Technology Work Session for the South African Army; Hosted by the CSIR

PROTECTION

Threat and Detection

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Outline of presentation

- Threat analysis
- Explosive detection
  - Positioning
  - Principles
  - Performance characteristics
  - Applications
  - Technology scope

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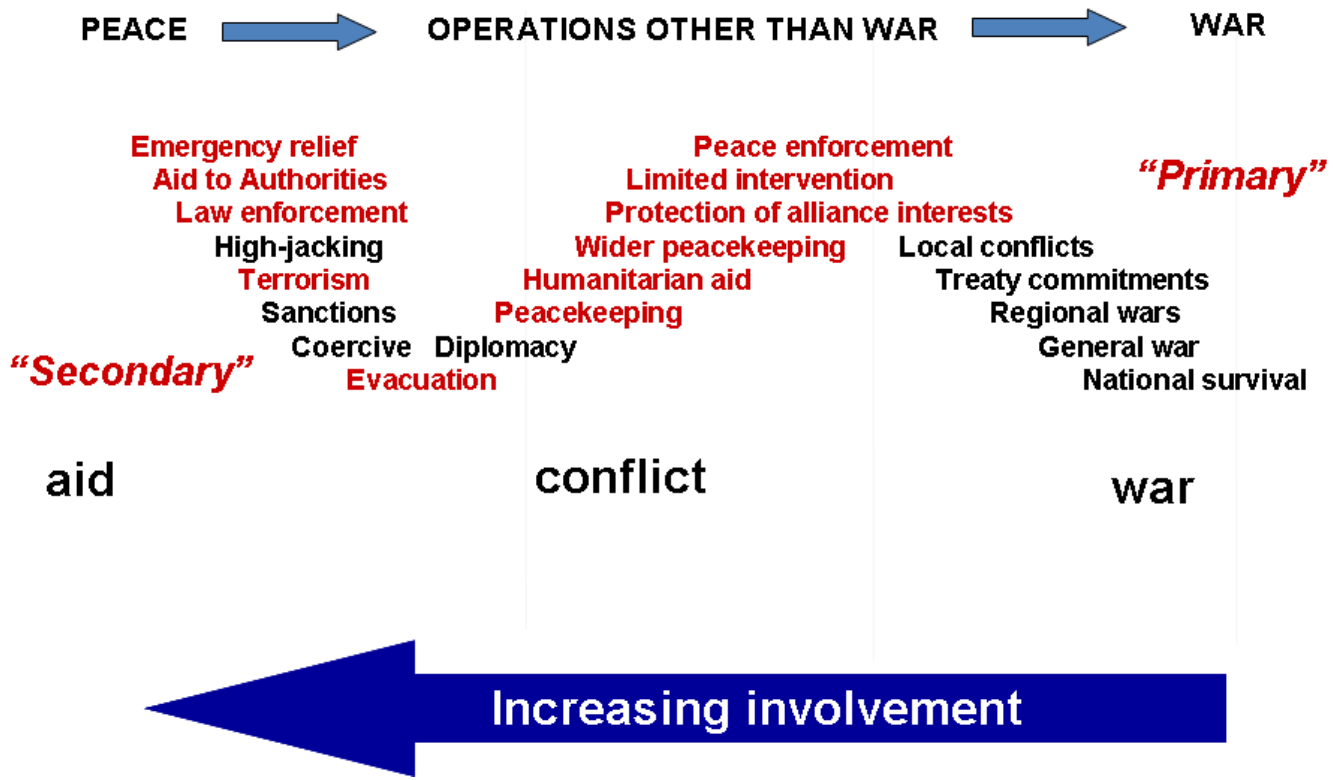
Threat Analysis

The Spectrum of Military Operations



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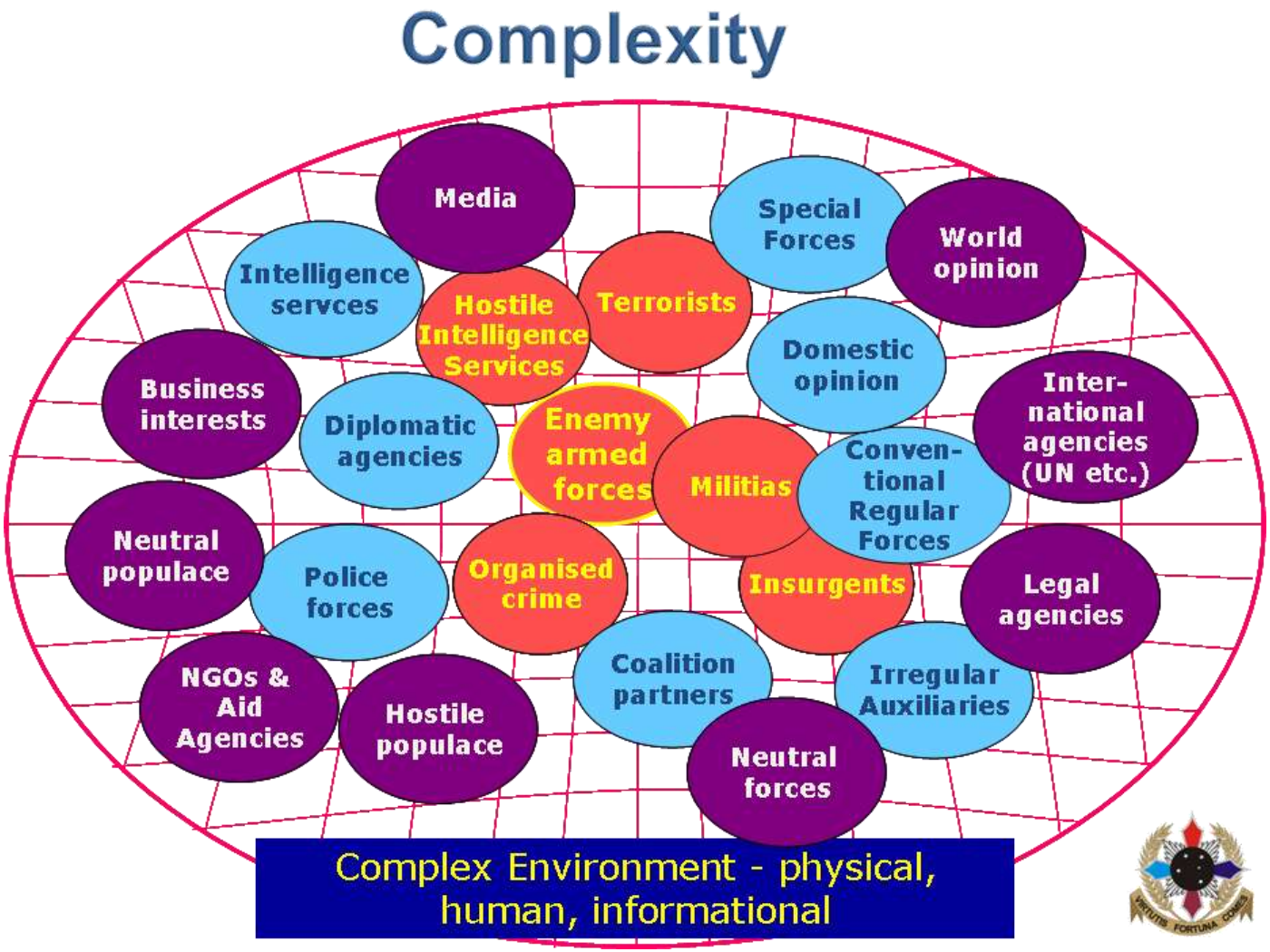
Threat Analysis



