



CLAWAR

August 24-26, 2020



MOSCOW, RUSSIA

Keynote Address – 3



Robotics Assistance to predict, prevent, detect, measure, protect, manage improvised CBE risks

Dedicated to the Memory of Prof. Valery G. Gradetsky

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Wednesday 26 August 2020

STRUCTURE

1. CONTEXT – THE CONVENTIONS

2. THE THREAT

3. COUNTER THREATS STEPS

4. PREDICTION: CBRNE THREATS (INFORMATION FROM Interpol, ICI)

5. THE ROLE OF ROBOTICS. AN EXAMPLE OF COOPERATION: THE TIRAMISU PROJECT

1. Context- The Conventions

CHEMICAL-BIOLOGICAL-RADIOLOGICAL-NUCLEAR-EXPLOSIVES

CBRNE



CWC Convention

13 January 1993



The Chemical Weapons *Convention* (CWC) is an arms control treaty that outlaws the production, stockpiling, and use of chemical weapons and their precursors

Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction and it is administered by the Organisation for the Prohibition of Chemical Weapons (OPCW), an intergovernmental organization based in The Hague, The Netherlands. The treaty entered into force on 29 April 1997.

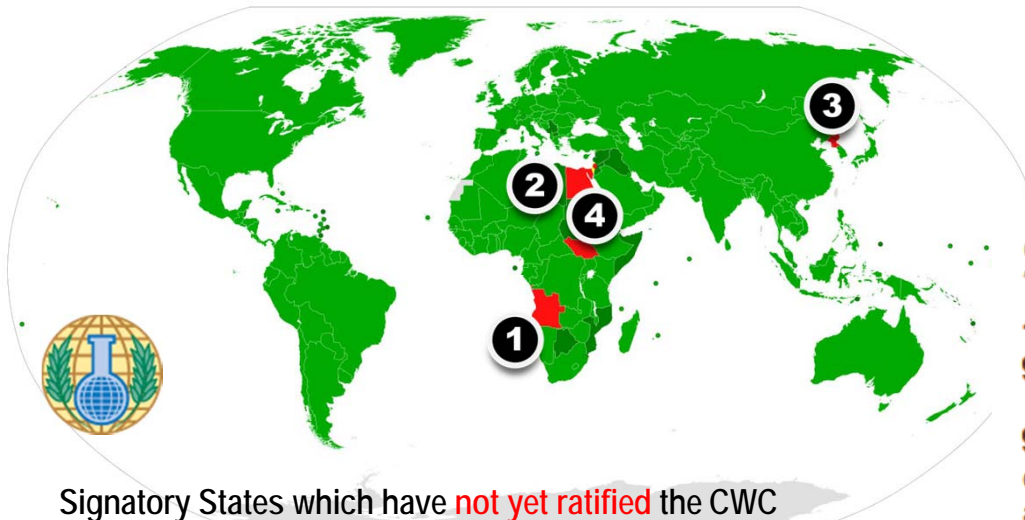
Statistics

191 States Parties covering **98%** of the global population

90% of the world's declared stockpile of 72,524 metric tonnes of chemical agent have been destroyed.

5,545 inspections have taken place at 265 chemical weapon-related and 2,024 industrial sites on the territory of 86 States Parties since April 1997.

4,913 industrial facilities are liable to inspection.



Signatory States which have **not yet ratified** the CWC

● ISRAEL (Signature:13 Jan 1993)

States that have **neither signed nor acceded** to the CWC

1. ANGOLA
2. EGYPT
3. NORTH KOREA
4. SOUTH SUDAN

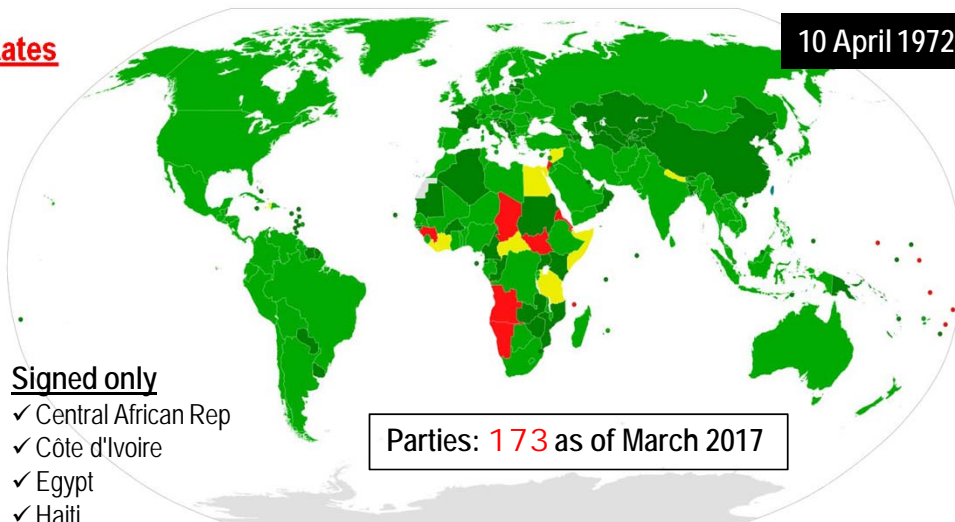
Convention on the Prohibition of the Development, Production and Stockpiling of
Bacteriological (Biological) and Toxin Weapons and on their Destruction

BWC Convention



Non-Signatory States

Andorra
Angola
Chad
Comoros
Djibouti
Eritrea
Guinea
Israel
Kiribati
Micronesia
Namibia
Niue
Samoa
South Sudan
Tuvalu



Signed only

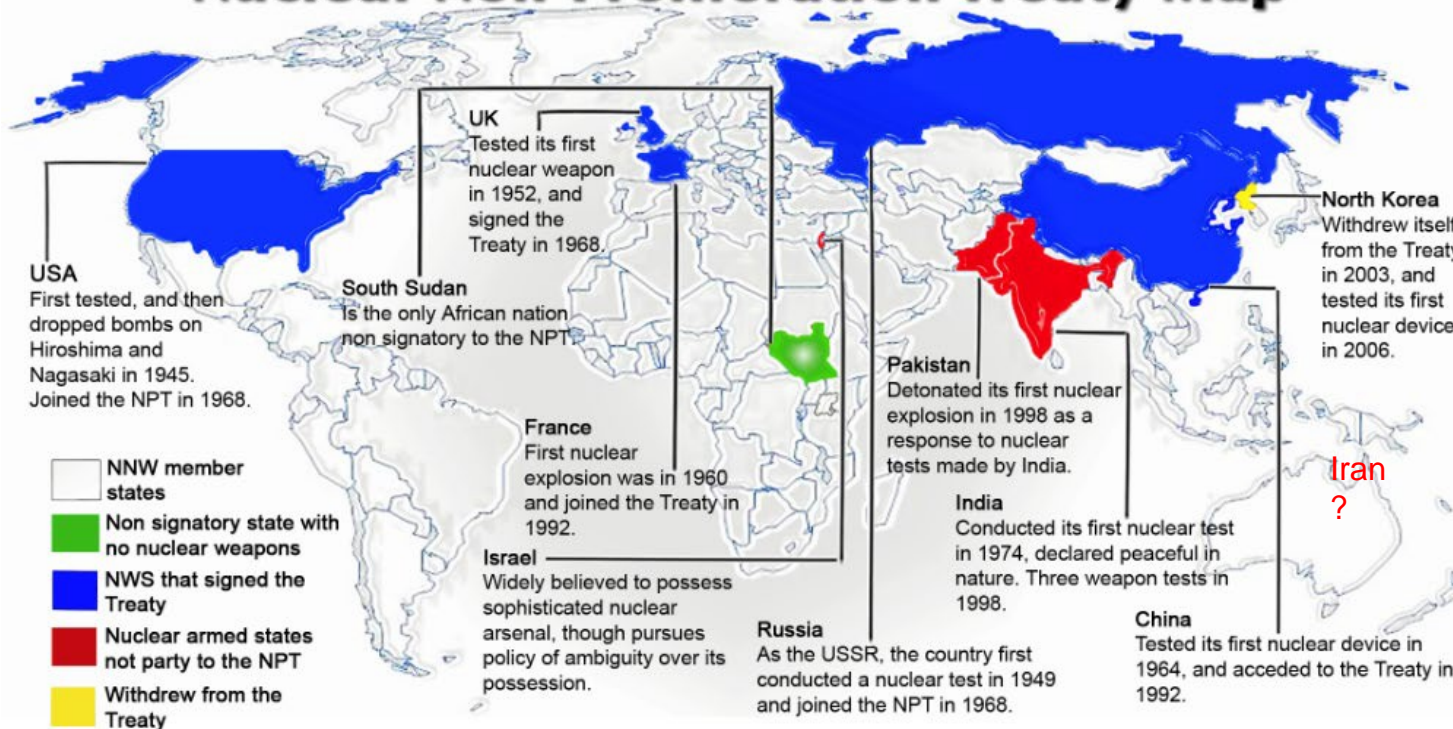
- ✓ Central African Rep
- ✓ Côte d'Ivoire
- ✓ Egypt
- ✓ Haiti
- ✓ Liberia
- ✓ Nepal
- ✓ Somalia
- ✓ Syria
- ✓ Tanzania

- Signed & ratified
- Acceded or succeeded
- Only signed
- Non-signatory

Biological Weapons Convention.
The **Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction** (usually referred to as the **Biological Weapons Convention**, abbreviation: **BWC**, or **Biological and Toxin Weapons Convention**, abbreviation: **BTWC**) was the first multilateral disarmament treaty banning the production of an entire category of weapons

