EFNDT WG5: From Landmines to Public Safety

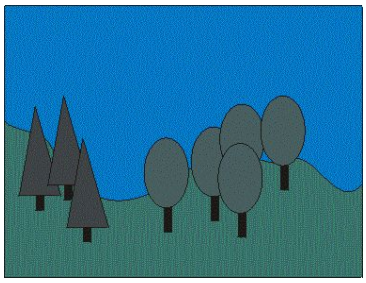
Kurt OSTERLOH, Uwe EWERT,
Federal Institute for Materials Research and Testing (BAM), Berlin, Germany
Vjera KRSTELJ, University of Zagreb,
Faculty of Mechanical Engineering and Naval Architecture, Zagreb, Croatia

Abstract. Some of the most perfidious remnants of war are mines threatening not only combating parties but also innocent civilian lives. Moreover, they make large areas inaccessible that otherwise could be used economically. This threat exists even long after cessation of hostile actions. Up to now, the range of tools for humanitarian demining is confined to mine detection dogs, metal detectors, prodders, manual excavation tools and mechanical clearance machines (flails and tillers). In 1999, this gave rise for the Board of Directors of the EFNDT to suggest whether detection methods commonly applied may also be helpful in detecting mines and the like. It was proposed to transfer existing NDT technology to these areas. As a consequence, Working Group 5 "Antipersonnel Landmine Detection (APLD)" was founded to support this concept. As soon as the group became aware of the fact that mines were encountered not only in the soil but also elsewhere the name was changed to "Antipersonnel Mine Detection (APMD)".

It now is becoming more and more obvious that vicious devises such as mines and bombs threatening lives everywhere represent an increasing risk to everybody. In contrast, the particular interest in antipersonnel mine detection is decreasing in favour of general security and safety. However, all these problems have in common that such devices need to be detected in time, i.e. before they become effective. This gives reason to extend the scope of the existing Working Group 5 accordingly. It is of advantage to exchange existing knowledge and there is a chance to keep the awareness of the mine problem alive by this way.

Introduction

While the land-mine problem still remains unresolved yet, we are encountering increasingly threats that have common essential (and scaring) features. Mined areas still hamper economic development [1], e.g. in Croatia, with 1174 square kilometres in 2005 [2], and it is in the same magnitude of that one with permanent crops (some 2 % of the whole state area). It is even questionable if the destruction of anti-personnel mines in mined areas will be completed duly in time as stated in Article 5 of the Ottawa Convention [3]. Nevertheless, mines are being converted into improvised explosive devices (IEDs) in some areas, e.g. in Afghanistan and Iraq. While mines have been applied in certain areas so affected field could have been identified, an IED is an ill-defined weapon of terrorism world-wide. Fig. **1** should illustrate not only this fact, but also the aim not only to prevent people entering certain areas but to hit anyone, i.e. even innocent and uninvolved people, anywhere. This is sadly proven not only by recent incidences but also by the number of incidences.



Mined areas:
making areas inaccessible

threat

Terroristic targets:
making victims anywhere

Fig. 1: intent of positioning explosive devices

It is anything than trivial to find reliable statistic figures about terrorism, but it appears to be too obvious that terroristic incidences are on the rise internationally. Some statistics reveal a particular increase in number of incidents particularly in the course of the Iraq conflict as shown in Fig. 2 [4]. When evaluating those figures one should bear in mind two aspects: (1) the number of incidences does not reflect the number of victims or the death toll, and (2) with regard to the reliability of statistics, any single death is one too much.