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Semi-conventional nature

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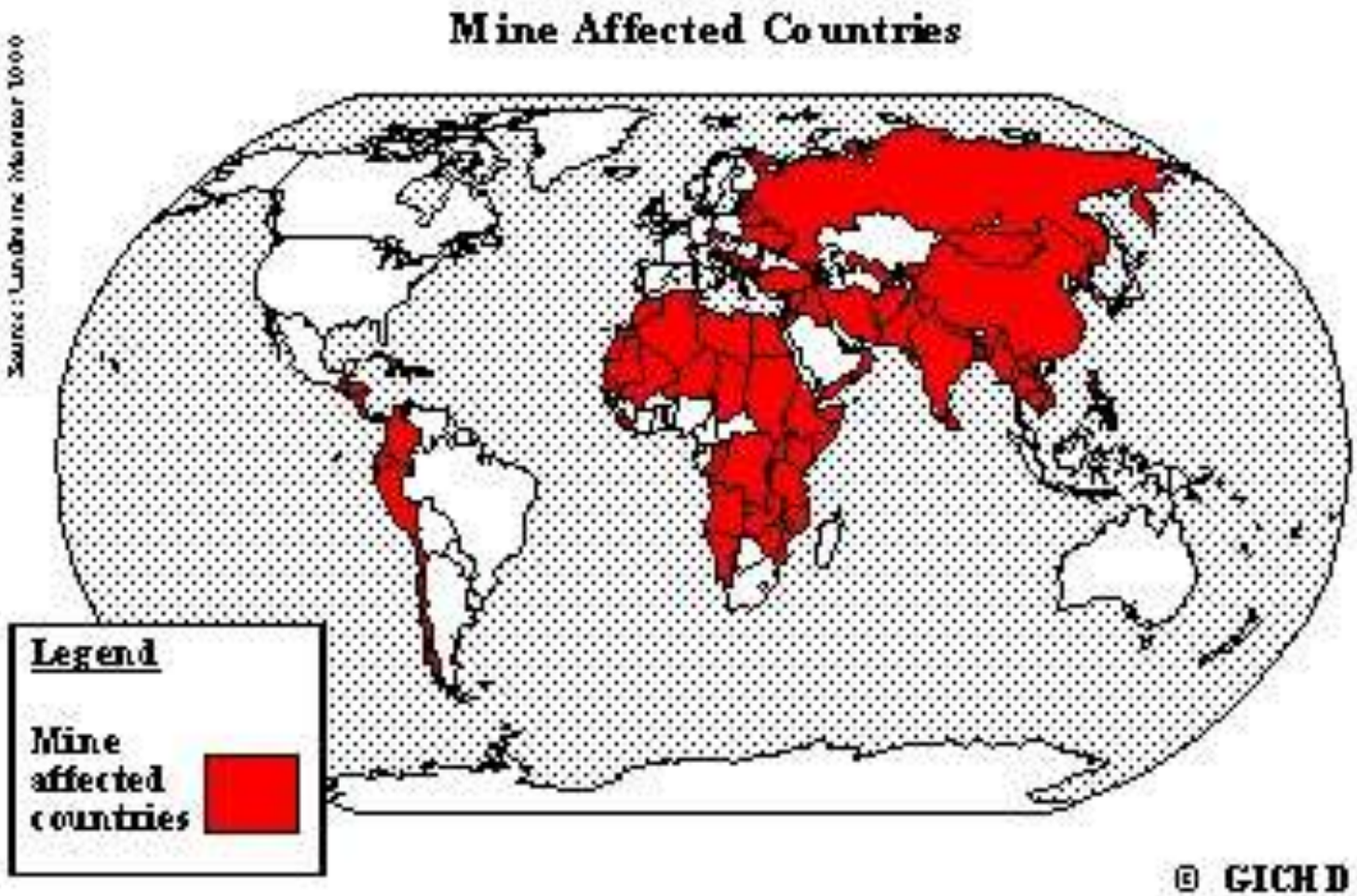
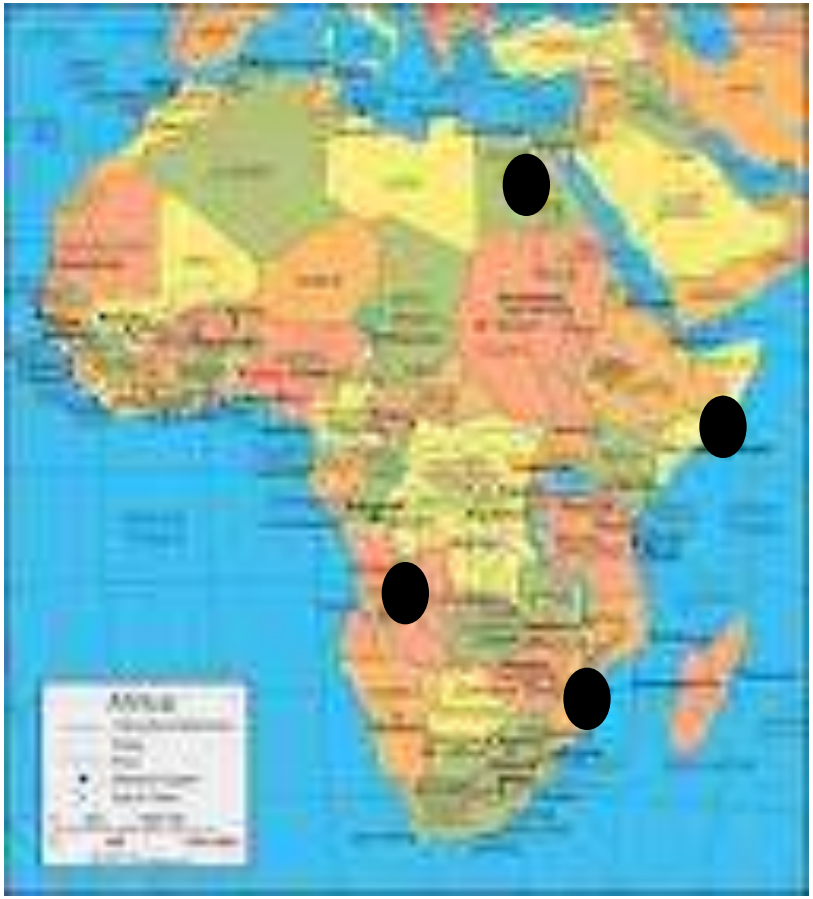
Asymmetrical Threat



