In the early 1990s, we were made aware of the global landmine crisis. At the time, it was clear that only a fast and efficient demining process could address this problem — and that the use of dogs to sniff out landmines was particularly promising. Mine dog detection has since grown to become a large segment of the humanitarian demining industry, but not without some difficulties. Most of the early MDD programmes were established by ex-military/police trainers who, while having considerable experience as dog trainers and handlers, had little understanding of the landmine problem. Many opinions and disagreements were voiced, practice was strongly individualistic, and there was little industry coherence (see Chapter 2). Moreover, the fundamental properties of vapour sensing for explosives (operational, physiological, chemical) had previously received little research attention. One consequence was that dogs missed mines with no clear explanation, and practitioners had a limited ability to respond to the problem.

The post-war situation in Bosnia and Herzegovina in 1997 and 1998 had a major impact on the way we use dogs today. Bosnia and Herzegovina became a Klondike for demining organisations, some of which took a gamble by using poorly-trained dogs in exchange for higher profit. Some companies further claimed a much higher productivity than their NGO and commercial competitors. Perhaps surprisingly, the quality of the product was never officially questioned during the early stage of the operation. This situation changed when Bosnia and Herzegovina became the first country to introduce national
testing of mine dogs, a painful process causing considerable mud-slinging between NGOs, demining organisations, and the national Mine Action Centre (MAC). Demining organisations outshone each other in making excuses for the appalling results. Their explanations were unconvincing. However, the MAC became the scapegoat and it was claimed that the test procedures were unfair. Yet some demining organisations managed to pass the test with most of their dogs. Nevertheless, the overall credibility of MDD had been significantly affected.

Consequently, the GICHD launched a study of mine dog detection based on a desire to improve overall MDD, define its limitations, and improve its credibility. In 2003, recovery has been partially achieved and MDD has improved. There is agreement on the basic principles of training and use of dogs. We largely understand the chemistry of vapour transportation in soil, and how environmental effects, including soil properties and weather, affect this process (Chapter 5). Despite all this, we are far from understanding the full potential and limitations of MDD. The line between success and failure is fine and blurred, and demining organisations keep crossing this line thus leaving mines behind. International standards\(^1\) for demining have been established, and are high, although not all MDD operations manage to live up to these standards. Recent reports reveal that the number of mines left behind by some dog teams is much higher than is acceptable (if there is any sense in which any mine being left behind can be considered acceptable). An ongoing and systematic application of research and operational improvement will improve this situation and make MDD faster, safer and more reliable than is the case today.

In the rest of this chapter, I discuss relevant issues requiring resolution or thought in order to achieve this improvement, and offer some comments about the way forward.

### Dogs versus alternative vapour technology

A successful demining technology is one that can speed up a demining process safely and reliably with a lower than proportional increase in costs. One alternative to dogs that has undergone significant development, is the use of another animal system (e.g. rats, see Chapter 4, Part 2). Artificial vapour detection also has the potential to compete with (or be used in conjunction with) animals. However, dogs (and rats) are still far better vapour detectors than any currently available technology. Furthermore, dogs and rats are sensitive to many different scents concurrently, a property that has proven difficult to replicate artificially. Artificial vapour detection of landmines therefore presents a real challenge, which is unlikely to be overcome by researchers in the near future. Even if the technology achieves the success levels of animals, it will take additional time for operational prototypes to be developed and final products to be absorbed by the industry.

Solving the landmine problem is a long process, and research into artificial noses may still pay off. That said, the current discrepancy between the sensors of animals and machines suggests that mine dogs and perhaps rats will maintain their role as leading vapour sensors for landmine detection in the foreseeable future. However, increased focus on quality of work (reflected in, and led by, IMAS) will require ongoing improvements in both the understanding of chemical and biological processes and the perfecting of training and using dogs and rats in the field.