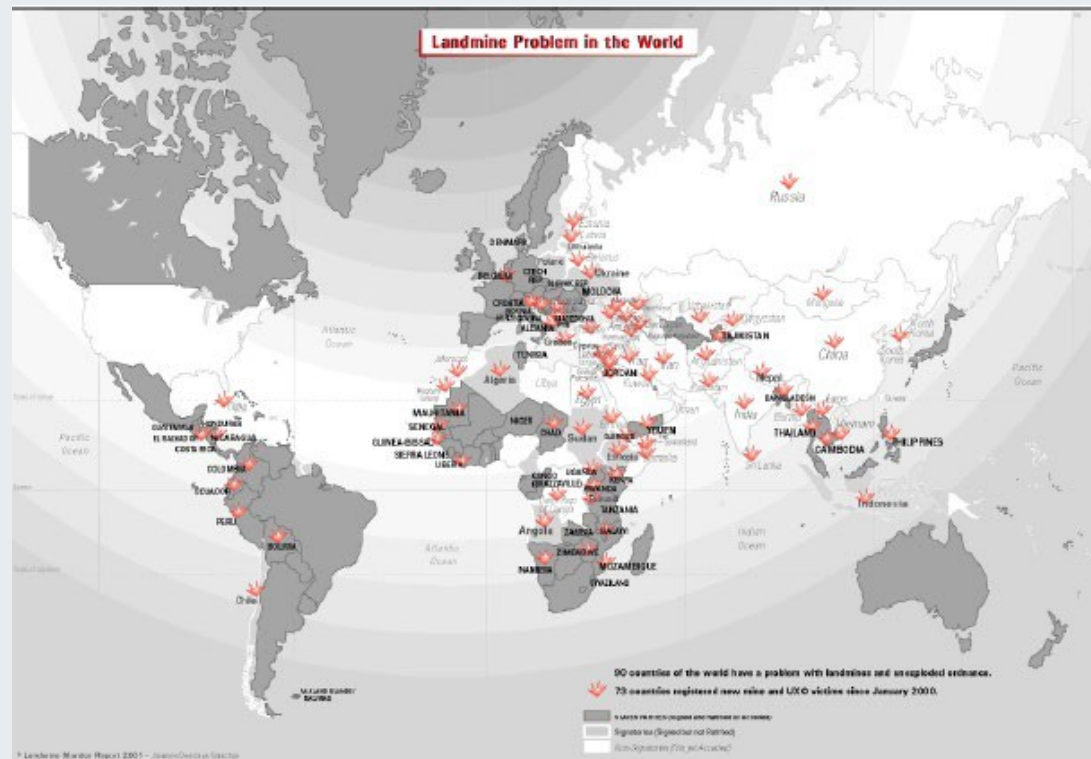
Radiological -
Nuclear weapons

Nuclear Non-Proliferation Treaty Map



The **Treaty on the Non-Proliferation of Nuclear Weapons**, commonly known as the **Non-Proliferation Treaty** or **NPT**, is an international treaty whose objective is to prevent the spread of nuclear weapons and weapons technology, to promote cooperation in the peaceful uses of nuclear energy, and to further the goal of achieving nuclear disarmament and general and complete disarmament. Between 1965 and 1968, the treaty was negotiated by the Eighteen Nation Committee on Disarmament, a United Nations-sponsored organization based in Geneva, Switzerland.

OTTAWA-OSLO Treaties 1997/1999: prohibition AP and CM

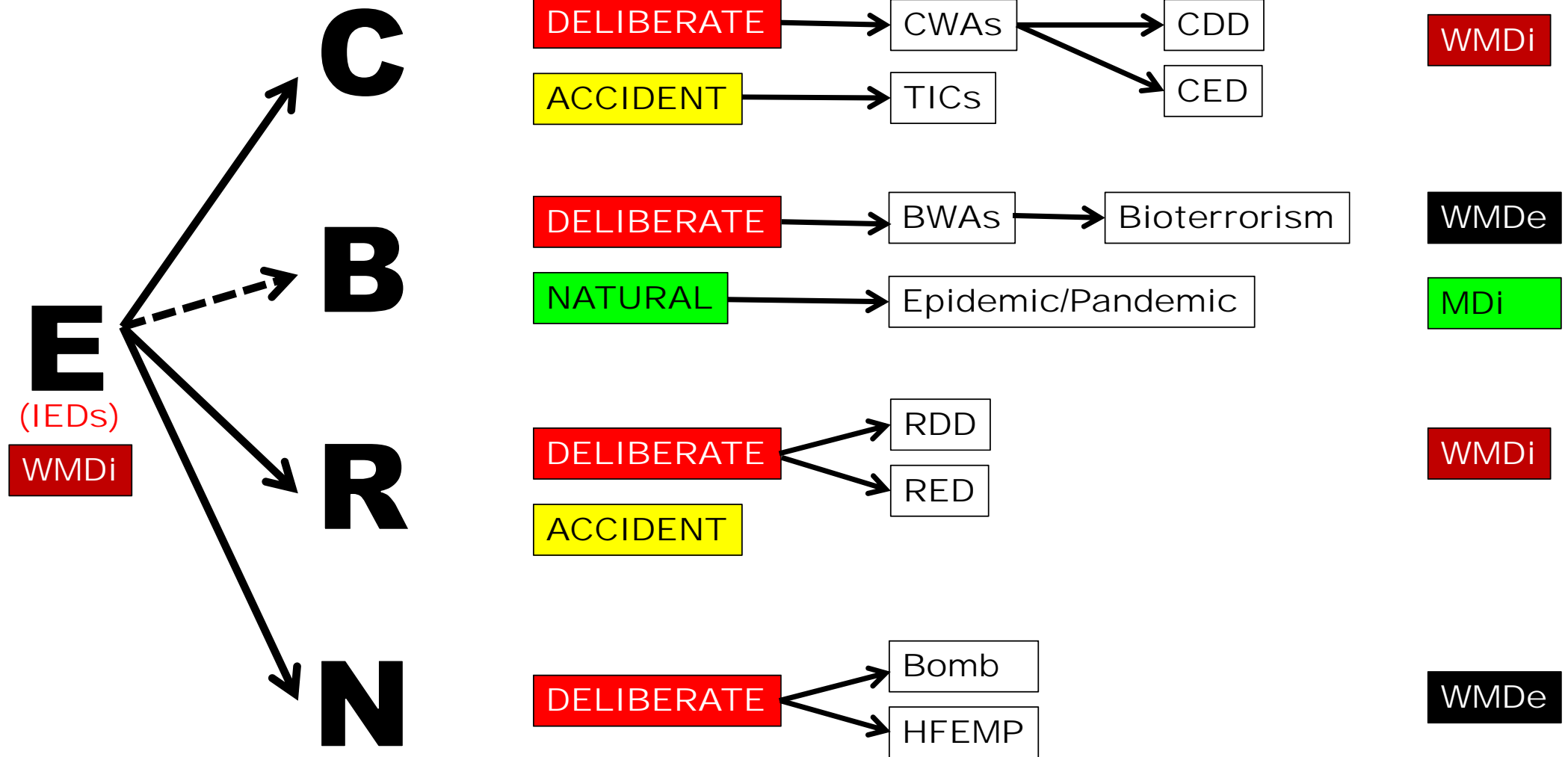


Convention on
the Prohibition
of the Use,
Stockpiling,
Production and
Transfer of Anti-
Personnel
Mines and on
their
Destruction
Oslo, 18
September
1997

2. The Threats

CBE: CHEMICAL BIOLOGICAL EXPLOSIVES threats

CBRNE threats



DD = Dispersal Device (use of IEDs); ED = Emitting Device (i.e. Tokyo sarin attack); HFEMP = High Frequency Electromagnetic Pulse; MDi = Mass Disruption; WMDi = Weapons of Mass Disruption; WMDe = Weapons of Mass Destruction; IEDs = Improvised Explosive Devices; TICs = Toxic Industrial Chemicals, CWA = Chemical Warfare Agents

Definition and use

- ▶ The term **improvised explosive device** (IED) came into common usage during the **Iraq War** (2003).