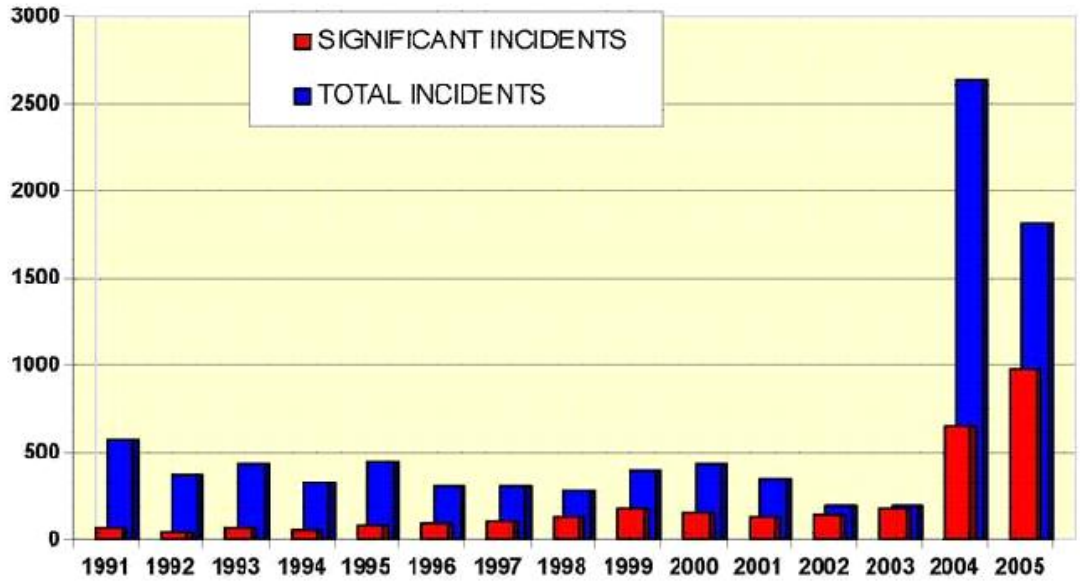


Fig. 2: Increase in number of incidents due to the Iraq conflict

In response to that recent development, the EFNDT Working Group 5 "Antipersonnel Mines Detection" [5], which has been founded in 1999 to search for technologies suitable for humanitarian demining among those readily available in other fields such as non-destructive testing, univocally decided to extend its scope of interest and activity which was endorsed by the Board of Directors in Vienna in November 2005. The new name of the working group now is "Public Security and Safety NDT Technology (PSSndtT)" [6]. These were the reasons for this decision in detail:

- The knowledge on explosives may be applicable to both, demining and rendering safe improvised explosive devices. As a consequence, activities of scientists/experts devoted to those areas could be rationalised,
- There is a large class of devices bearing a danger to public safety which are presently not covered explicitly by the present WG5 scope but should be included due to the current situation,

- Harmonisation of education and certification of personnel in humanitarian demining as well as in the detection of explosive devices such as UXO, ERW and IED is of growing interest since more and more agencies and organisations may getting involved in this area. An implementation of EFNDT (ISO EN) standards system is possible would be helpful in this context,
- In the course of rising public concern concomitant research programs may be funded more swiftly, probably with new financial resources.

1. Subjects of Concern

Mines and IEDs constitute a threat we all do not want to become a victim of, but they exist. This should be the occasion to explain why both terms, "security" and "safety", are included in the description of the subject and the scope. It is, in fact, a peculiarity of the English language to have them both and to use them slightly differently. In order to find commonly accepted definition, the most authentic way would be to consult the Merriam-Webster's [7] as a rather considered reference. "Safety" means (1) "*the condition of being safe from undergoing or causing hurt, injury, or loss*" as well as (2) "*a device (as on a weapon or a machine) designed to prevent inadvertent or hazardous operation*".

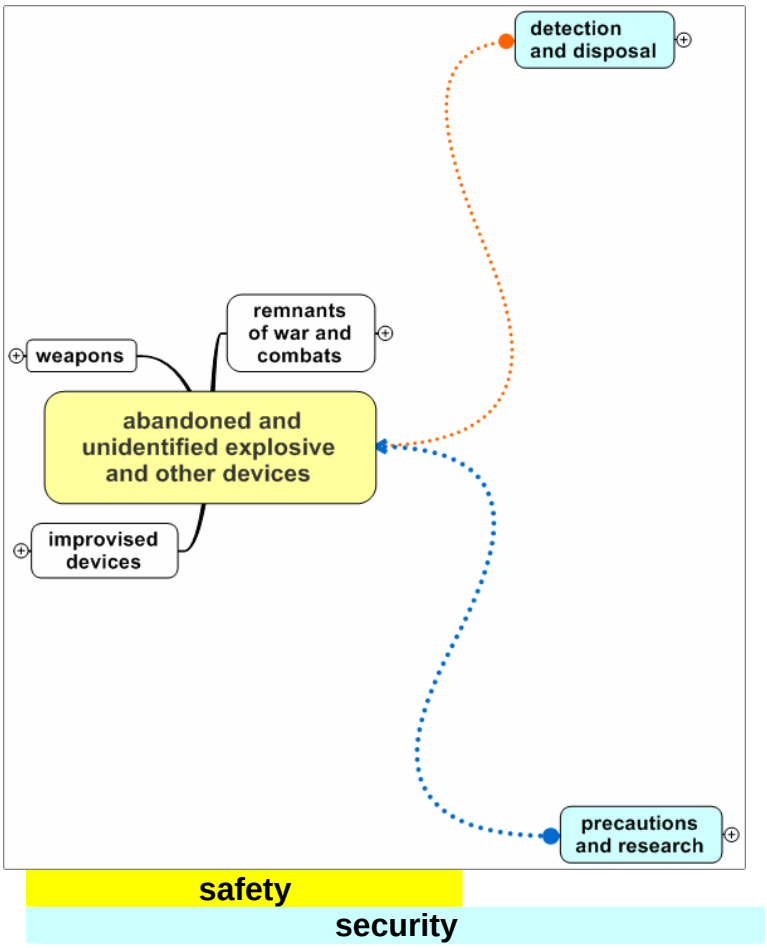


Fig. 3: Threats and counter-measures

In this context, it can be interpreted as avoiding coming too close to anything that has a potential to do any harm or to have a safety pin not in place, in other words, to stay away from anything that is depicted in and around the yellow box in Fig. **3**.

