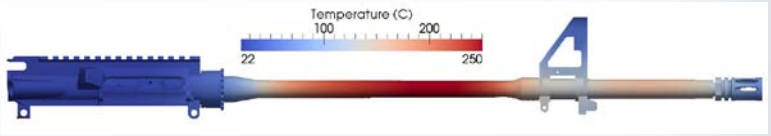
Weapon Thermal Characterization



T1 T2 T3 T4



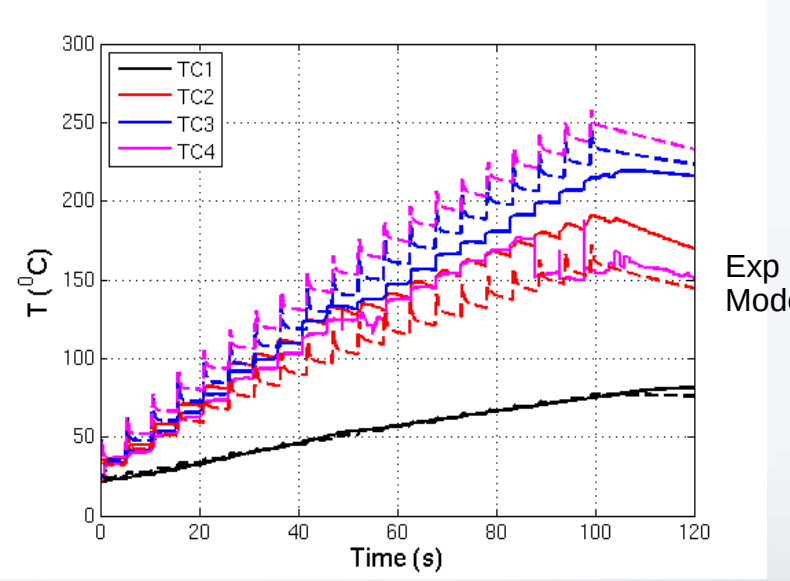
FLIR



After 60 rounds (104.2 s)

Modelling

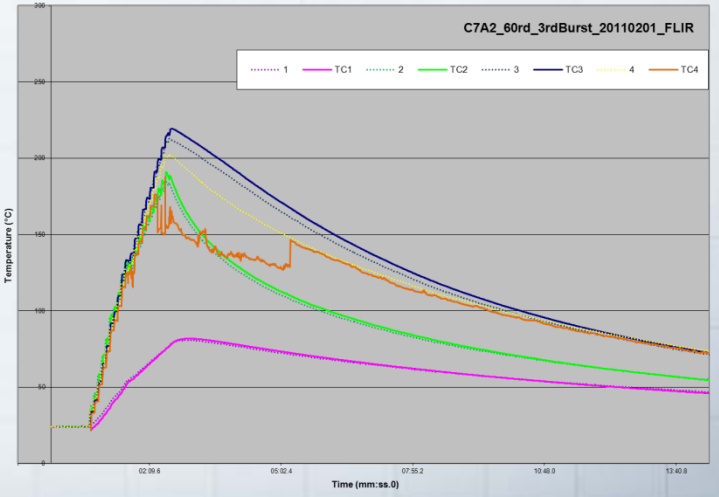
- Global rates of heating and cooling seem to be in good agreement; Temperature underestimated / overestimated depending on position
- Further model refinement: Distribution of the gas temperature and/or heat transfer coefficient inside the gun barrel during firing
- Simulation capability to be used in new weapon concepts