\(^1\) IMAS ([www.mineactionstandards.org](http://www.mineactionstandards.org)).
Alternative sensor technology

Vast sums have been spent on the development of more efficient sensor technologies. Many detection principles have been studied by hundreds of research organisations. The results, however, are discouraging, as there has been no real breakthrough. Furthermore, the demining sector is small and almost insignificant: it is therefore questionable whether the market is big enough to justify the costs of developing and mass-producing seemingly promising new technologies for humanitarian demining. More likely is that humanitarian demining will profit from spin-off effects of military or security requirements, rather than becoming a real market in itself. Moreover the demining industry tends to resist the introduction of new technologies for many reasons, one of which is that high-tech equipment is considered less appropriate for programmes aiming to develop and sustain local demining capacity. While it can be argued that this view is unnecessarily pessimistic, targeted improvement of current technology, such as MDD, is likely to have a greater positive impact on the speed and quality of humanitarian demining during the next 20 years than is research into new technologies.

Future role of the GICHD MDD project

The GICHD MDD study was implemented as a series of independent but closely interlinked sub-studies. The aim was to develop international standards and guidelines, including conducting the necessary research to understand strengths and limitations. The study has, however, evolved into something more. It now provides a focal point and a platform for cooperation between research and practice. Without such a focus, it seems likely that MDD will slide back to what it was before: a fractured industry flavoured by discrepancy of opinion and practice (Chapter 3). The GICHD intends to maintain its research coordination role and to provide the MDD industry with an independent and impartial focal point for exchanging information for as long as is needed and funding can be obtained. The aims of the project will change over time, as a direct product of current and future research results and practical experience. Below are some current and planned areas of focus for the GICHD during the next two years.

Disseminating information

There will be an ongoing focus on dissemination of research products to the MDD community. As research chapters are completed, publications will be made and distributed. However, research reports alone may not be the best way to disseminate information. Complex issues, such as the vapour transportation process (Chapter 5) or training methodology (Chapter 1), are hard to explain in writing in a way that is clear to operational staff. For some, it may be difficult to relate written information to field or training situations. It is therefore important to use a variety of presentation approaches. Video films, as a supplement to written reports, should increase the understanding of facts and recommendations from research, and could additionally stimulate use of research reports as reference material. Currently, the GICHD is producing four video films as a pilot project, three of which will complement this book. Filming is planned to take place in Afghanistan, Angola, Bosnia and Herzegovina, Cambodia, Croatia, Norway, South Africa, and Tanzania. The final product will be completed in late 2003.
Environmental factors

Although vapour transportation in soil is reasonably well understood, there is a long way to go. Vapour availability at ground level largely depends on the quality of target scent emanating from the landmine. A well-sealed landmine may not be detected by a dog under perfect conditions simply because too little scent is transported to the surface. To determine the availability of vapour at the surface, it is necessary to take flux rate (leakage) from landmines into account. It is known that some mines are easier to detect than others, but very little research has been undertaken to determine the flux rate from different landmines. A landmine leakage library could be as valuable to an MDD organisation in the future as technical data about metal content in landmines is for a manual mine clearance organisation today. Understanding of the relationship between flux rate, target scent at surface level, and the effects of weather and soil properties on migration of vapour through the soil, is essential to be able to predict whether the detection potential is above or below detection benchmarks for different equipment — including dogs and rats. Defining the limits of detection will assist in the understanding of the optimal deployment of animal detector systems and productivity, and safety should also be improved.

With the above thoughts in mind, the GICHD has recently expanded its partnership with Sandia National Laboratory. Two new projects have been designed: one will address flux rate from landmines, the other will enable computerised simulation of the vapour transportation process. Results from these two projects are expected in 2003.