Top Ten Mine Affected Countries



- Somalia – 1.0 million
- Mozambique – 3.0 million
- Bosnia-Herzegovina – 3.5 million
- Kuwait – 5 million
- Cambodia – 9 million
- Iraq – 10 million
- Afghanistan – 11 million
- Angola – 15 million
- Iran – 16 million
- Egypt 23 million

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Ammunition Dump Incidents

- Nigeria (Lagos) January 2002
- Mozambique (Maputo) January 2007
- Congo (Brazzaville) March 2012

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IED Sources

Explosive Remnants of war (ERW) | Commercial explosives

Mines

UXO

AXO

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Threat Levels

TL	Mines/UXO/AXO		IED/Booby trap	
	Description	**Examples**	**Description**	**Examples**
01	A/P mine (blast)	PMN, PMD-s, Type 72	Small blast type devices <200 g explosives	Letter and parcel bombs
02	UXO/AXO small size	Hand/rifle grenades, cluster bomblets	Small shrapnel type devices <200 g explosives	Booby trapped grenade
03	A/P mine shrapnel type	POM-Z, OZM-4,OZM-72, PROM-1	Directional shrapnel type devices	Improvised claymore, nail bomb
04A	A/T mine under wheel	TM-46, TM 57, TMA-3	Blast type devices 1 – 7 kg explosive charge	Container with 1 – 7 kg explosive charge
04B	A/T mine under hull/double & triple mines	TM-46, TM-57, TMA-3	Blast type devices 7 – 21 kg explosive charge	Container with 7 – 21 kg explosive charge
05	UXO/AXO medium size	60 – 120 mm mortars and artillery warheads to 155 mm	Mortars and artillery rounds used as main explosive charge in devices	Roadside bombs
06	A/T mine hollow charge	TMK-2, AT-4	Hollow charge warheads (RPG-7, M-40)	Roadside bombs for side-on attack against vehicles
07	A/T SFF	TMRP-6, TMRP-7, UKA-73	EFP type devices	Explosive charge with metallic platter
08	UXO/AXO large size	Sea mines, aircraft bombs (50 – 500 kg explosive charge)	Devices with 50 – 500 kg explosive charges	Vehicle bombs, culvert bombs
09	CBRN	CBRN warheads	Bulk chemicals	Chlorine, ammonia, Liquid petroleum gas