Exp : solid
Model: dash

Experimental

- FLIR and thermocouple measurements
- Thermocouple problems



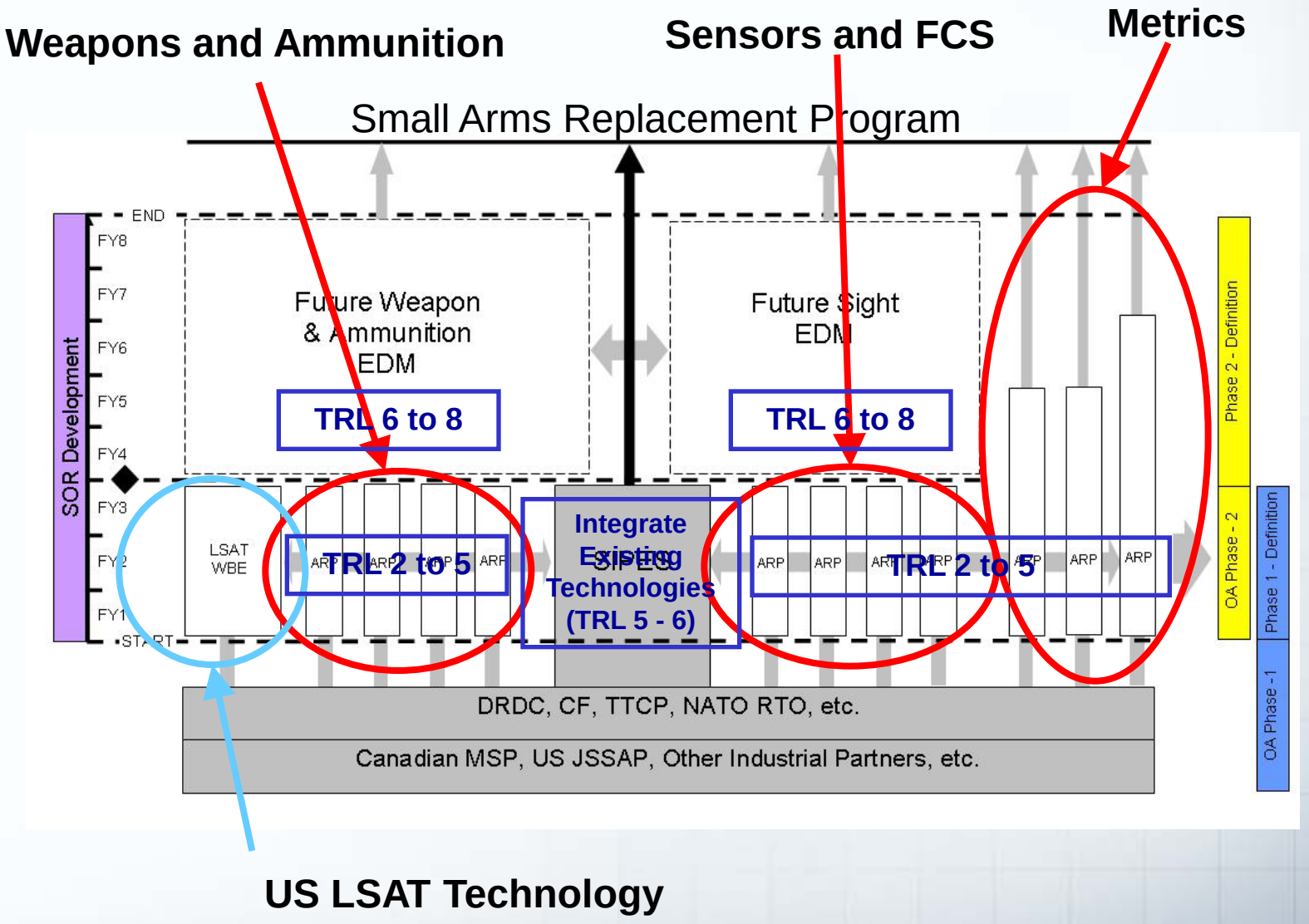
60 rounds with 3 shot bursts every 5 secs

Power and Data Rail

- Colt Canada under a separate effort, and as part of the NATO effort, is developing a powered rail
  - Centralized power
  - Data and video
  - FCS control
- This will be integrated into the SIPES weapon concept as opposed to retrofitting versions that are being developed for existing weapons.
- The power system will be capable of receiving power from soldier worn power