Breeds

It has always been difficult to find suitable dogs for training as mine detection dogs within the currently used breeds. The 11 September 2001 tragedy made the situation worse because it triggered an increased worldwide requirement for dogs to sniff out explosives at airports. The demand for detection dogs now far exceeds the supply. In 2001, the GICHD published a report analysing positive and negative properties of dog breeds for mine detection. One of the conclusions was that there are probably breeds better suited to mine detection work than the currently used breeds. One suggested alternative was the Swedish drever, a scent hound bred for hunting. It is of course unlikely that an experimental breed would be adopted for use by a necessarily conservative industry with limited financial resources. The GICHD has thus purchased and donated eight drevers to four demining organisations, commercial and non-commercial, for experimental training and comparison with more traditional breeds. The end result could be that we will have more and better breeds to choose from in the future. The GICHD will continue to facilitate this project, including publishing results from the experimental training of drevers. Breeding and training of MDDs is however a slow process. It will inevitably take several years before we have enough experience to draw conclusions.

Rats — a realistic alternative

Rats have many advantages compared to dogs (Chapter 4, Part 2). They are easier and faster to breed and can be trained from about six weeks of age. Some rats, such as the African giant pouched rat, have a life span of up to seven or eight years. Rats also exhibit repetitive search behaviour, a much-desired quality in a mine detection animal.
Rats are small, easy to accommodate and transport and as wild animals should be more resilient to local environments than dogs, especially in tropical climates. Rats behave differently to dogs and this reflects in the way rats are trained and used. For example, in contrast to traditional ways of training and using dogs there is almost no rat/handler dependency. Communication between the handler and the dog is vital for successful MDD, at least in most programmes using dogs. Elimination of dependency between the animal and the handler will largely eliminate miscommunication errors, which is one of the most common reasons for missed landmines.

The APOPO rats project has shown promising results and the GICHD has supported this interesting research programme during the last two years. APOPO has undertaken experimental training of rats in different configurations and with different rat species. The African giant pouched rat has shown the most promising results. APOPO trains rats for direct and indirect mine detection. Although rats have shown good potential for direct detection, the use of rats in a REST concept (indirect detection) may be a more promising application. The research project has now reached a stage where field search and REST rats will soon be tested operationally. Important in this process is proper documentation and an effective validation. However, even if all these challenges are addressed, it is not automatic that rats will be taken into use. The demining industry is small and breaks with the principles of a free
market economy. Economic decisions on demining are often based on political agendas. Donors may fund their favourite NGOs rather than those with the highest productivity. And the use of technology can often relate to where the technology has been developed, with governments only funding programmes if they use machinery or detectors from their own country. Also, the selection of technology may be based as much on tradition and political influence as on a search for the optimal system. Clearly, six years of research would be a waste if the rats were not adopted in the field. The challenge, as with all new demining technology, is to ensure that research is accompanied by the development of practical procedures and equipment and field testing on an operational scale. Prejudices about rats due to their reputation for harbouring disease and bringing death must also be addressed. If rats are accepted by the industry, it will be necessary to establish a capacity to breed, train and introduce rats to demining organisations: rats are not available for purchase in the same way as dogs. Clearly, if rats are only marginally used, it will be difficult to defend and fund a comprehensive support centre. But without such a centre, it unlikely that demining organisations will adopt and maintain programmes using rats.

**Improving operational procedures**

We have so far prioritised studies of environmental factors and Remote Explosive Scent Tracing (REST) at the cost of studies on the operational use of dogs in the field. Dogs are used differently, and there are pros and cons with different operational procedures. Intensive analysis of the functional areas of MDD field operations will identify the links between behaviour, routine and efficiency of work, potentially leading to optimisation of the use of dogs. This is a more time-consuming but effective alternative to traditional evaluation methods which tend to oversee field operations without making in-depth analysis of procedures.

There will therefore be a stronger emphasis on studies of MDD operations in the future. A series of case studies will eventually be available for comparison, some of which have already been completed. Some of the results show surprising dependencies between speed and applied procedures, dependencies that the demining organisations themselves had not yet observed or recognised.