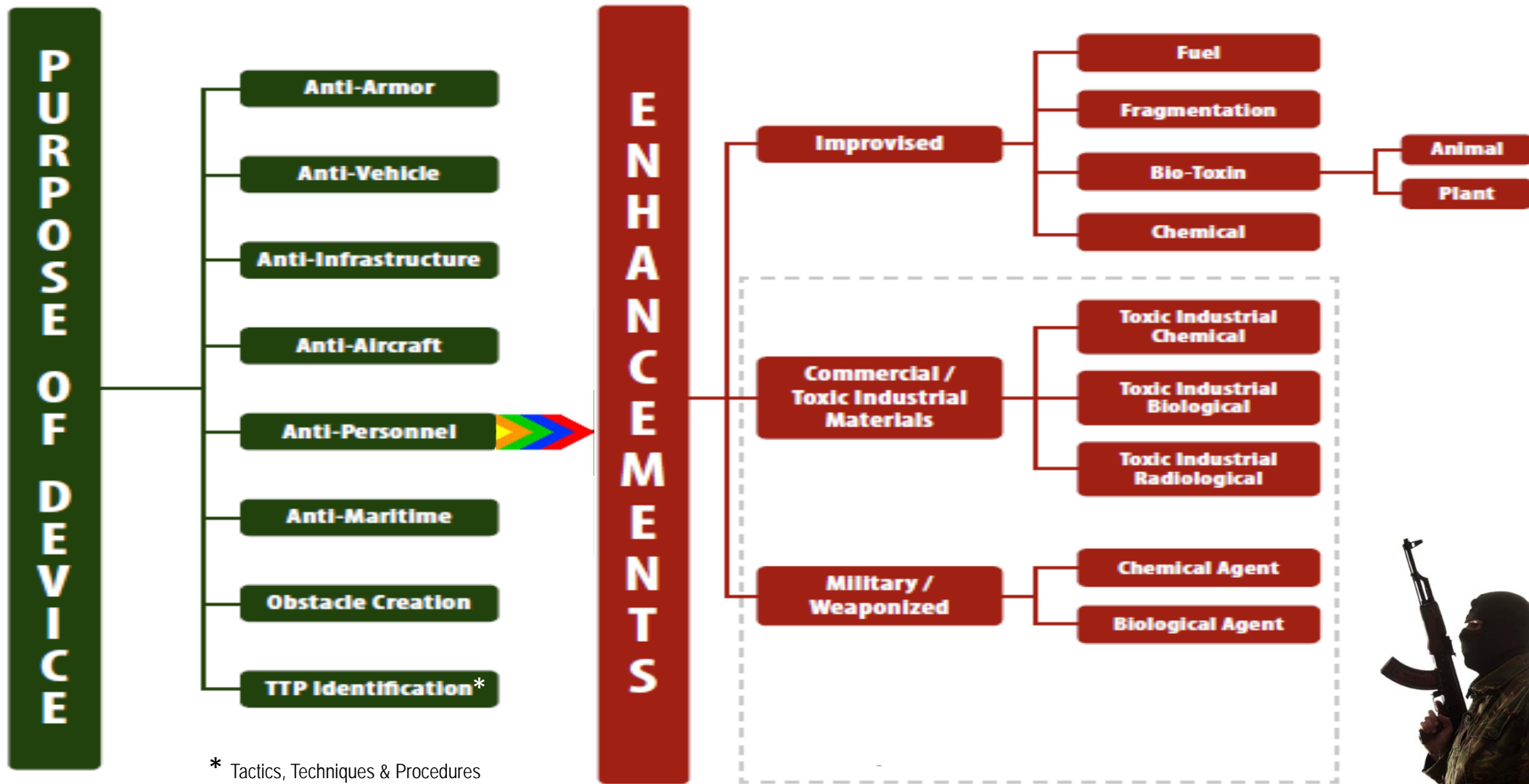
An **IED attack** is the use of a “homemade” bomb and/or destructive device to destroy, incapacitate, harass, or distract.

IEDs:

- Are **used** by criminals, vandals, terrorists, suicide bombers, and insurgents.
- Come in **many forms**, ranging from a small pipe bomb to a sophisticated device capable of causing massive damage and loss of life.
- Can be **carried or delivered** in a vehicle; carried, placed, or thrown by a person; delivered in a package; or concealed on the roadside.



IEDs aiming



Chemical Weapon *vs.* Chemical IED

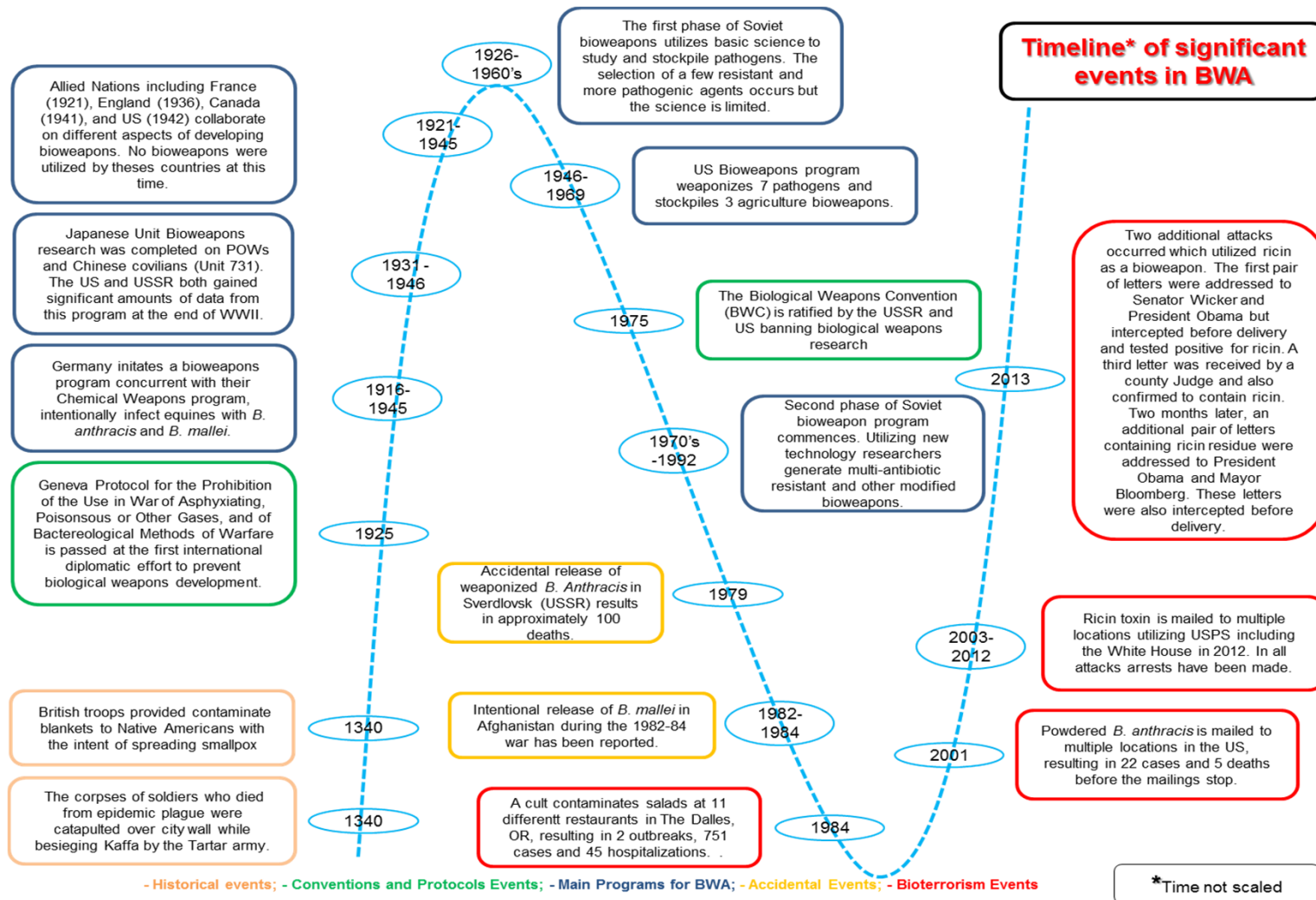
A **CW** is a manufactured standardized munition
such as an artillery projectile.
It is designed for the utmost efficacy of the chemical agent
and therefore
the way of delivering it to the objective,
is conceived and engineered to this purpose.

A **chemical IED**, takes advantage of the IED to deliver the agent
and therefore the efficacy is **NOT** assured
as this is not a suitable method designed for this purpose.
Consequently and fortunately the effectiveness of the agent is jeopardized.