The term “security” has a wider scope: “*the quality or state of being secure: as (a): freedom from danger: SAFETY, (b): freedom from fear or anxiety, (c): freedom from the prospect of being laid off*”. All further definitions concerning financial matters, such as “deposit” etc., may be of less interest in this context. However, it includes an active aspect: *“(a): something that secures: PROTECTION, (b1): measures taken to guard against espionage or sabotage, crime, attack, or escape, (b2): an organisation or department whose task is security*”. This active component is indicated by the turquoise colour in Fig. 3, i.e., the countermeasures are summarised on the right side, the ones currently in use at the top and those of more supporting character, applied in other fields or considered for further developments at the bottom. This scheme should be the skeleton for the consecutive figures.

2. Evolving a Concept Step by Step

2.1 Previous Subject of Mine Detection

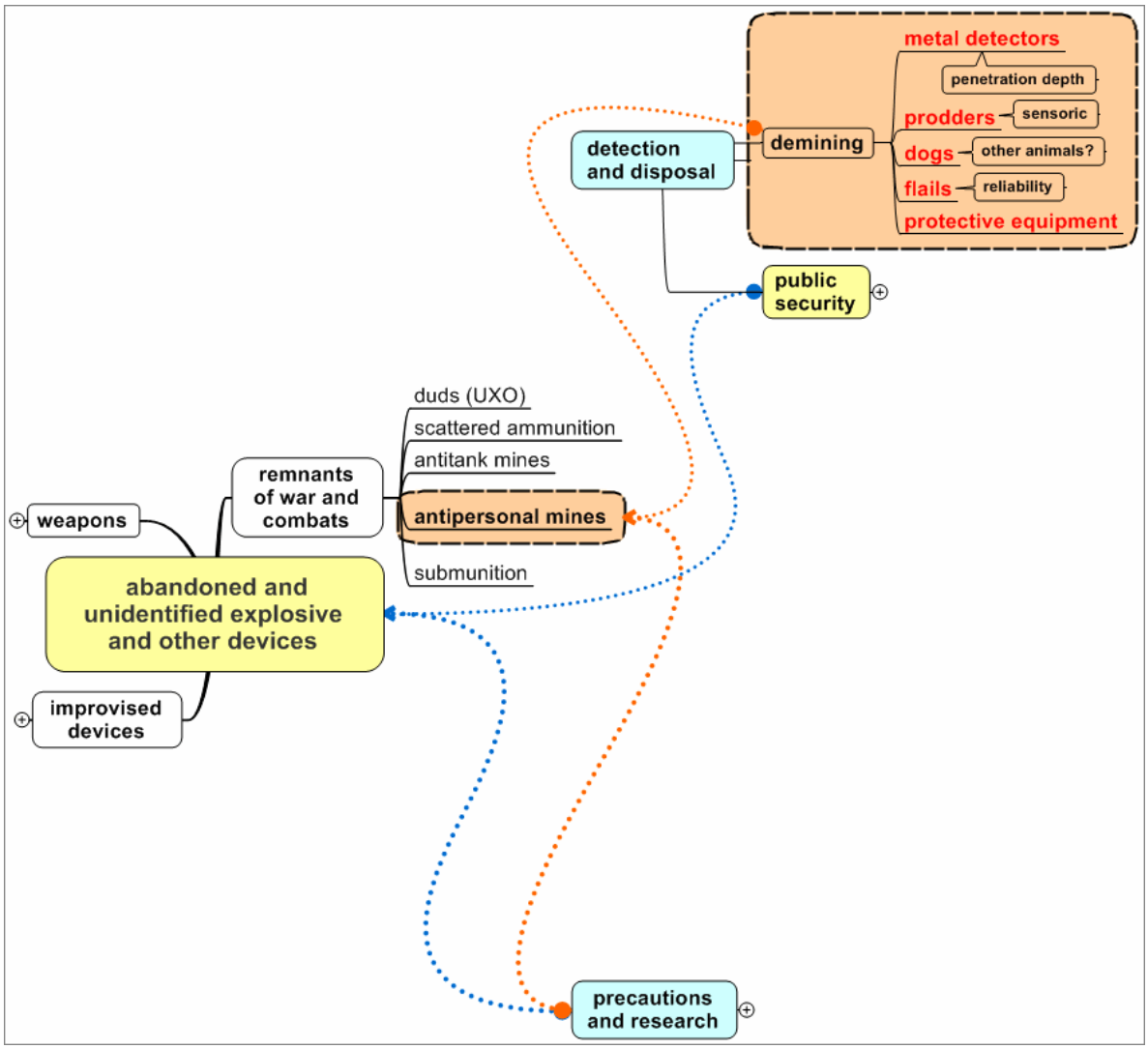


Fig. 4: Former and future scope of interest and activities

The focus of interest and activities of the previous scope of Working Group 5 is inserted into the skeleton of the previous Fig. 3 and shown in detail now in Fig. **4** marked by the light brown colour. There are still the same four tools being used in humanitarian demining