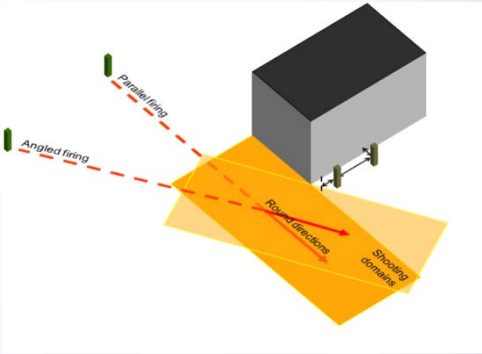
For Illustration

Small Arms SOR Development Program



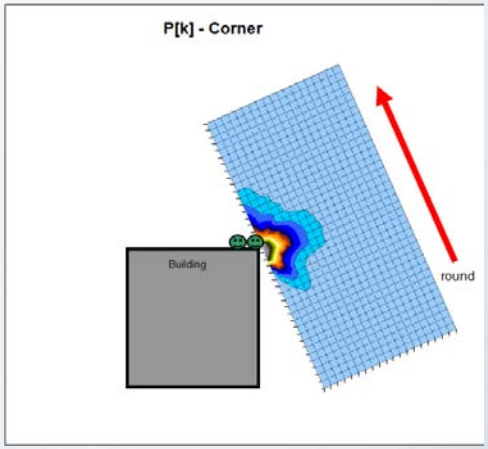
Evaluation of Programmable Ammunition

Corner



Objectives

- Estimate and compare the effectiveness of various calibers and designs of AB grenade solutions against hidden targets (e.g. defiladed position) using different scenarios.
- Measure the advantage provided by ABM with respect to PD grenades



Methodology

- Modeling of the rounds and their effects for different scenarios
  - Using public domain information.
  - Using DRDC generated experimental information
- Experimental systems analyses

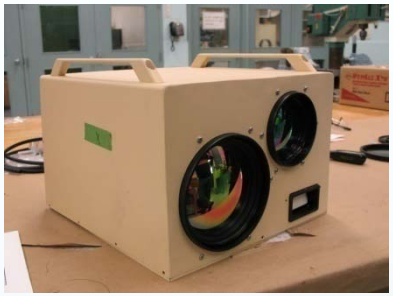
Automatic Target Cueing (ATC)

Objective

- Develop a weapon sight with automatic targeting capabilities (ATD/ATR)

Status

- Algorithm is capable of, in real time,
  - Detecting dim and small moving targets (ex.: humans) of one to two pixels with very low false alarms
  - Detecting, recognizing and tracking humans and vehicles
  - Capable of recognizing and tracking human heads with both sight and target moving
- Proven in larger format hardware
- Next step is sight size format



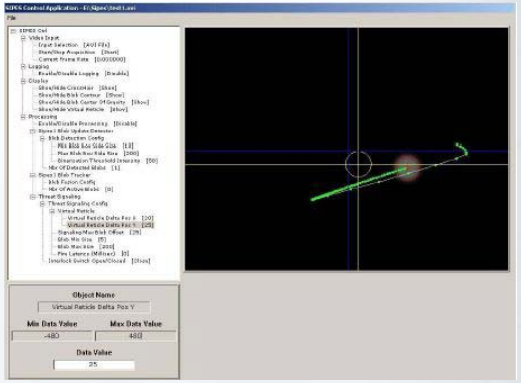
Assisted Target Engagement (ATE): Concept Test Bed

Objective

- The objective of the ATE concept is to significantly increase hit probability and weapon effectiveness

Status

- A concept test bed was developed and preliminary tests performed using a LWIR sight
- In an operational system:
  - ATE will be combined with ATC
  - A multi-sensor sight would be used
- Prototype will need to be evaluated by Users



Blob detection and tracking system

AN/PAS-13B Heavy TWS mounted on a VEC91

Movable (X-Y) target

NATO head target

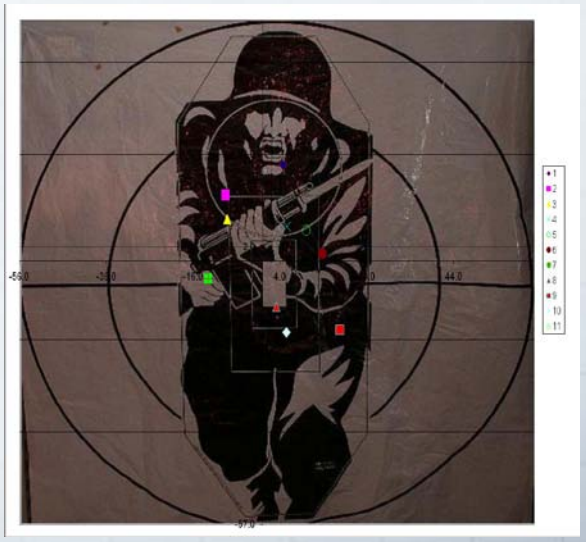
Canadian Forces Operational Shooting Program

Objectives

- Provide a baseline for evaluation of the ATE concept
- Understand training process and level of shooting proficiency of CF soldiers
- Convert the test requirements into scientifically usable parameters