Asymmetrical threat increase

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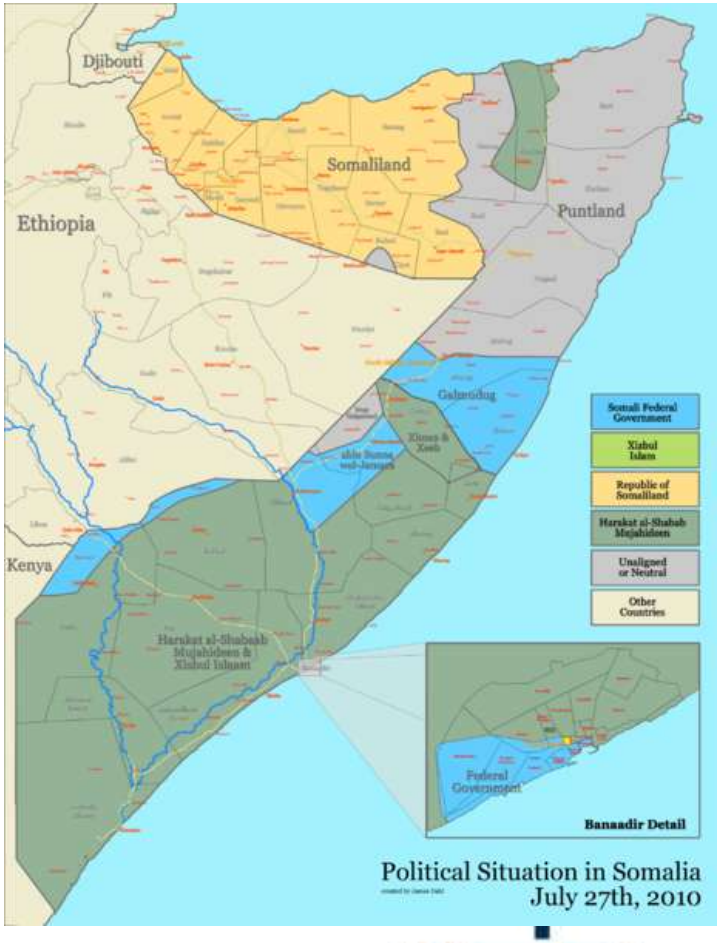
Somalia (2008/2009) AU intervention

- Period January 2008 to March 2009
- Force level 5250
- Casualties
  - Killed 22
  - Wounded 53
  - Total 77

- ERW incidents
  - Mines a/p 0
  - Mines a/t 3
  - UXO 3
  - AXO 6
  - IED 51



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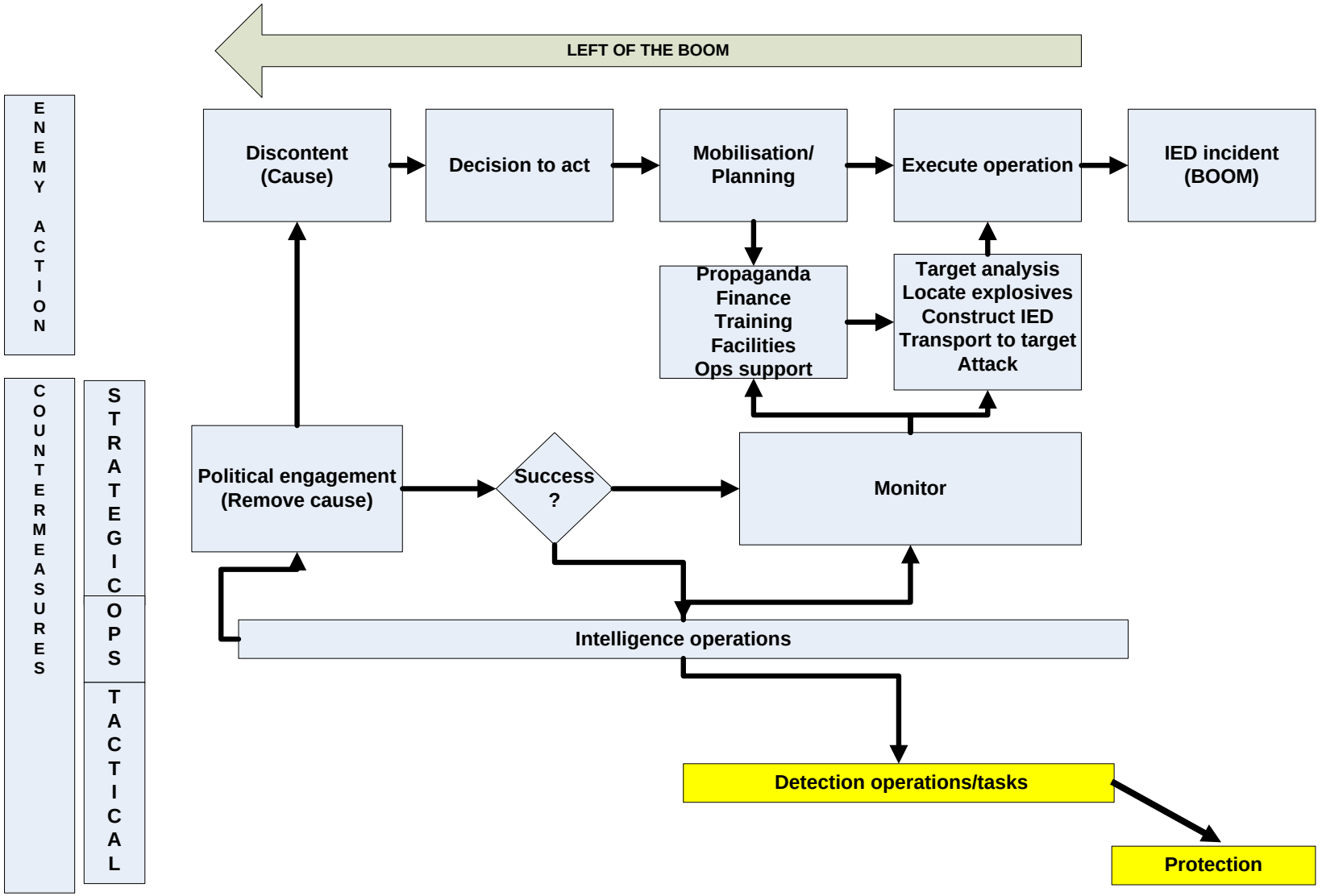
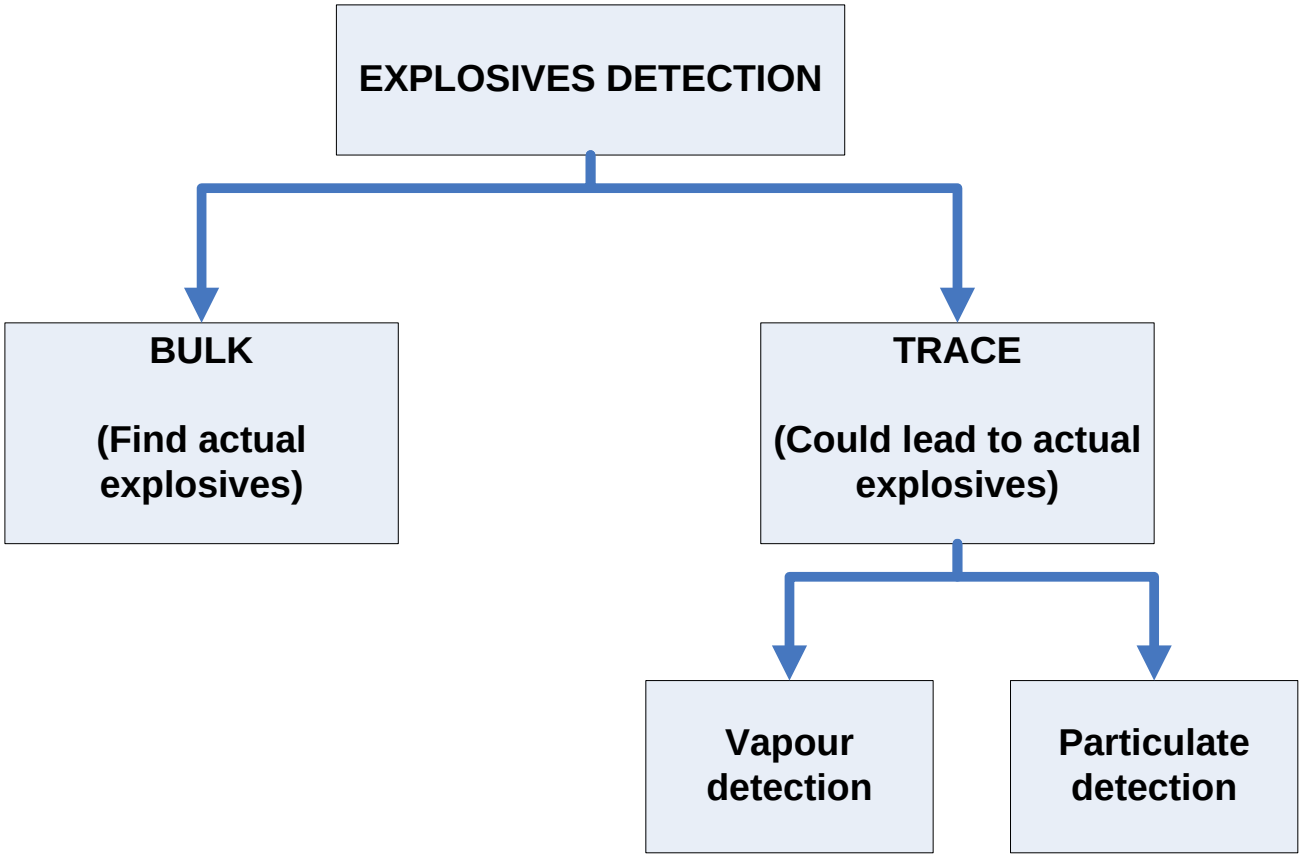
Explosive detection - Positioning