as before which are metal detectors, prodders, mine search dogs and mechanical demining machines (flails), though numerous alternatives have been suggested and developed at least in parts [8]. Personal protective equipment cannot be generally developed since demining is in progress in different parts of the world with their very own climate, weather conditions and habits. Another aspect becomes evident in this figure that antipersonal mines are just one class of remnants left from wars and armed conflicts. Unexploded ordnance (duds, UXO), lost and stray ammunition, large antitank mines and particularly vicious submunition constitute also considerable threats in the affected countries. Particularly the latter ones cause considerable headache even in current activities of humanitarian demining. At the end, all kinds of explosives lying around and therefore uncontrollable are of public concern (as indicated by the blue arrows in Fig. 4).

2.2 Further Threats

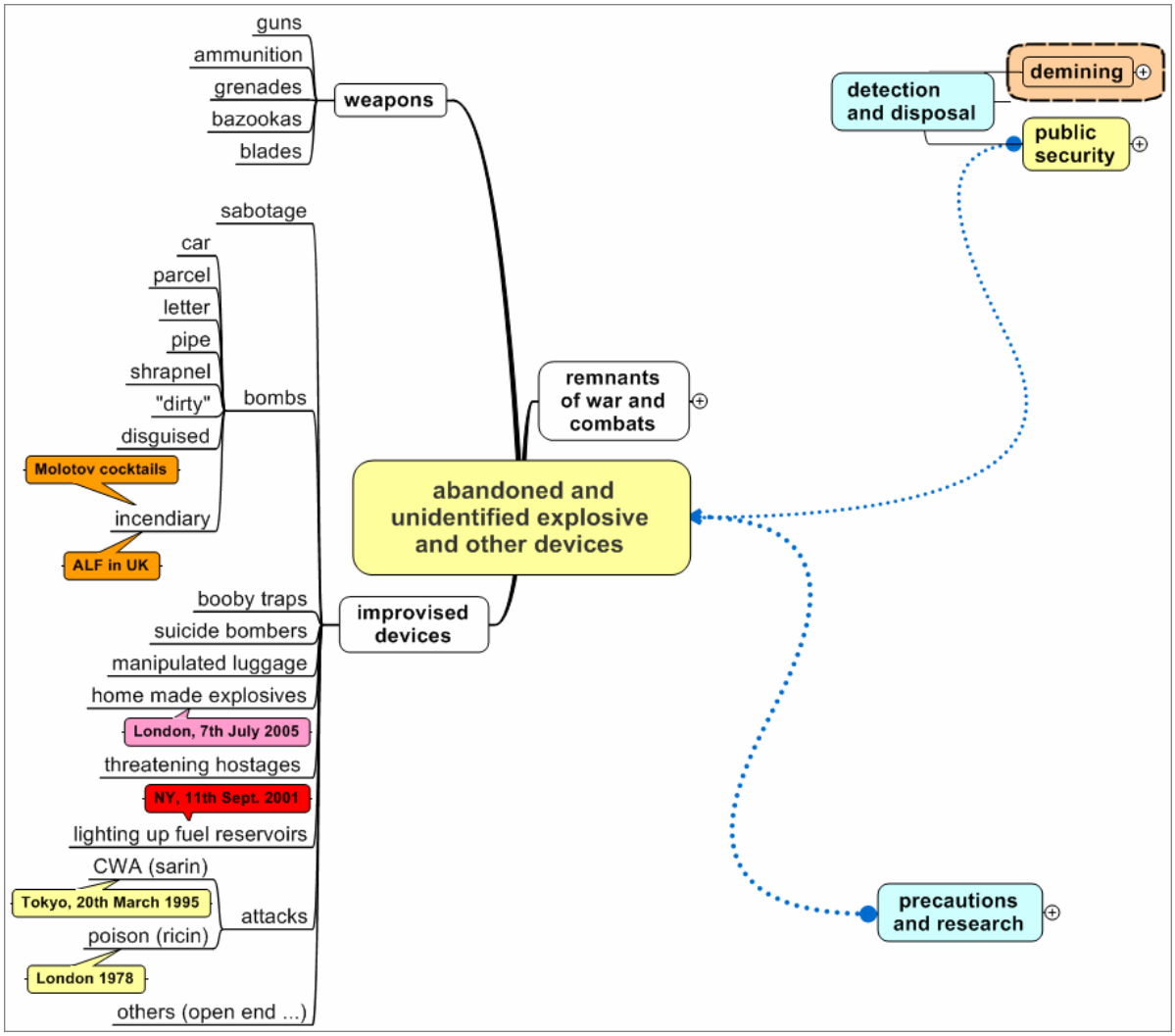


Fig. 5: Challenges of public safety

As the scene moves from mines to IEDs, it appears to be like entering an apparent cat-and-mouse game. In difference to mines, there are no definite types, they are just improvised. Hiding bombs in every-days utensils, or even in toys, can make the situation particularly wicked. All this makes rendering save anything else than a routine procedure, radiographic inspection remains more or less the only routine. A radiographic image [9] may form the base for the decision of the next action – and here we are, radiography is a typical non-destructive technology that is not common in humanitarian demining. The fact that really