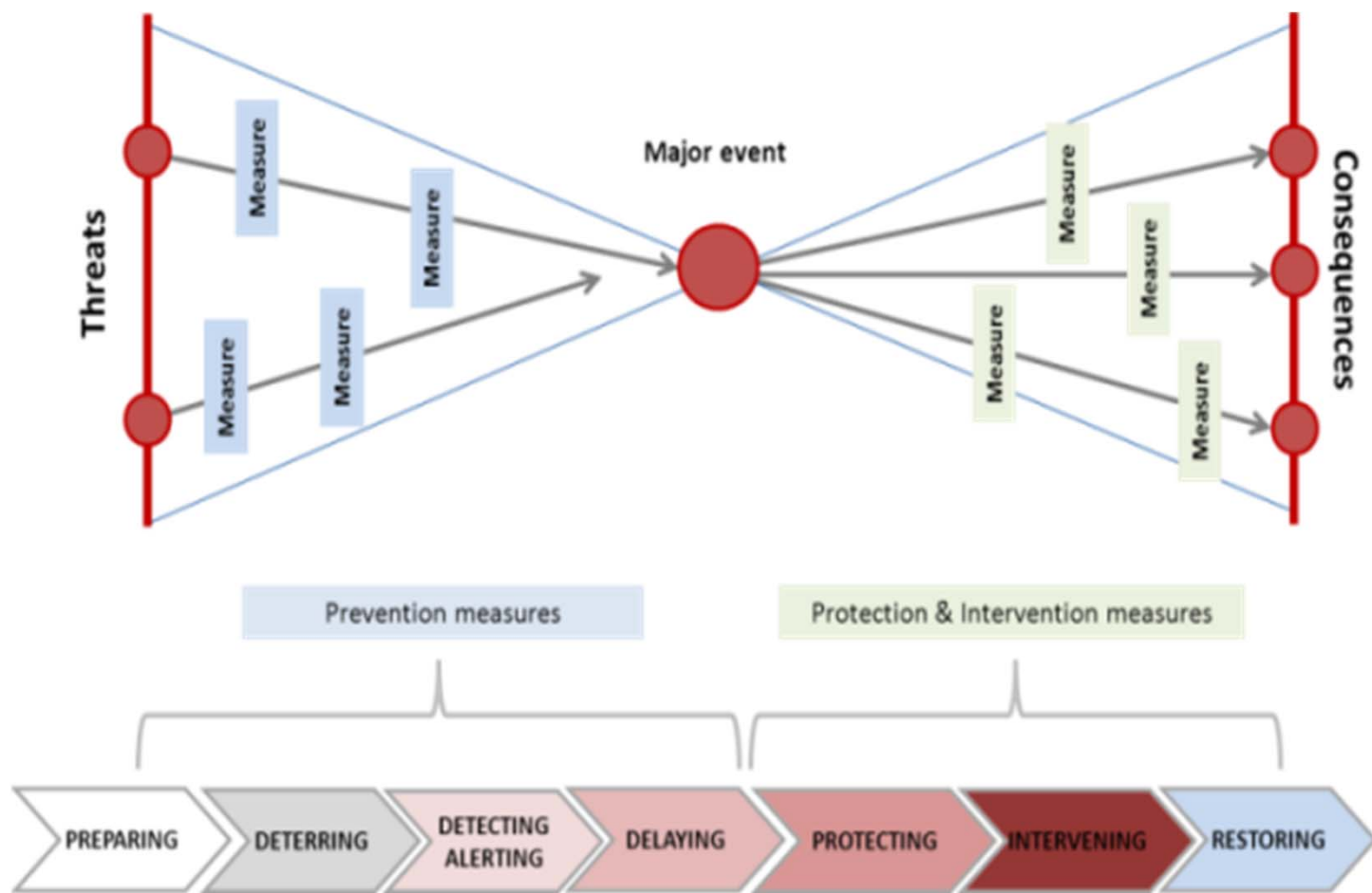
Disasters involving pathogens

- Disasters in past and recent years (Ebola in Central-East Africa, African Pest in the Belgian Ardennes, Inundation in Mozambica (2019) or in Bosnia (2014) or in Iran (April 2019), earthquakes in Italy (2017), contamination with bacteria/viruses in hospitals, DAS in Waste, pesticides in agriculture, and other ones have generated epidemics or local diseases.
- WHO publishes a list of top emerging diseases likely to cause major epidemics.
- The initial list of disease priorities needing urgent R&D attention comprises: Crimean Congo haemorrhagic fever, Ebola virus disease, Lassa fever, **MERS and SARS coronavirus diseases**, Nipah and Rift Valley fever.
- Three other diseases were designated as 'serious', requiring action by WHO to promote R&D as soon as possible; these were chikungunya, severe fever with thrombocytopenia syndrome, and Zika. Other diseases with epidemic potential - such as HIV/AIDS, Tuberculosis, Malaria, Avian influenza and Dengue, must also be taken into account.
- Beside natural bio-events, bioterrorism is also to be considered

Past significant events in BWA



3. Counter Threats Steps



Our approach will be based on detailed evaluation of the current technologies (rapidity and accuracy), their possible improvement and/or integration on mobile platforms, and on the development of new tools,

At each step of the disaster, the existing counter measures will be identified and assessed:

- Identified, whereas they are human (intelligence services, public and private security forces and intervention teams) or technical (communications and data intelligence analysis measures, chemical, biological, radiological, explosive risks detection...)
- Analysed: are they efficient to face the identified disaster scenarios? Alone? Combined with each other? At what cost? Balance between effectiveness/cost? Are all the security objectives fulfilled by the existing measures?

4. Prediction, prevention: THREATS

**CONTRIBUTION INTERNATIONAL INSTITUTE AND ICI-IMEKO-CBRNE
RISE WORKHOP**

ALAN GRIMMER (A.GRIMMER@INTERPOL.INT)

CBRNE COORDINATOR

INTERPOL GLOBAL PRESENCE

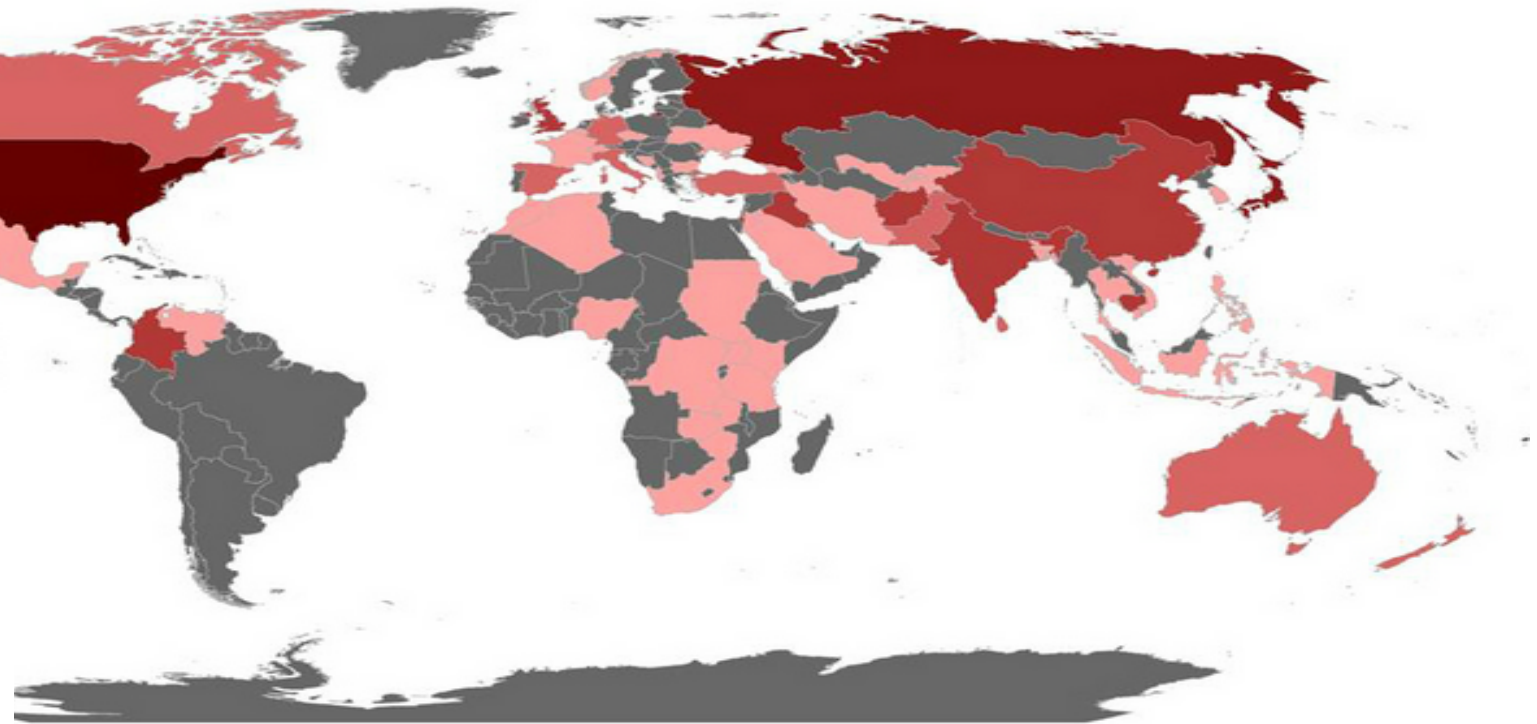


WHAT?

CBRN Events Worldwide, 1990-2013

Plots, successful
acquisitions, and
actual attacks

Number of Events per Country



START ➤➤➤

Source: Profiles of Incidents Involving CBRN by Non-state actors dataset

<http://warontherocks.com/2014/08/a-global-picture-of-non-state-actors-and-cbrn/>

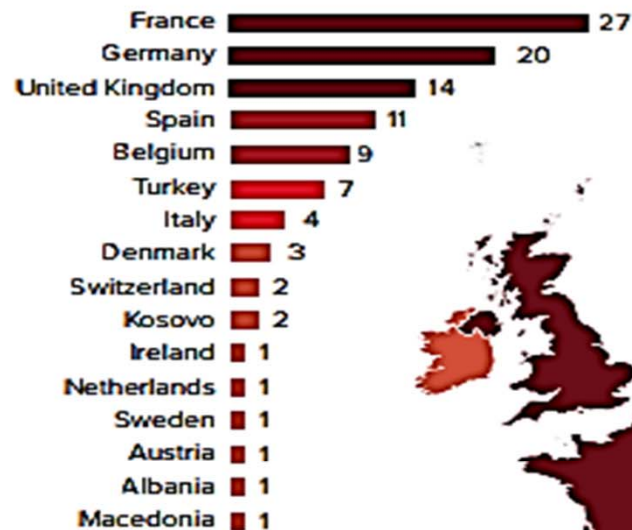
WHAT?



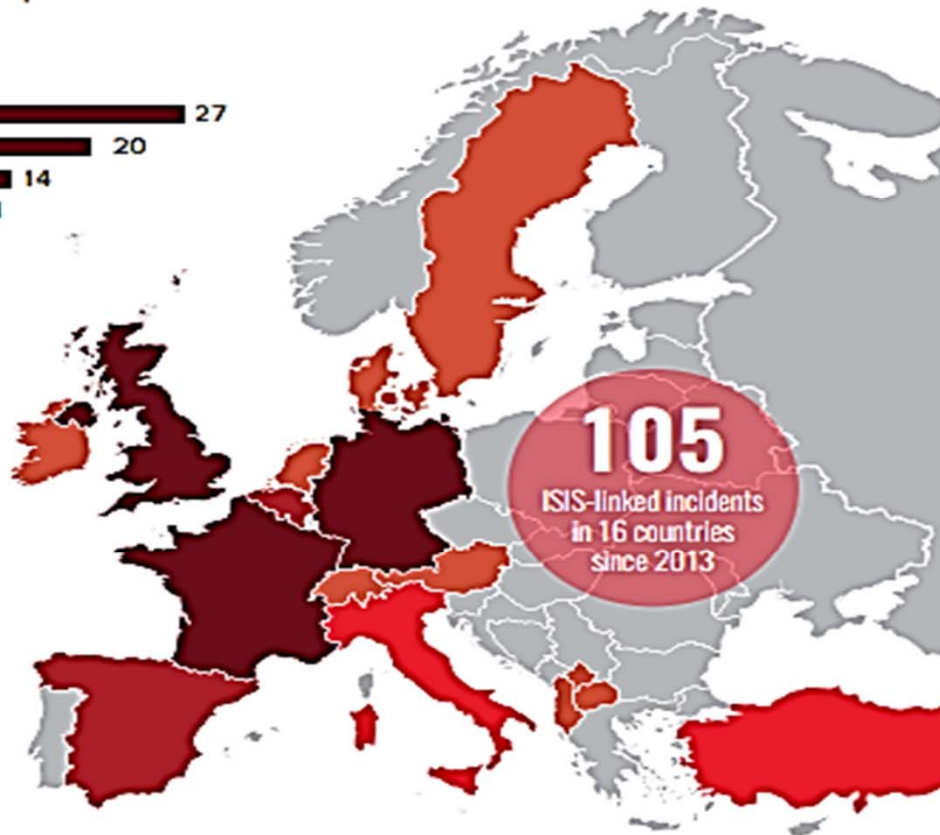
TERROR CAMPAIGN IN EUROPE

ISIS-linked incidents in Europe since 2013

Sept 2017



Number of incidents for plots to attack, providing material, financial support, and arrests