Explosive detection - principles



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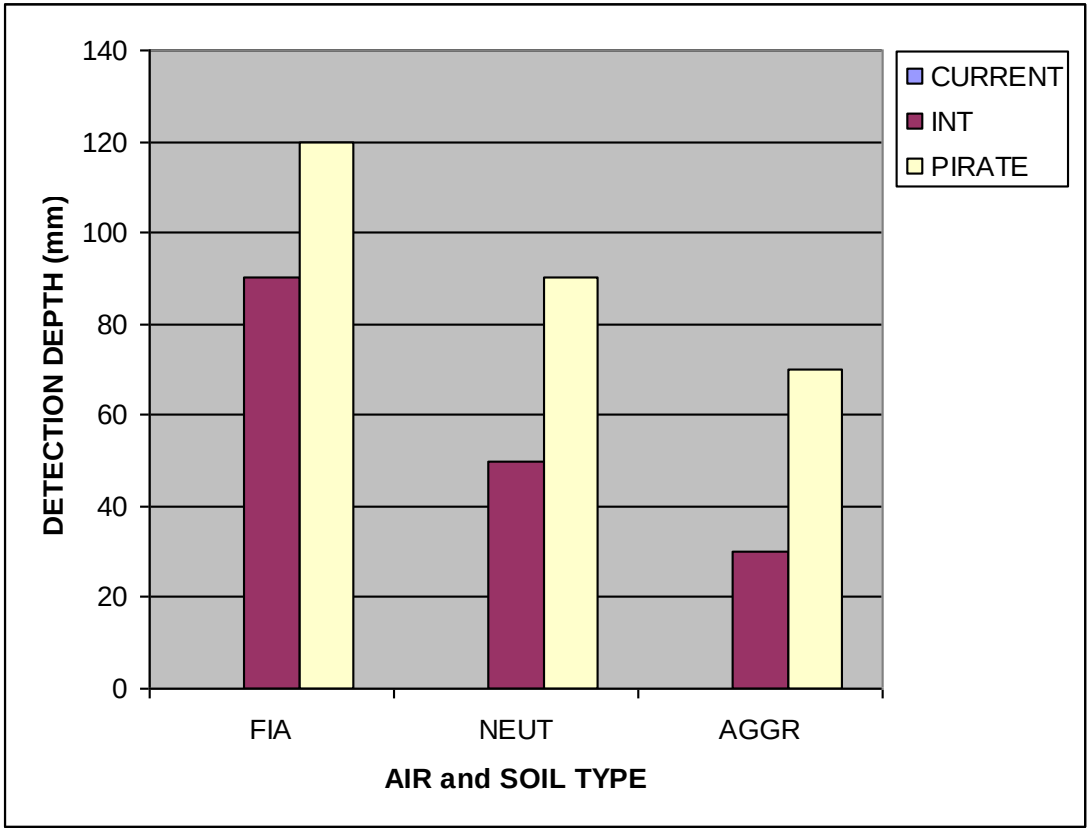
Detection - SA Army current capability