complicates the situation is that the scope of threats is even broader, ranging from any kind of weapons to threats not necessarily linked to just explosives. In Fig. **5**, the broad spectrum of threats is given that does not only entail explosives. It starts with the weapons where fire guns need ammunition, but knives and daggers do not. Most improvised devices are explosive ones, but again, some bombs are incendiary ones such as the well known "Molotov cocktails". It should be noted that the "Animal Liberation Front" (ALF) in Great Britain is specialised in arson. Probably the most dramatic attack using fuel instead of an explosive was the "September 11th" attack in New York in 2001 where the kerosene of the planes exploded in the course of the crash.

Even the kind of explosives exceeds by far the range encountered in the military battlefield. In particular, an awful unstable home-made explosive has been involved in the London Underground and bus attack on 7th July 2005, namely triacetone triperoxide (TATP). This explosive is easily prepared by household chemical that all can be bought in any chemist shop. But it is very dangerous to handle so it has been given the nickname "devil's grandmother". In a dry state, it can spontaneously explode. Means of attacks could well be other substances than explosives, such as sarin in Tokyo on 20th March 1995 or ricin in the so-called "Bulgarian umbrella" in London in 1978. So it is by far more than a hypothetical consideration to include substances other than explosives into considerations of threat detection. As with IEDs and booby traps, another sort of cat-and-mice game will be entered where improved technologies on one side enable to detect more and more threatening substances in increasingly lower concentrations and the other side endeavours to prevent detection by all means, and there are ways to achieve this. So this remains open ended as far as one can see right now. Since it is certainly unnecessary to re-invent the wheel, material sciences and non-destructive testing may already have one or the other technology and thus has a potential to contribute to the prevention of terrorist attacks by detecting threats in time. This is for sure one of the big challenges of our time, a sound argument for Working Group 5 to reconsider its scope.

3. Threat Specifications and Countermeasures

3.1 Current Practice

As a consequence, numerous technologies as shown in Fig. **6** are already well introduced in the area of public security and safety to detect threats and to take protective measures in time. Metal detectors as well as certain inspection procedures are common in any airport of the world and in many entrances of public buildings. Smoke sensors use to be in an operable state all time. While such measures are routine preventive measures, others are held in readiness for cases of enhanced suspicion or increased security requirements. Some analytical methods such as ion mobility spectrometry (IMS), laser induced breakdown spectroscopy (LIBS) or Raman spectrometry that are all available even for on-site applications certainly belong to the latter group. Radiation monitoring is applied at certain borders where radioactive contraband may be suspected. In any case, visual inspection certainly will keep its central role in public security, not to forget that this is also part of non-destructive testing. So it is certainly helpful to distinguish between fast and simple to apply technologies on one hand and more sophisticated ones on the other applicable on request only. It should not been overseen that smoke detectors may also contribute to prevent arson. In cases where rendering save is not possible IEDs might be brought to explosion under controlled conditions entailing shielding and covering with shock absorbing materials. Some detection technologies are less common but shall be particularly in the future focus of Working Group 5.