**Remote Explosive Scent Tracing**

In contrast to common opinion, the most important challenge in humanitarian demining is usually to determine where landmines have *not* been laid. Much greater areas are typically suspected as mined than those actually mined. Area reduction is often 90 per cent of a demining operation and has a more significant immediate impact on the community than clearance. REST is an example of a system that should work fast to define mine-free sectors of land. If REST could be applied for area reduction, vast areas of land could
be released more quickly and at a much lower price than using any other demining technology. REST has already been used as a rapid road verification tool (Chapter 4, Part 1). The system is, however, poorly understood and little is known about its limitations, particularly in relation to how best to train and use REST dogs (Chapter 2, Part 2). It is thus difficult to use REST for area reduction today. The use of REST can best be illustrated by describing it as a way of capturing images of large areas rather than small areas, such as those covered by a search head of a metal detector. This allows higher sampling speed, which is key to an efficient demining technology.

This book has described the various elements of a REST process, including one method for training REST dogs. Dogs can easily be trained to detect the correct substance and to sniff out contaminated (positive) filters, but the pitfalls are many. Small and seemingly trifling errors applied during training can make a difference between success and complete failure. Dogs will typically pick up any possible clue that could help indicate whether filters are positive or negative. Without full understanding of these clues, dogs will fool us by applying clue-based detection rather than real detection of scent. In this context a clue means an aid that the animal uses to detect what it thinks we want it to detect. A clue can be a scent, the lack of scent, a signal from the handler or simply a tendency towards non-random placement of positive filters in an analysis set-up. We have only recently become aware of some of these problems, and need to understand them better before the REST system can be fully applied.

REST is prioritised by the GICHD because of the potentially high impact of this technology in the future. REST could become one of the most effective area reduction tools provided that its strengths and limitations have been fully defined. The various elements of REST also need to be optimised, to increase its potential use and credibility. Current and future activities involve the following components:

**Filter technology and sampling equipment**

Key properties of a REST filter are the ability to trap the highest possible concentration of TNT molecules during sampling and to release a high percentage of the same molecules during analysis. The current filter cartridges (used by Mechem, NPA and NOKSH) may not possess these properties or could be improved. Another issue is the ability to absorb dust during sampling. Dust contains much higher concentrations of TNT molecules than air at ground level. Filters capable of trapping more dust without clogging will therefore increase the overall mass of TNT in the filter. The Swedish Defence Research Agency has been asked to investigate the positive and negative properties of the currently used filter cartridges and to develop improved filters and sampling equipment. This is an ongoing process and prototypes are soon to be presented.

**Area reduction application**

An important weakness of REST is that we do not know the size of the detectable scent plume above landmines. The plume size will depend on many factors, including type of mine, soil properties, environmental factors, filter material, suction pressure and sampling technique. Practical field experience suggests that REST sampling will pick up mines from a minimum distance of eight metres. The reliability of this estimate is, however, unknown and it is necessary to fully determine variations in the detectable plume if the aim is to use REST for area reduction. NPA-Angola has been asked to manage a test project and undertake repeated sampling and analysis in a test field, which differs from most other test fields in that the minimum distance between landmines is 35 metres to avoid cross contamination. The sampling and analysis
involves ten sampling sequences over a period of 12 months. Each sampling sequence will involve the use of 1,600 filter cartridges. The results will be used to determine reliable detection distances for mines, which will help to define the optimum size of sampling area for REST.

**REST validation, Bosnia**

The REST dogs trained by NOKSH (Chapter 2, Part 2) for the GICHD study on REST are now being used as verification tools for further research. A short-term test and confirmation programme has been designed in collaboration with BHMAC, NPA-Bosnia, and NOKSH to determine whether the dogs can find mines reliably in Bosnia. If this proves to be the case, BHMAC and NPA-Bosnia will consider using the REST system in Bosnia in the future. Preliminary results from this project indicate good results. However, it is also clear that detectability of mines is linked to weather patterns at the time of sampling, and weather could influence reliability. The NOKSH dogs will also be valuable assets for the GICHD when carrying out trials on new filter cartridges and for quality control of filters from test projects in Angola and Tanzania.