Status

- Preliminary Pilot study at CFB Valcartier, Cambrai Range
  - Five soldiers +
  - PWT 1 to 3
- Test results are being analyzed by GD-OTS
  - Challenge: inadequate trials measurement equipment



Target Sharing

Objectives

- Develop the mathematical basis to estimate the pose (position, attitude) of a soldier's assault rifle using sensors appropriate for non-GPS accessible environments.
- Experimentally validate pose accuracy estimates for a selected set of COTS sensors

GlobalSat GPS
Microstrain IMU

Background

- Related to work done at DRDC in "Non-GPS Reliant Indoor/Urban Nav for Dismounted Soldier"

Way Ahead

- Catalog typical shooter movements and C7 positions where target sharing may be employed.
- Set up a vision-based tracking arena to measure the orientation of a representative C7 in earth-based coordinates

Acoustic Detection

Objective

- Characterize the performance and operational value of soldier and rifle mountable acoustic sensing systems (detector and software)

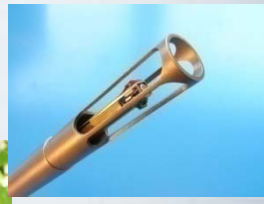
Technologies of interest

- Rifle Mounted Gunfire Locator, Ultra Electronics
- Boomerang Warrior-X, BBN Technolgies
- Early Attack Reaction Sensor (EARS), QinetiQ
- Soldier Wearable Acoustic Gunfire Detection (PILARw), 01dB MetraviB
- Acoustic Vector Sensors, Microflown Technologies

Status

- Acquisition phase

Acoustic Vector Sensors



SSTRM Process and Status

- Two Phases, Development and Implementation
- Objective of the Development Phase is to develop in collaboration with Industry/Academia-Government stakeholders a comprehensive technology roadmap using Industry Canada's framework and supporting the CF soldier modernization effort
- Implementation of the SSTRM 2011-2025 Action Plan is intended to engage a national collaborative effort to support the develop of soldier system solutions for the Canadian soldier of the future. An iPMO (interdepartemental project management office) will manage R&D proposals and offers from industry and academia.

http://soldiersystems-systemesdusoldat.collaboration.gc.ca/

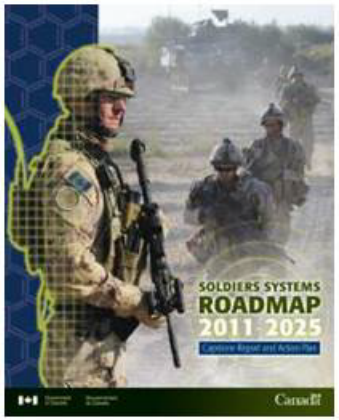
ICee

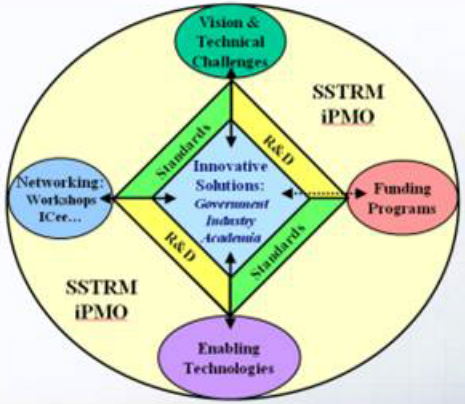
Capstone Report

Implementation

Domains/Workshops

- Power/Energy
- Lethal/Non-lethal
- C4I/Sensors
- PPE
- Human & Systems Integration





SSTRM Lethality Vision and Themes

Vision 2025

- To provide lightweight, effective, portable and integrated weapon system which provides scalable lethal and non-lethal effects, against a variety of targets at the desired range/conditions, minimizing collateral damage, and system physiological/cognitive burden

Themes Objectives

- Weapon platform – To provide an integrated weapon platform which will increase weapon effectiveness, provide scalable lethal and non-lethal effects against future protected and unprotected target spectrum
- Ammunition – To improve the terminal effects of weapons systems at all engagement ranges while significantly reducing weight and volume
- WM-SATS – To provide enhanced and accurate target detection, surveillance and hand-off using a Weapon-Mounted Situational Awareness and Targeting Suite (WM-SATS) with integrated ballistic solutions

Questions?

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