ISIS-LINKED PLOTS AGAINST THE WEST

Incidents since 2013 broken down by weapon*



70 CASES
EXPLOSIVES



16 CASES
VEHICLES

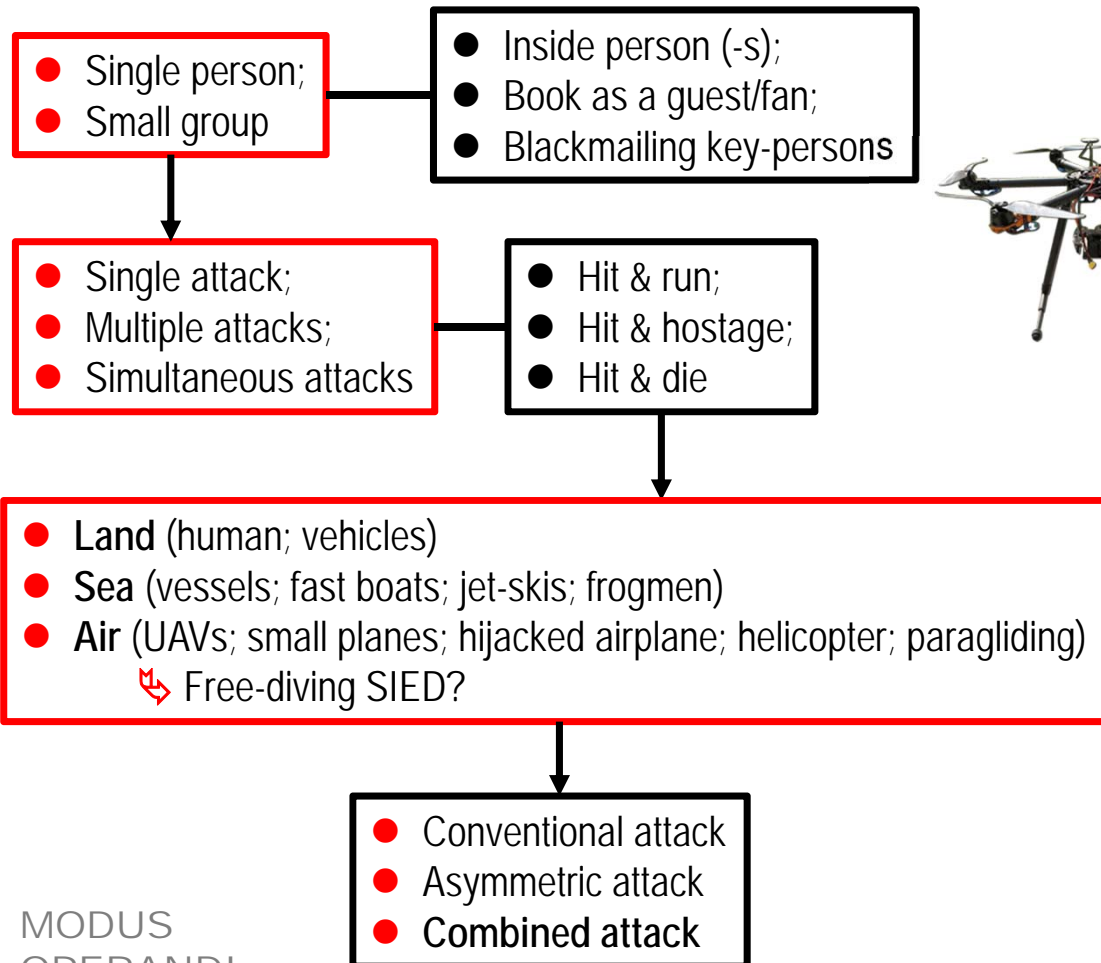


50 CASES
EDGED WEAPON

TERROR THREAT SNAPSHOT

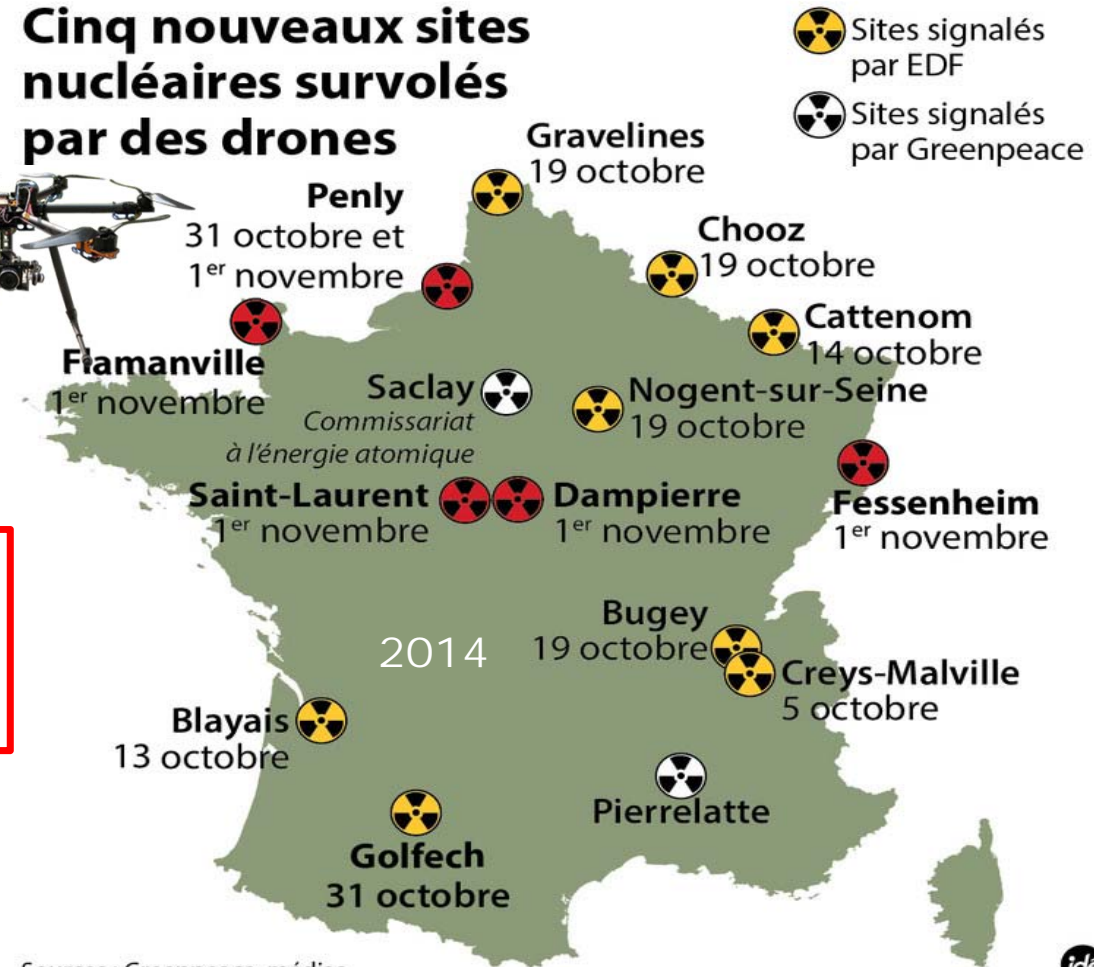
SEPTEMBER 2017

HOW?