Limited to mine detection (metal detection and prodders)

Sensitivity - (R1M1 a/p mine)



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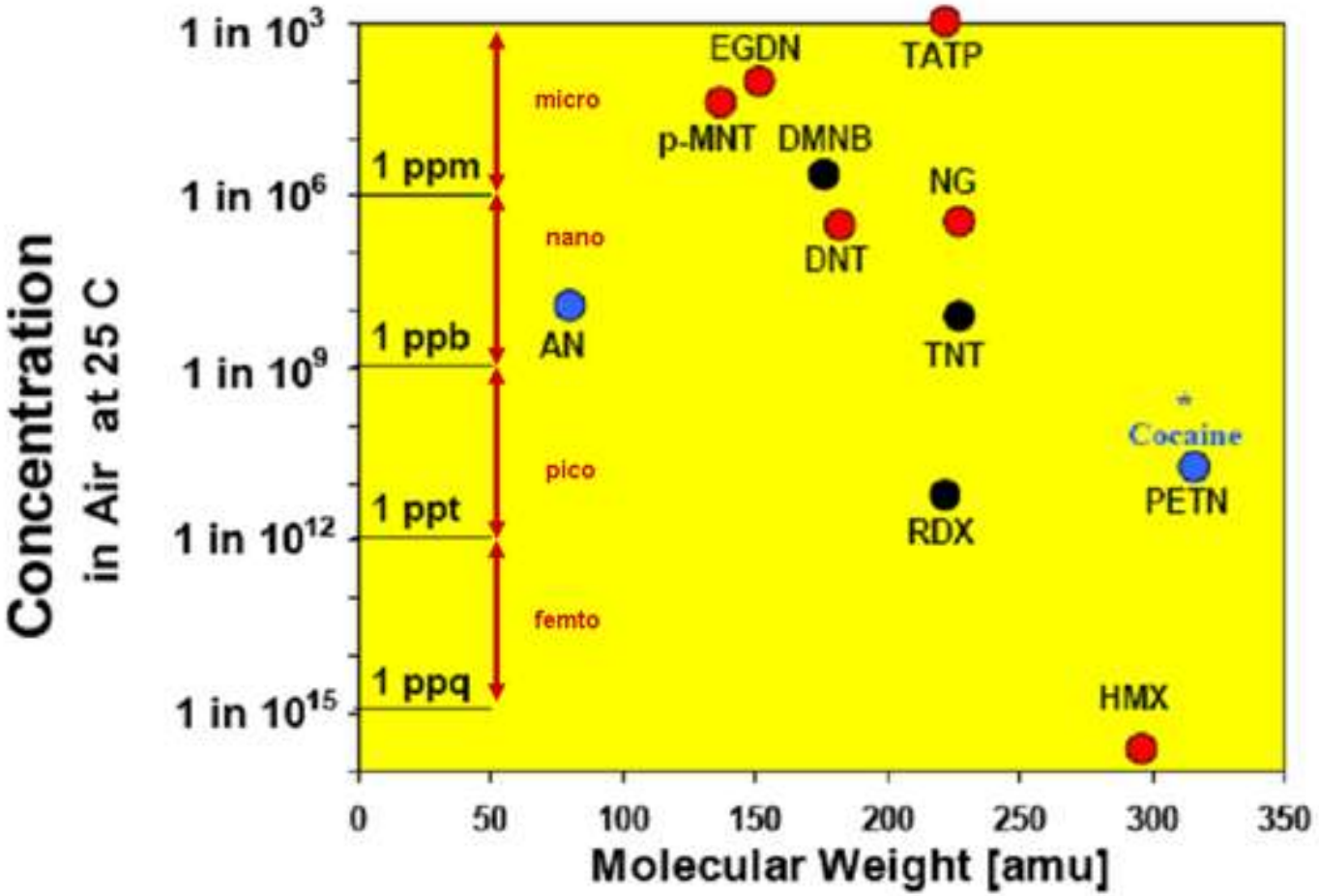
Explosive detection- Concentration levels