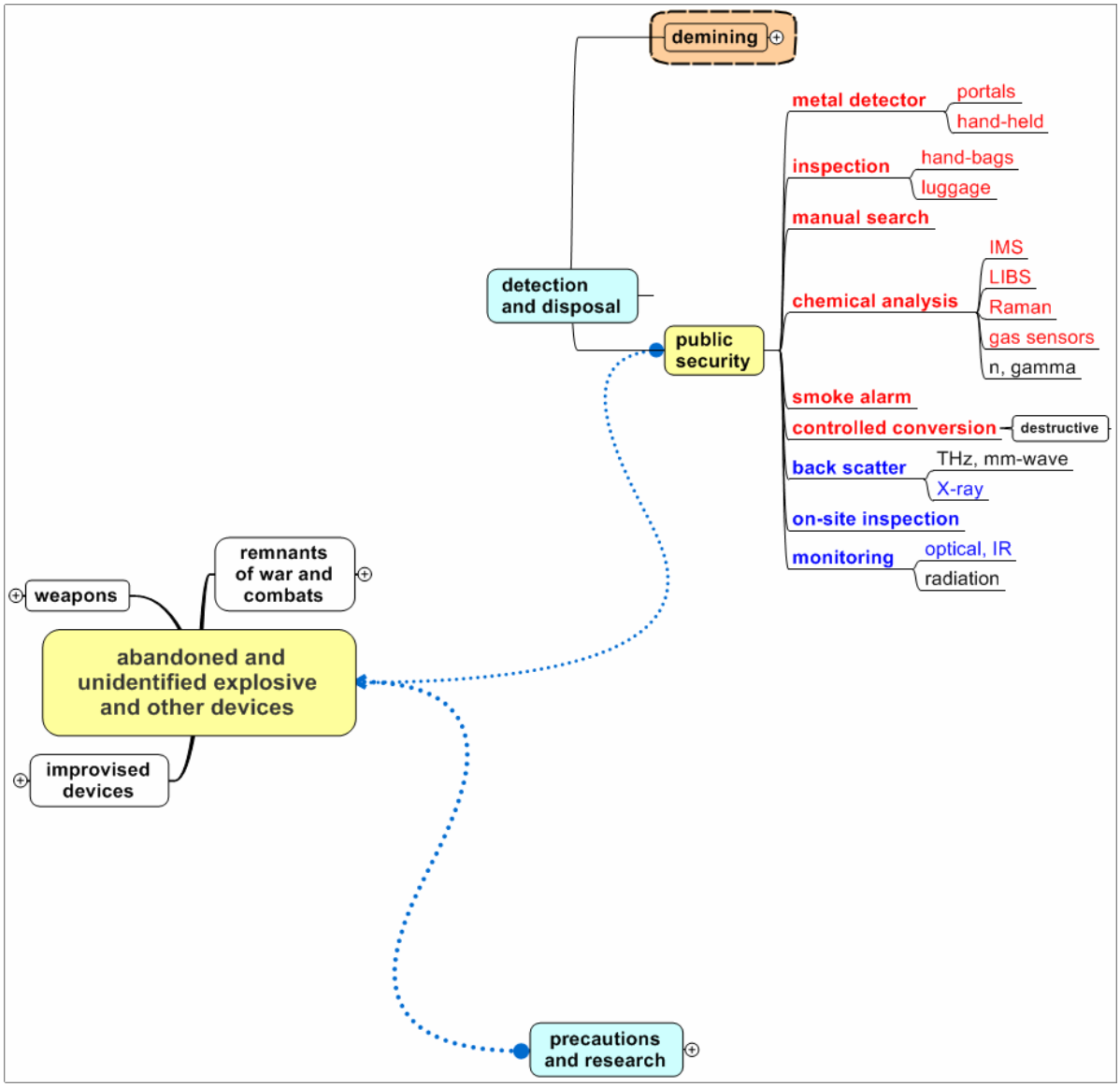


Fig. 6: Means of public security:
Well introduced procedures are written in red, less common ones or those only occasionally used in blue or black.

3.2 Supports and Future Developments

Numerous technologies and procedures are more common in other areas such as pure technical safety rather than in public security, examples are shown in Fig. **7**. Monitoring the environment and maintenance of technical equipment are well established procedures as well as a comprehensive body of standards and regulations concerning the management as well as the education of qualified personnel. Like indications of flaws in the technical area it is essential to have also those of any kind of threats, and might be definitely longer than that of crack sizes or signs of corrosion. Reliability assessments should help to re-evaluate both, current technology and common practise and thus contribute to further improvements. Moreover, as the challenges increase it becomes more and more essential to probe for alternative and novel approaches to the problem. There is no escape from the cat-and-mouse game. Even worse, it does not allow the time and resources to develop novel approaches for countermeasures from scratch.