MODUS
OPERANDI

Cinq nouveaux sites nucléaires survolés par des drones



WEAPONIZED DRONES



Types of UAVs used by IS are **scratch-built**, **self-assembled** and **ready-to-fly** UAVs



WEAPONIZED DRONES



WEAPONIZED DRONES



Quadcopter modified with an improvised releasing system and modified 40mm grenade projectile / equipped with an dual releasing system and two attached improvised bomblets

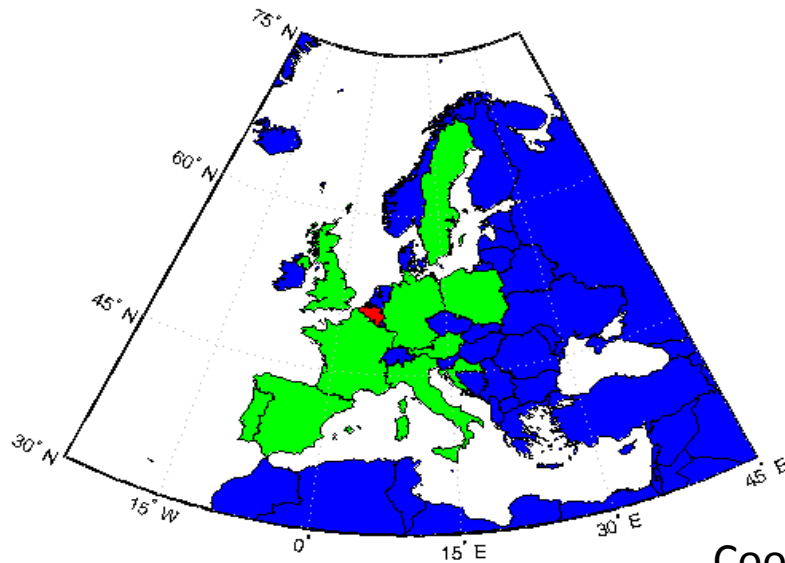


5. The role of robotics. An example of cooperation: TIRAMISU Project

Toolbox Implementation for Removal of Anti-personnel Mines, Sub-munitions and UXO



Funded FP7 program (2012-2016)



24 Partners – 11 Countries

9 Academies

9 SME

2 RTO

1 NGO

1 IND

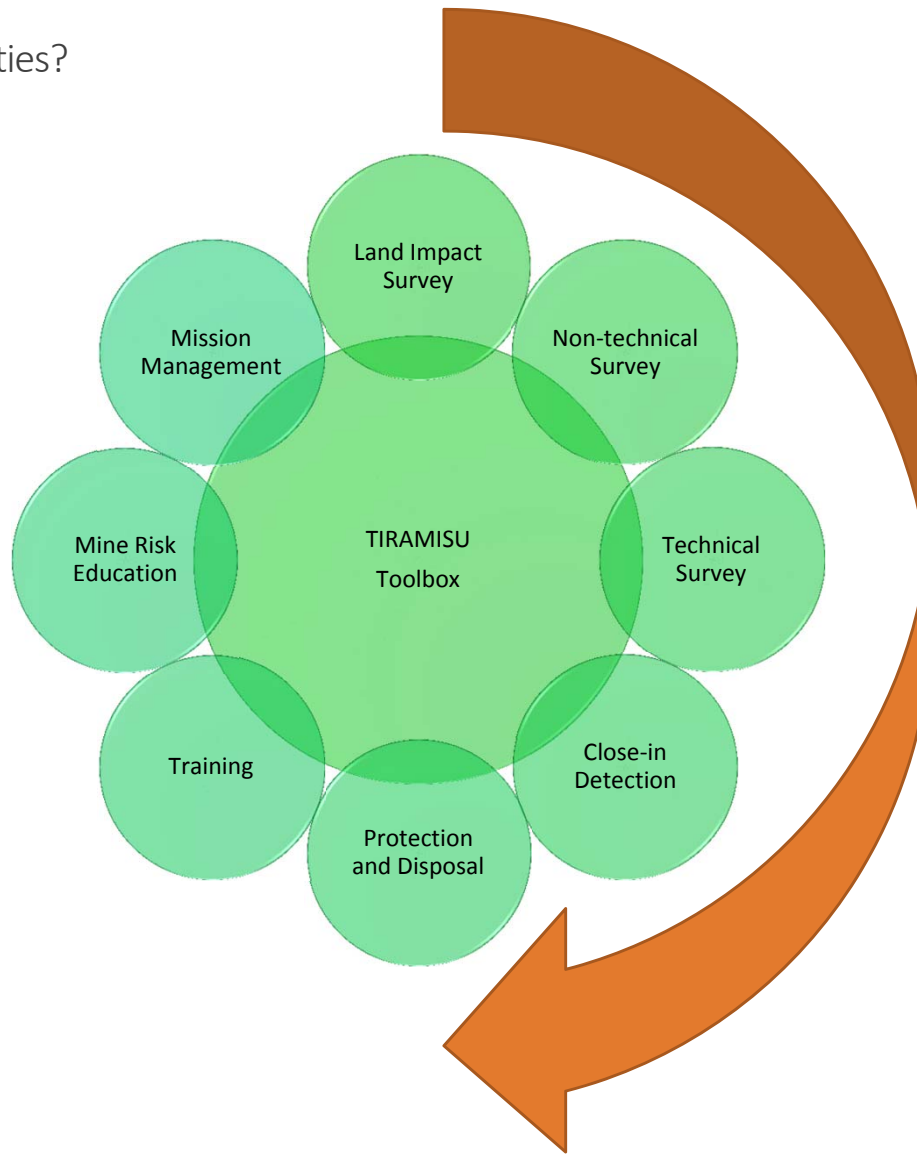
1 EU - CROMAC

PAB: 10 experts from GICHD, UN,
Field Stakeholders

EUB: 12 MAC

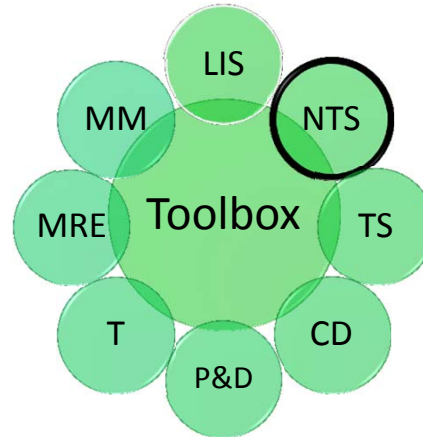
Coordinator: **Prof. Yvan Baudoin**, RMA

Tools for Which Activities?



Activities
Leading to
Land
Release

Non Technical Survey



Objective?

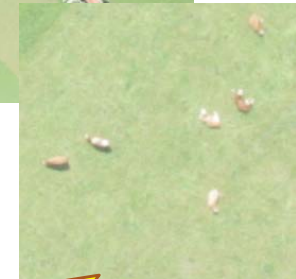
Confirm Hazardous Areas

How?

- Data gathering: RS, mine records,
- Indicators: absence/presence

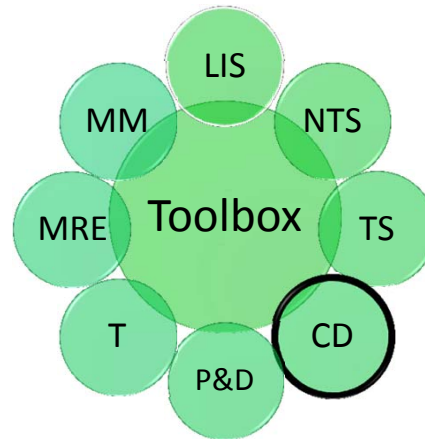
Who?

IGEAT, RMA, DLR,
FGUNIZ, CTDI, EUSC, PLUS



Local Scale

CLOSE-IN DETECTION AND STAND-OFF DETECTION



Objective?

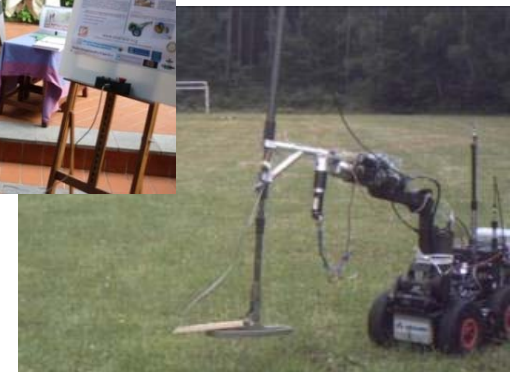
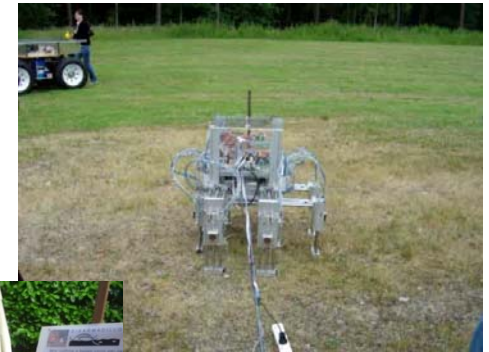
Precisely detect and localise

How?

- Metal & GPR: Array, Stand-off
- Chemical and biological sensors (Honeybeed)
- Intelligent prodger

Who?

ISR, RMA, DLR, USTAN, CSIC,
NOVELTIS, VALLON, IDS, DIMEC,
PIERRE



Mine Risk Education

Objective?

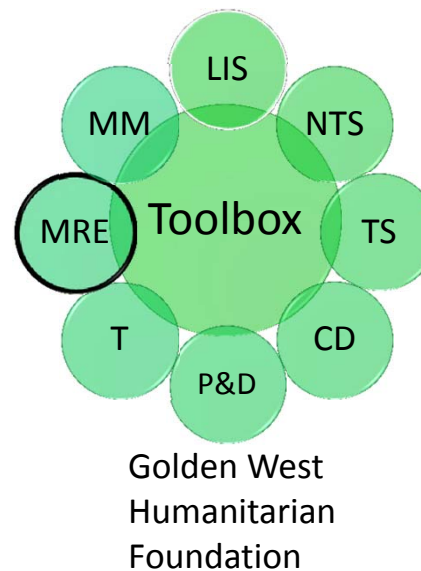
Reduce the risk of injury from mines and UXO

How?

- Computer database and games
- Theatre play = social event

Who?

SNAIL-AID, PIERRE,
BRIMATECH, IMM, RMA



UNHCR

E-Training

E-tutor → *Antipersonnel Landmines Identification*



G A M

Charact.

Arming

Neutraliz.

Disarming

Test

Guest

TIRAMISU Sub-e-tutor 5: VS-50

Welcome to the fifth sub-e-tutor. This sub-e-tutor will provide you with a good knowledge about the VS-50. You will learn its characteristics and different procedures related to arming, neutralization and disarming. As well as the theory, there are some videos which help you to understand how the mine works.