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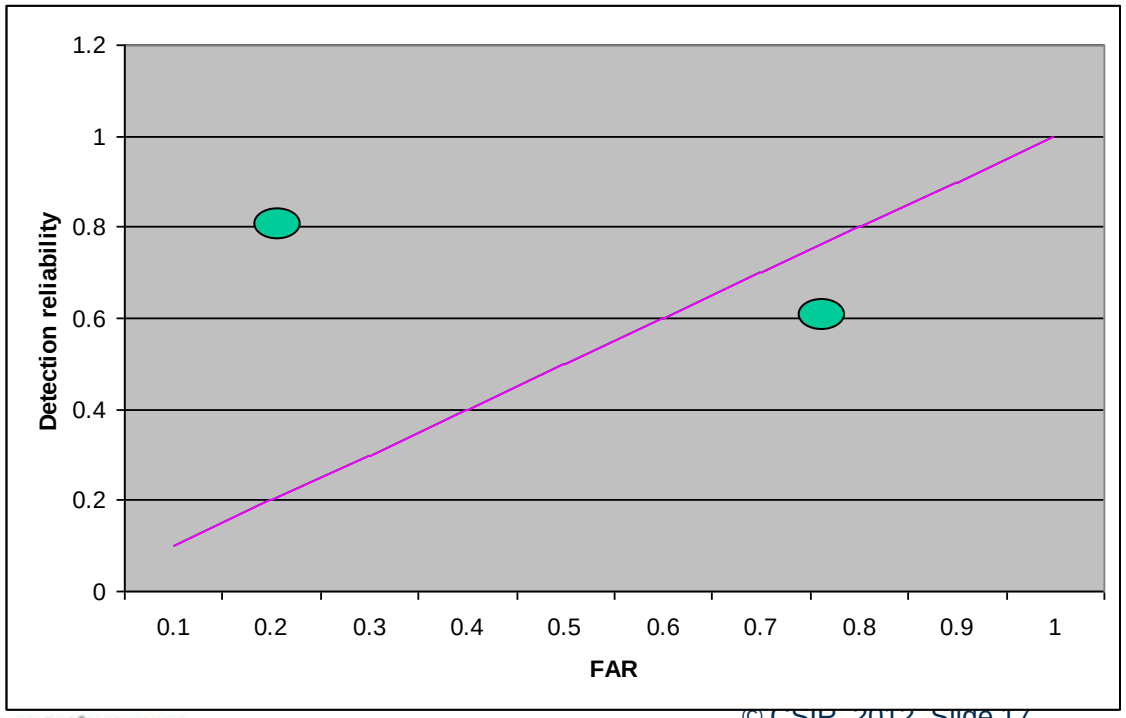
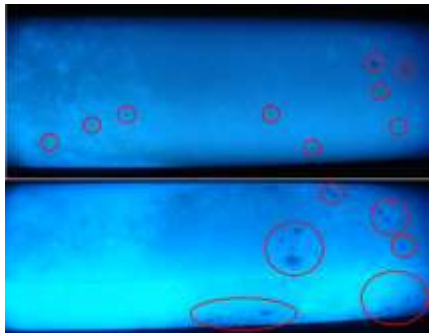
Explosive detector performance parameters

- Sensitivity P_d
- False alarm rate (FAR)
- Reliability R_d
- Receiver operating characteristics



Explosive detection applications



- Routine screening of large numbers of personnel/vehicles
- Screening of large numbers of hand-carried items
- Screening of mailed and shipped items
- Screening of containers
- Bomb/explosive searches
- Special investigations
- Mine/UXO detection

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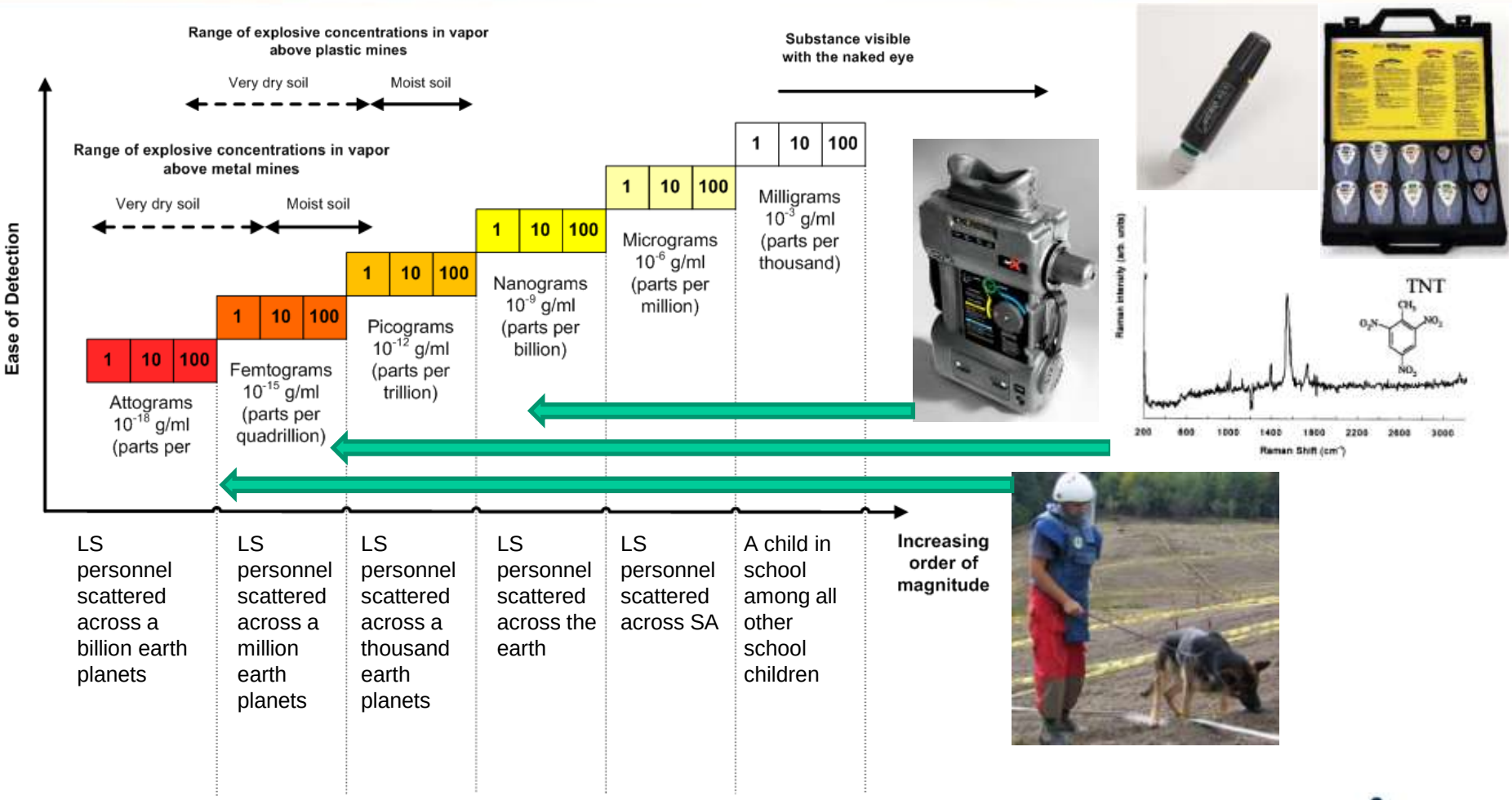
Sensitivity of current explosive detection systems