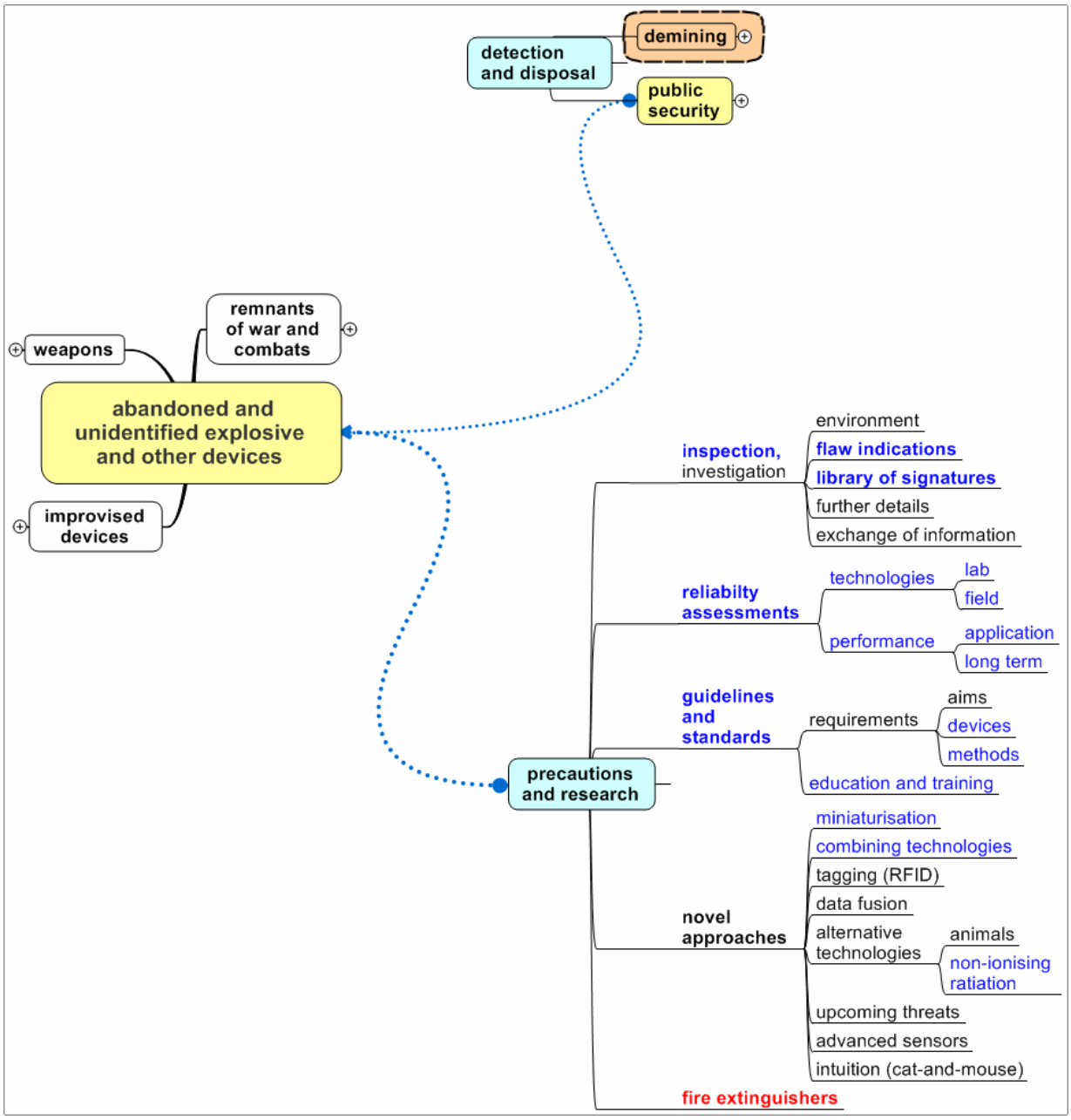


Fig. 7: Measures supporting public security and safety:
Introduced technologies are kept in blue, others that are open for future developments in black. Fire extinguishers are state of the art equipment in many places; their role in the common public security may deserve re-evaluation.

Promising future technologies become apparent in the area of sensor technologies, training animals with a highly developed olfactory sensing other than dogs (rats, bees), non-ionising radiation such as mm-waves and terahertz that allows application on persons, intelligent tagging of dangerous materials which are essential in certain technological processes that includes radiofrequency identification (RFID, miniaturisation that does not only reduce the size of devices but makes them working significantly faster and combining technologies via data fusion so the result becomes more meaningful than the sum of separate procedures. Monitoring and preventive measures such as sprinkling systems are already standard in fire protection leaving the questions if such systems may be also suitable for the prevention of terroristic attacks. It might be worth to consider those for implementation in public buildings and/or commuter traffic facilities. These are only examples of a range of subjects where the Working Group 5 could well be able to contribute, either in developing

new concepts, validating new approaches, assessing reliability and drafting guidelines to assure appropriate use.