This sub-e-tutor is divided into 4 modules:

1. Characteristics
2. Arming procedure
3. Neutralization procedure
4. Disarming procedure





The Steel insert is inserted by force in the Pressure Pad.

◀ ▶ ⏮ ⏭ ⏯ ▶▶ R R1 R2

- Air Bag
- Charge Locator
- Cocking Block
- Cover Plate
- Detonator Plug
- Detonator Plug Gasket
- Flexible Rubber Sac
- Lower Mine Body
- M41 Stab Detonator
- Pressure Pad
- Spacer Ring
- Pressure Pad Retaining Ring
- Steel Insert
- Safety Pin
- Stirrup
- Safety Pin Housing
- Striker
- Striker Spring



G A M

Charact.

Arming

Neutraliz.

Disarming

Test

Guest

TIRAMISU Sub-e-tutor 4 Valmara 69

Welcome to the fourth sub-e-tutor. This sub-e-tutor will provide you with a good knowledge about the Valmara 69. You will learn its characteristics and different procedures related to arming, neutralization and disarming. As well as the theory, there are some videos which help you to understand how the mine works.

This sub-e-tutor is divided into 4 modules:

1. Characteristics
2. Arming procedure
3. Neutralization procedure
4. Disarming procedure





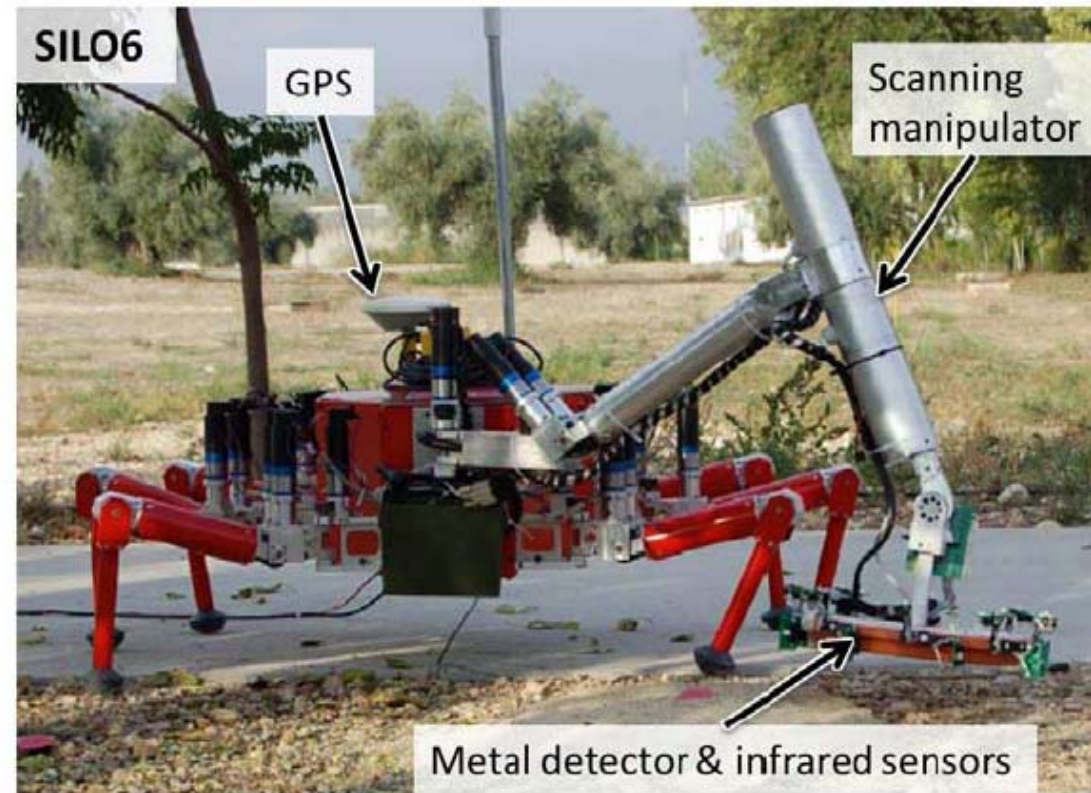
◀ ▶ ⏮ ⏭ ⏯ ▶▶ R R1 R2

- 5 Prong Fuze
- Dome Nut
- Forked Safety Clip
- Fragmentation Canister
- Fragmentation Canister Cover
- Fuze Well Gasket
- Mine O-Ring
- Mortar Projector Sleeve
- Mortar Projector Sleeve Cap
- Striker Housing
- Striker Housing Cap
- Vertical Prong
- Vertical Prong Tension Spring

Clawar Robots to help: Legged robots. Pioneering work in CLAWAR

- Baudoin, Y, and Doroftei, I. 2012. TriDem - A Wheeled Mobile Robot for Humanitarian Mine Clearance. In Proc. 6th IARP Workshop on Humanitarian Demining (HUDEM), 24-26 April, Sibenik, Croatia, pp. 93-98.
- Baudoin, Y., Habib, M.K., Doroftei, I. 2011. Mobile robotics systems for humanitarian demining and risky interventions. Using robots in hazardous environments. Woodhead Publishing Limited.
- Kopacek, P., Silberbauer, L. 2008. A new Locomotion Concept for Humanitarian Demining Robots. 7th IARP International workshop on Humanitarian Demining, El Cairo, Egipto.
- Fukushima, E., Freese, M., Matsuzawa, T., Aibara, T., and Hirose, S. 2008. Humanitarian demining robot gryphon. Current status and an objective evaluation. Intl. Journal on Smart Sensing and Intelligent Systems, Vol. 1, No. 3, pp.735-753.
- Habumuremyi, JC., et al. 1998. Rational designing of anelectropneumatic robot for mine detection. CLAWAR'98, First International Symposium, Brussels, Belgium; November, 26-28.
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- Nonami, K., et al. 2003. Development and control of mine detection robot comet-II and Comet-III. JSME International Journal, Series C, Vol. 46, N°3, pp. 881-890.
- Gonzalez de Santos P, Cobano J, Garcia E, Estremera J, Armada M. 2007. A six-legged robotbased system for humanitarian demining missions. Mechatronics, 17: 417–430.
- Marques, L., Rachkov, M., and Almeida, A.T. 2002. Control system of a demining robot. In Proc. of the 10th Mediterranean Conference on Control and Automation. Lisbon, Portugal.

Legged robots

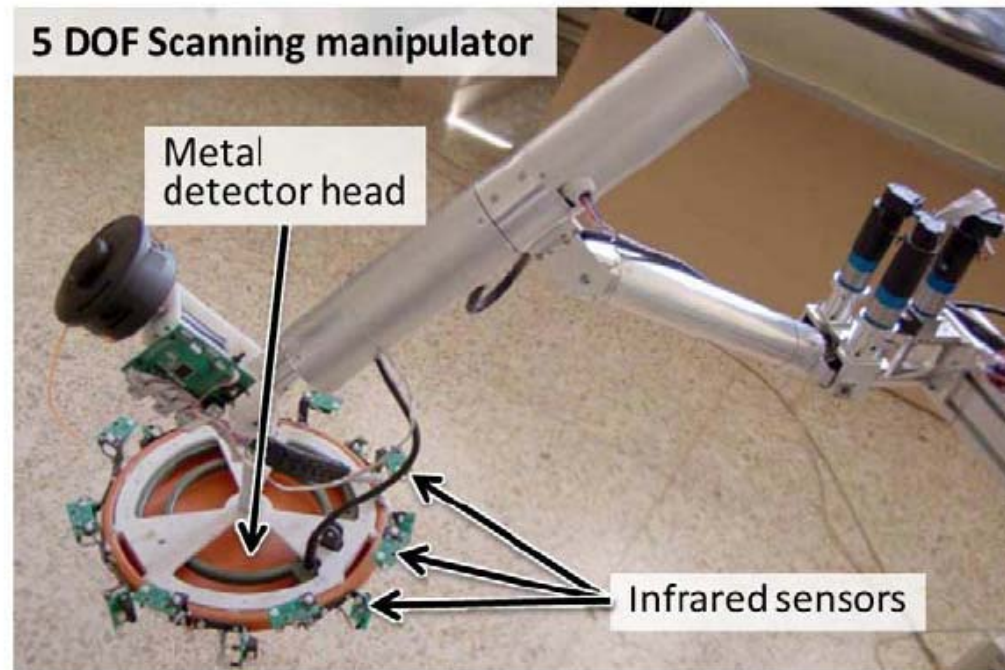


Armada, M., Cobano, J., Garcia, E., and Gonzalez de Santos, P. Configuration of a legged robot for humanitarian de-mining activities. **IARP International workshop on Robotics and Mechanical Assistance in Humanitarian Demining, Tokyo (Japan), 2005..**

P. Gonzalez de Santos, E. Garcia, J.A. Cobano, and T. Guardabrazo. Using Walking Robots for Humanitarian De-mining Tasks, **Proc. 35th ISR, Paris, France, March 23-26, 2004.**

Cobano J, Ponticelli R, Gonzalez de Santos P. Mobile robotic system for detection and location of antipersonnel land-mines: field tests. **Ind Robot**, 2008; 35(6):520–7.