**The use of rats**

It is now clear that rats can be trained to detect landmines in the field (Chapter 4, Section 2). As APOPO have argued, the economics of training and using rats operationally could be lower than for dogs. However, there is need for a proper test and validation to justify such claims, and to field test the use of rats in minefields. There is also need for further work on the potential of rats as REST detectors. The work of APOPO is helping to identify undesired clues that animal detectors will use to help detect contaminated filters. Thus APOPO will potentially help to identify essential improvements for REST dog programmes.

**Operational sampling concept, area reduction**

If it is proven that REST has potential for area reduction, the next step is to develop safe and efficient sampling methods. To search roads, REST sampling teams walk in the tracks created by heavy mine-proof vehicles. This method will have less application outside typical road scenarios where vegetation could prevent the sampling team from following the tracks, and tripwires would be a real risk. It is clear that new sampling techniques must be developed. This work, has, however been postponed in anticipation of the results from research and tests on REST area reduction application.

**Establishing REST testing facilities**

There are two possibilities: one is to establish many REST analysis facilities in mine-affected countries; the other is to centralise the analysis service in a few locations. The latter is probably the easier and less costly approach, and the GICHD is exploring the possibility of establishing centralised REST testing facilities in three locations (Bosnia and Herzegovina, Southeast Asia, Southern Africa). It remains to be seen whether the cost and logistics of shipping large numbers of filters are viable.
**International standards and guidelines**

The IMAS series of standards has been recognised and endorsed by the international community. Mine dog detection is an element of this package, with five standards describing how to treat, test and use mine dogs. The MDD standards have been developed in collaboration with the UN, GICHD and various MDD organisations. It is difficult to write standards that satisfy all segments of an industry, but the MDD series of standards have largely been perceived as suitable. That said, results from systematic empirical field experience and research results suggest the need for a revision in the near future to accommodate the new “wisdom”. Revision of standards is a time-consuming and costly process and should be avoided if there is no real need or if there are few changes to the original conditions. However, the results from field-testing of the standards and from the studies reviewed in this book imply a comprehensive revision, likely to be initiated in 2003. As part of that process, it is essential that the standards are fully understood and that there is IMAS compliance within the MDD community. The MDD community itself has recognised these requirements and the GICHD has been asked to play a facilitating role and to manage a process of training and helping national mine action authorities and demining organisations. This work, identified as the Mine Dog Standards Implementation and Support Committee (SISC), began in 2002 and will be further intensified in 2003.

**The way ahead: issues to debate**

Improving demining is more than just improving technology. Improvements depend on political issues, coordination of funds, collaboration between operators, regulatory authorities, donors, research institutions, the UN and more. It is difficult to predict the future of MDD because it depends on a changing political environment and international cooperation between actors. The GICHD is prepared to continue to work towards improvements of the MDD industry, in terms of improving the technology and by actively influencing the framework of the MDD industry. The table below reflects some of the many current trends and problems of MDD. Each topic is followed by a section which is meant to facilitate discussion about the future of MDD.

---

**Stand-by route clearance - funding/coordination**

About 750 dogs are currently used in 23 countries, but almost half of them are in only two countries (Afghanistan and Iraq). There are few mine detection dogs in other mine-affected countries. The overall impact on global demining is thus limited.

International humanitarian demining operations were previously undertaken in a few countries, but the trend is now to resolve landmine problems in many countries concurrently. This does not mean that more mines are laid today than before, but there is a growing international pressure to resolve the global landmine problem. This has caused a growing need for rapid route clearance and, in the absence of alternative technology, MDD is one of the few real alternatives. Yet some of the major commercial MDD companies have said that the market is too small to consider further expansion. At the same time, the UN complains about the lack of MDD capacity in many countries, especially those with an urgent route clearance requirement. The discrepancy between the UN and the MDD community in defining the requirement is a paradox. Clearly there is a need for more MDD, but it seems difficult to coordinate funds and requirements.
Debate
If there is a need for a significant standby MDD capacity, it would perhaps help to examine why “free” MDD capacity is unavailable or is too expensive. One reason is market unpredictability, preventing investment into larger flexible MDD capacities. MDD may therefore maintain a less significant role in humanitarian demining if the framework of the industry remains the same as today. To change this would require initial investment from the international community in return for dog (or perhaps rat) teams that could be rapidly deployed around the world. Agreements could be made with one or several demining organisations and the dog/rat teams could be used in one or several permanent locations between emergency operations, including Angola, Bosnia and Herzegovina, Cambodia, Croatia, and Mozambique.