Explosive detection – Technology scope

Detection Technology	Detection Order of Magnitude		Operational Detection Range			Limit of Detection							Technology Evaluation Parameter					Maturity of Technology					
	Bulk	Trace	Close Proximity	Standoff	Remote	Grams	Milligrams	Micrograms	Nanograms	Picograms	Femtograms	Attograms	Cost	Processing Time	Portability	False Alarm Rate (FAR)	Species Selectivity	Theoretical Concept	Patent Registered	Proof of Concept	In Development / R&D	Small to Large Scale Production	Accepted Industry Standard
Spectroscopic / Spectrometric (MS, IMS, LIBS, SERS, IRS, PAS, MS - DESI, MS - DAPCI, etc)		x	x										High	Long	Low	Low	High				x	x	x
Chromatographic (LC, GC, HPLC, GC-MS, FID in GC, etc)		x	x										High	Long	Low	Low	High				x	x	x
Electromagnetic Imaging (GPR, Infrared, Terahertz, Microwave, X-rays, Gamma Rays, etc)	x			x									Mod	Fast	Mod	Mod	Mod				x	x	x
Neutron Based (TNA, FNA, PFNA, PFTNA, Neutron backscatter/resonance etc)	x		x										High	Mod	Low	Mod	Mod				x	x	x
Magnetic (NQR, NMR, ESR, etc)	x		x										Mod	Fast	Mod	Mod	Low				x	x	
Novel Optical (LIDAR-Raman, DIAL, DIRL, CARS, LIF, LIBS, Optical Phase Conjugation, Coherent Control, etc)		x		x									High	Fast	Mod	Mod	High				x	x	
Chemiluminescence / Fluorescence (MMOF, AFP, Luminescence, etc)		x	x										Mod	Fast	High	Mod	Low				x	x	x
Biosensors (Dogs, rats, bees, Antigens/antibodies (ELISA), robotic insects)		x	x										High	Fast	High	Mod	High				x	x	x
Electronic Noses (Neural networks, SAW sensors, conducting polymers, Microcantilevers, etc)		x	x										High	Mod	High	Mod	High				x	x	x

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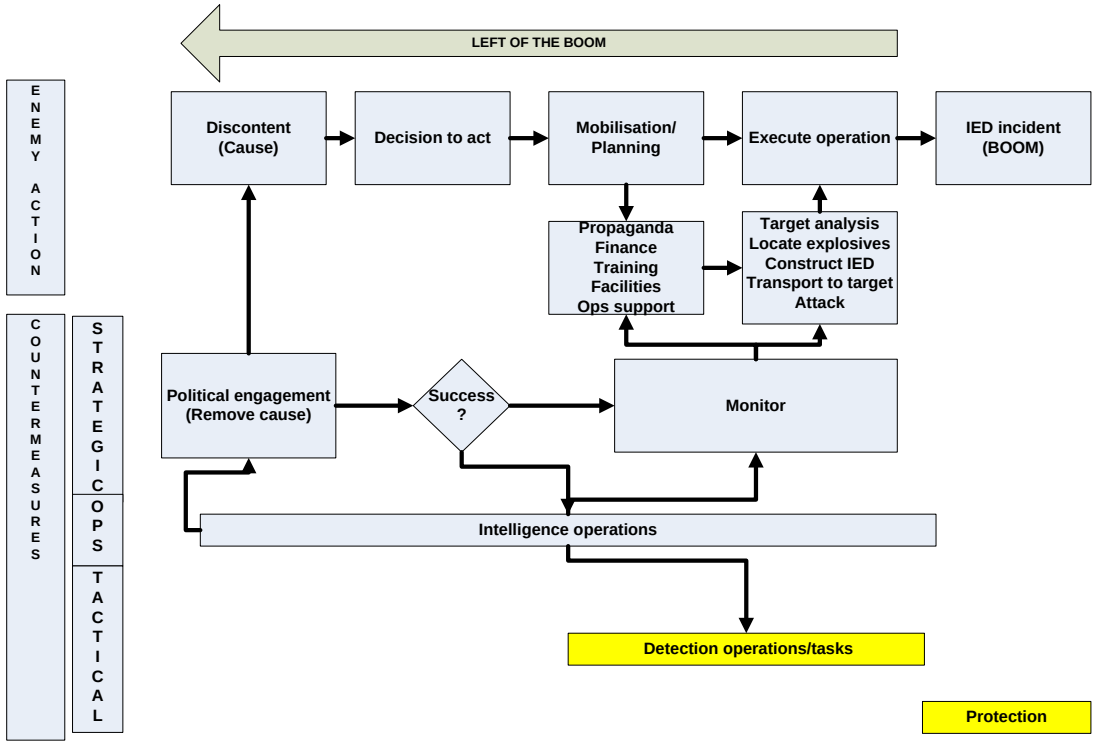
Conclusions



"If you cannot detect-you must protect
If you cannot protect-you must detect"

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Thank You

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