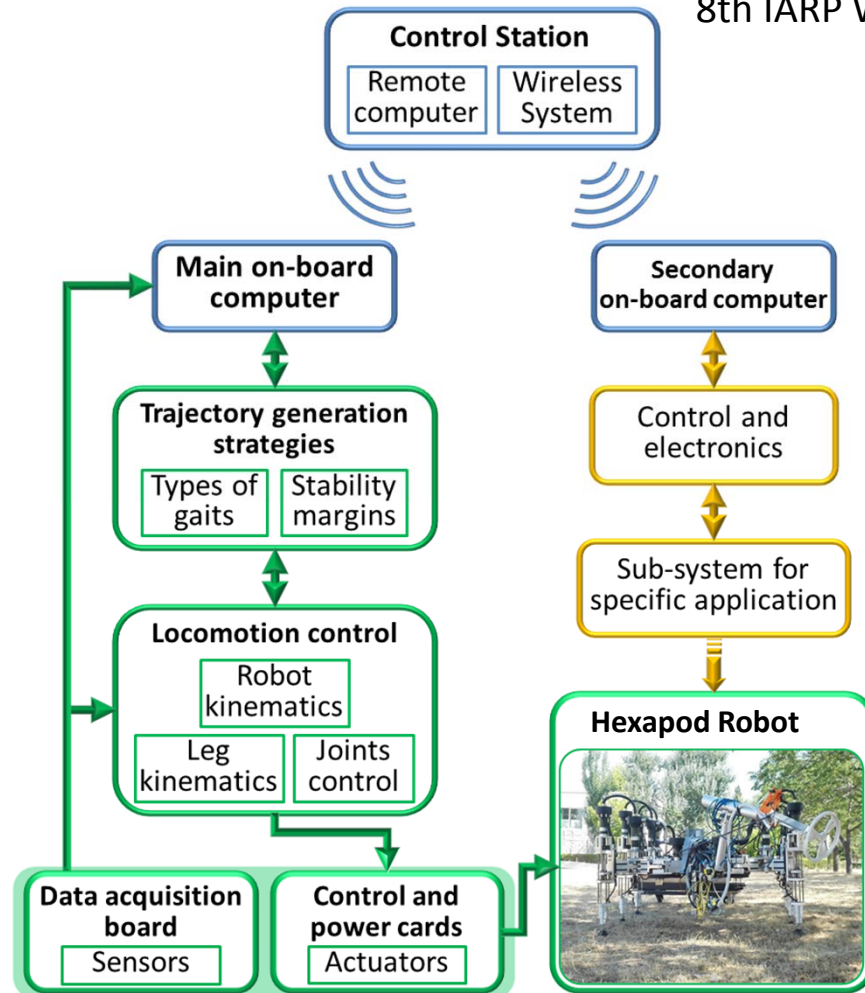
Robot arms with sensors



Ponticelli, R., Garcia, E., Gonzalez de Santos, P., and Armada, M. 2008. A scanning robotic system for humanitarian de-mining activities. **Industrial Robot**, 35(2), pp. 133-145.

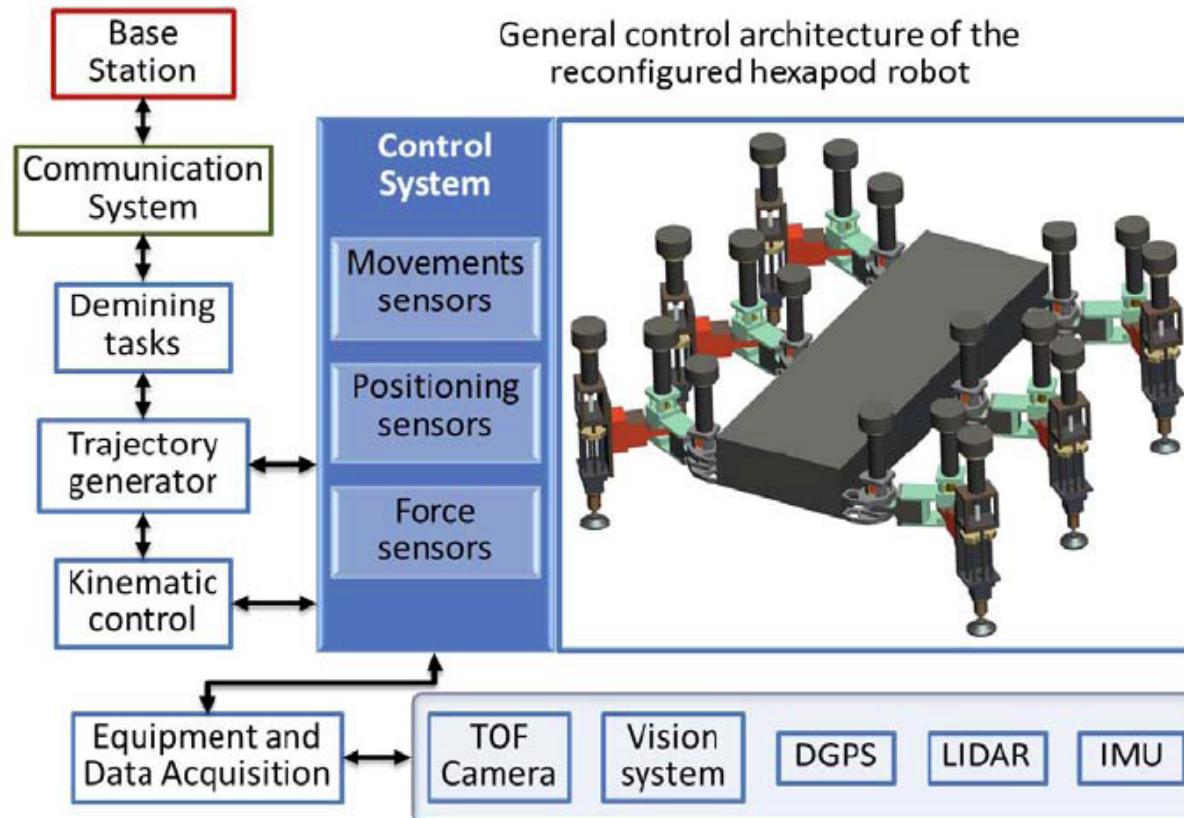
Legged robots

Héctor Montes, Lisbeth Mena, Roemi Fernández, Javier Sarria, Pablo González de Santos, Manuel Armada. HEXAPOD ROBOT FOR HUMANITARIAN DEMINING. 8th IARP Workshop on Robotics for Risky Environments. Lisbon. January 2015.



Baudoin, Y., et al. 1999. EC Brite/Euram TN on Climbing and Walking Robots, including the Support Technologies for Mobile Robotic Machines, (CLAWAR), Year 2 Report: TASK 9, Humanitarian demining.
Baudoin, Y, and Doroftei, I. 2012. TriDem - A Wheeled Mobile Robot for Humanitarian Mine Clearance. In Proc. 6th IARP Workshop on Humanitarian Demining (HUDEM), 24-26 April, Sibenik, Croatia, pp. 93-98

Legged robots



Fernández, R., Montes, H., Salinas, C., González de Santos, P., Armada, M. (2012) "Design of a training tool for improving the use of hand-held detectors in humanitarian demining", **Industrial Robot: An International Journal**, Vol. 39 Iss: 5, pp.450 – 463.

Legged robots

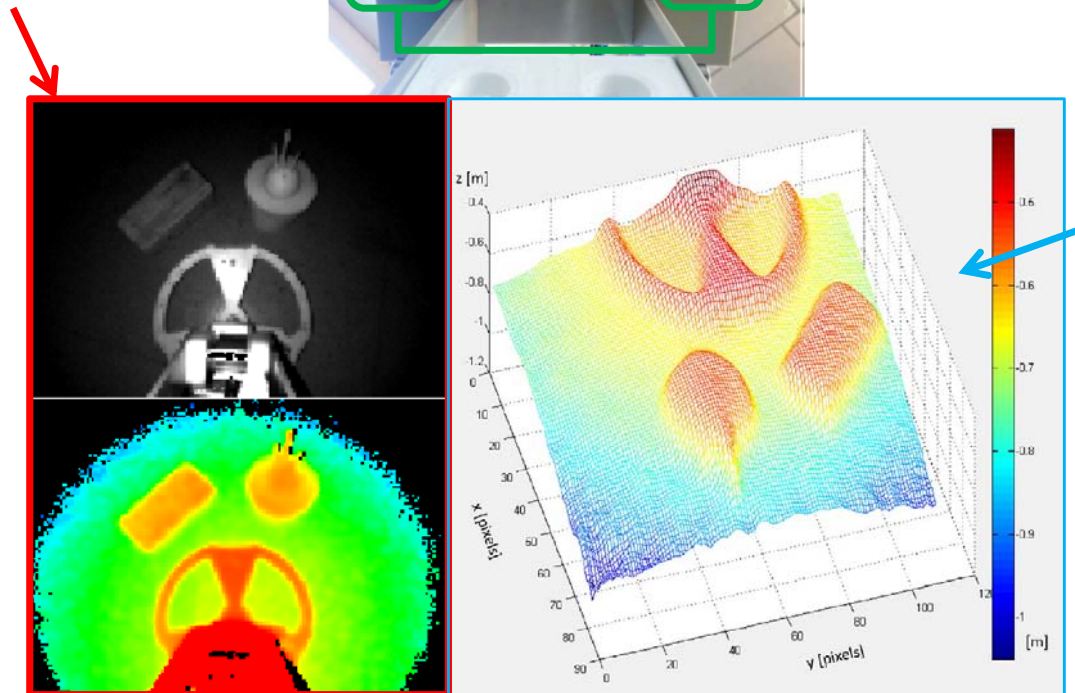
Advanced sensors for detection of APL

Amplitude and
distance of
mini-ToF



Camera mini-ToF

Camara mini-RGB



Terrain surface
mapping

Acknowledgements:

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Managing Director
International CBRNE Institute (ICI)
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B6210 Les Bons Villers (Frasnes Lez Gosselies)
BELGIUM

BrigGen (ret) Ioannis Galatas, MD, MA, MC (Army)
Manager, ICI CBRN Knowledge Center

Many thanks for your attention !