The key to success, if it is agreed that this is needed, is coordination of donors and funds. Donors need to work together in a depoliticised fashion on this issue, which is probably impossible without the help of the UN, the EU and some other major institutions.

NGOs and MDD
NGOs have been careful in using dogs. When making choices between dogs and other technology (manual demining and to some extent mechanically assisted clearance systems), MDD loses because of too many opinions, uncertainties and unproven aspects of MDD.

Debate
When basic principles of training, operational use and environmental effects are commonly understood, dogs and rats may become a real alternative for these organisations, again resulting in increased use of dogs and perhaps rats.

Debate
If there is a need for a significant standby MDD capacity, it would perhaps help to examine why “free” MDD capacity is unavailable or is too expensive. One reason is market unpredictability, preventing investment into larger flexible MDD capacities. MDD may therefore maintain a less significant role in humanitarian demining if the framework of the industry remains the same as today. To change this would require initial investment from the international community in return for dog (or perhaps rat) teams that could be rapidly deployed around the world. Agreements could be made with one or several demining organisations and the dog/rat teams could be used in one or several permanent locations between emergency operations, including Angola, Bosnia and Herzegovina, Cambodia, Croatia, and Mozambique.

The key to success, if it is agreed that this is needed, is coordination of donors and funds. Donors need to work together in a depoliticised fashion on this issue, which is probably impossible without the help of the UN, the EU and some other major institutions.

Debate
Vapour detectors will eventually be produced, although they are likely to have several limitations compared to animals. Vapour technology could, however, prove useful when testing dogs and rats for quality control and accident investigation. If a missed mine has been found, soil, dust or air could be sampled and sent to centralised labs for analysis. This could be a simple process and the result could help determine whether there is detectable target scent above the mine.

REST
REST has a major potential in humanitarian demining. Yet only two organisations use REST today and the technology consequently has a limited impact on global demining. REST is further limited to verification of roads. The lack of proven concepts of training and using REST dogs is probably the main obstacle to dissemination of the technology. Many organisations have shown interest in using REST, but are awaiting significant improvements of the REST concept and technology.
Debate

With a few REST analysis facilities in central locations, there would be no need for demining operators to specialise in filter analysis. The far simpler sampling process could be undertaken by almost any demining organisation, thus making REST a better alternative than it is today. REST sampling teams may typically form part of emergency operations — for road clearance and area reduction. Filter cartridges could be sent out of the country for investigation. A small and adapted demining capacity can subsequently deal with positive (contaminated) sectors of land or road. All this requires that:

- REST has a proven potential for road verification and area reduction.
- There is sufficient REST analysis capacity to serve a greater market.
- Proven concepts of sampling have been developed and tested.
- The logistics, constraints and costs of shipping filters are affordable.

Testing and accreditation

National test and accreditation regimes have only been established in a few countries. The mucky and time-consuming way of testing dogs prevent most countries from developing test and accreditation procedures. This again can be explored by MDD organisations, some of which are willing to trade poor quality of work in exchange for higher profit.

If only a few dogs are used in one country, it is questionable whether a test regime is worth establishing. Should dogs be used at all under these circumstances? Or should they be operational without any form of control and accreditation?