Conclusion

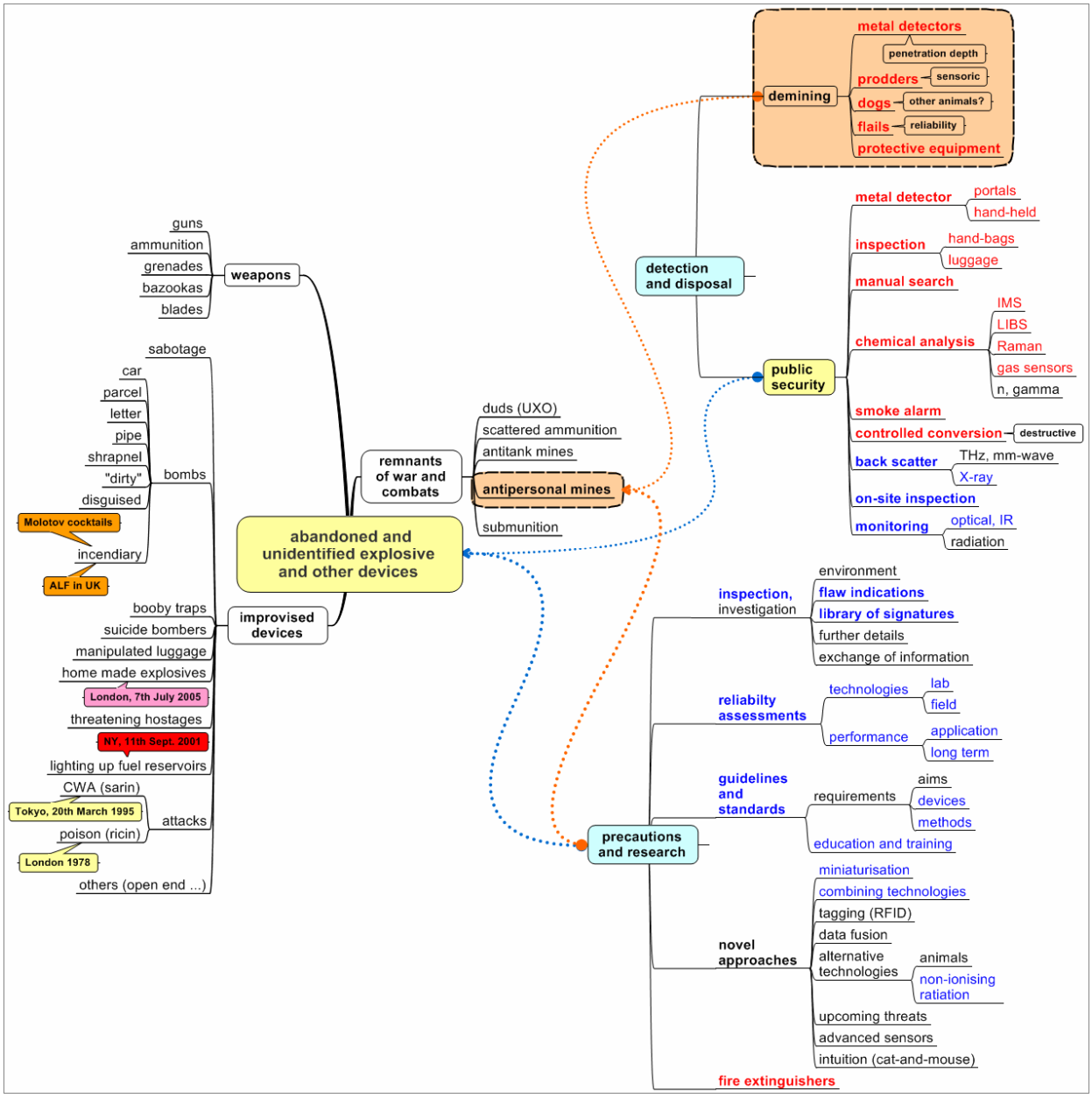


Fig. 8: WG 5: from demining to public security and safety in an overview

Finally, the skeleton of Fig. 3 can be completed to a comprehensive presentation shown in Fig. **8** that includes all details from the previous figures 4 to 6. It should demonstrate the vast range of challenges on one side (to the left in the diagram) and numerous countermeasures (on the right side) of which a substantial part is related to non-destructive testing. This is in support of a central part of the concept of Working Group 5 already realised in humanitarian demining, i.e. not necessarily to develop new approaches from scrap but to check existing non-destructive testing technologies for their capability to being applied for public security and safety.

This mind-map also shows that the subject “antipersonnel mines” will be not forgotten at all. Moreover, it now is embedded in a much larger context of currently existing

threats concerning the general public. In particular, precaution measures and research intentions may well cover aspects of both areas, the humanitarian demining problem and concerns about public security.

References

[1] How do landmines affect development? http://www.mines.gc.ca/I/I_F-en.asp
[2] Landmine Monitor Report 2005: Toward a Mine-Free World,
ISBN: 0-9738955-0-0, http://www.icbl.org/lm/2005/
[3] Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction, http://www.icbl.org/treaty/text/english
[4] Larry C Johnson (2006), Mayhem in Counting Terrorism,
http://noquarter.typepad.com/my_weblog/2006/02/mayhem_in_count.html
[5] Kurt Osterloh, Uwe Ewert (2002), EFNDT WG5 APMD, Achievements and Future Tasks
8th ECNDT Barcelona (Spain), June 17 21, 2002, Technical Papers, (CD and Abstract Volume p. 321)
[6] Kurt Osterloh (2006), EFNDT WG5: von Antipersonenminen zur öffentlichen Sicherheit,
ZfP-Zeitung 98, 28-29
[7] Merriam-Webster OnLine, http://www.m-w.com/
[8] Kurt Osterloh, Christina Müller, Uwe Ewert (2002)
Bedrohung durch Minen - können zerstörungsfreie Prüfmethoden zur Beseitigung beitragen?
ZfP-Zeitung 82, 33-40
[9] Ewert, U., Osterloh, K., Zscherpel, U. (2003)
Specialised radiological techniques for security applications
NDT 2003, 42nd Annual British Conf. on NDT,
Worchester, GB, Sep. 16-18, 2003, p. 9-14, ISBN 0 903132 31 1