Current methods of testing dogs require vast areas, a high number of landmines and much preparation. It also takes about six months to plan, prepare and develop a test field (including the required soak time). This prevents testing and accreditation during early stages of demining operations — when dogs are typically most needed, when funds sit loose among donors and when there is no other quality control mechanism in place. The risk is that MDD organisations can get funds without being able to deliver a satisfactory product. Not being able to control the dogs and the clearance product means that any twist will always rule in favour of the MDD organisation. Under such circumstances, the risk of being “caught” for poor quality of work is small, especially when knowing that dogs are typically used in areas with a low density of landmines.

Debate

The MDD industry will continue to improve further, resulting in a higher degree of self-regulation. The serious MDD organisations could find it beneficial to be accredited within a self-regulatory system. Donors are likely to be increasingly aware of potential problems with mine dogs/rats and funds could be withheld if an organisation has not received accreditation or has turned down membership of a self-regulatory system.

Testing of dogs could be easier and more technical with advancing technology and knowledge. Detection benchmarks could be established in the future and odours with different odour thresholds could be presented to the dogs for detection. If the dog is incapable of detecting target scent with a sufficiently low odour, it fails the test.

Future testing could involve a two-stage test, one aiming at showing ability to detect sufficiently low concentrations of target scent, and the other aiming at proving that the dog is sufficiently tuned into the scent picture in the operational theatre. The first could be taken anywhere in the world and could be standard for all dogs. The second would be more area specific, perhaps for each country or area. It would be much easier for all mine action authorities to establish test regimes if there was no need to establish huge test facilities. Traditional ways of testing dogs could become redundant, provided that technology and proven methods of measuring concentrations and establishing reliable benchmarks have been developed.
Dogs - primary or secondary clearance roles

The increased use of mechanical mine action systems has brought changes in the use of dogs. Mechanical mine clearance is rejected by many as being capable of full clearance. It is thus necessary to combine mechanical clearance with other clearance systems. Dogs have proved useful for verification behind machines and the combination with machines thus increases cost effectiveness. Machines play their greatest role in Europe, in countries like Bosnia and Croatia. One reason is that salary levels are much higher compared to developing countries in Asia and Africa. Manual demining is therefore less attractive as costs for manual operations are comparatively high.

Debate

It is interesting and surprising that dogs in some countries (Croatia and lately Bosnia and Herzegovina) are prevented by law from being used in a primary clearance role. The rationale for this rule is not known. It could, however, be a sign of low confidence in MDD. Another reason could be high unemployment and thus a desire to keep more people employed, typical for manual clearance methods. This is a real challenge and threat to the MDD industry. Clearly, dogs are useful in a follow-up role behind machines, but the use of dogs should not be so limited. That said, these legal restrictions emphasise the need for significant improvement of the MDD concept. If governments distrust the reliability of dogs and this is why dogs have been prevented from primary clearance, systematic research coupled with operational improvement and documentation may help re-establish credibility.

How to rely on environmental factors

It is commonly understood that vapour detection depends heavily on differences in soil properties and environmental effects. MDD organisations have a basic understanding of most of these effects but they are rated differently, resulting in a poorly defined potential for the use of dogs. It is thus likely that some landmines are missed because dogs are used under unfavourable conditions.

Although many weather factors are commonly understood, it is still difficult to relate their effects to availability of scent at ground level. The uncertainty is high as vapour at surface level heavily depends on leakage from the source itself — the landmine. We know that some landmines are less detectable than others, but knowledge is still limited in this field.

Debate

Environmental factors and soil properties can be incorporated into computer modelling systems - in the future accessible via Internet, and usable in the field. An important but still missing element of the computer modelling system is the mine leakage library, an assessment of the vapour leakage of every known mine type. When we know the flux rate from landmines, we will have a pretty good means of predicting the level of target scent at surface level.

Organisations using rats, dogs or vapour detectors could use this facility to determine anticipated minimum level of scent, which again is to be compared with the odour threshold accreditation level for each dog, rat and vapour detector. The facility could also be used to measure predicted scent levels against proven detection levels for vapour detectors. Detection levels for dogs, rats and vapour detectors could be graphically represented against predicted scent levels in an area and this would help determine whether there is potential for the use of dogs, rats or vapour detectors.