Mine Action Technology Now and In The Future:

Is it realistic to expect great leaps forward in technology?

In order to realistically predict the future of demining techniques and technologies, past and present technology must first be examined and critiqued.

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Introduction

The term "mine action" comprises a series of related activities, all aiming to minimize the problem of landmines. Mine action is no longer a simple mine removal process reserved for a few specialized demining organizations. It is a complex process of activities undertaken by many different commercial and non-commercial organisations – both national and international. When I began my demining "career" in the early 90s, we didn't worry too much about the scope and complexity of the mine problem. We focused on slow and steady removal of landmines. Every village or road cleared was a victory. The appreciation shown by people who were able to come back and cultivate their land without risking being mutilated or killed was sufficient for us to feel that we were doing something useful.

Today, the whole world is more aware of the enormous scope of the problem when seen in the global context. Consequently, 122 countries have signed the Ottawa treaty prohibiting the production, use and export of AP mines. There is a growing consensus about how we should conduct mine action programs–with current technology and methods. The new International Mine Action Standards (IMAS) help us to undertake activities in a safer and more efficient way. Impact surveys help us to define the scope of the problem and enable improved planning of mine action activities. We understand the need to prioritize our clearance activities, and that the impact on people's lives should be used as a key indicator for priority setting. It is generally accepted that mine risk education programs are effective, especially when coordinated with survey and clearance, and that special attention should be given to the victims of landmines. In brief, we are more efficient and professional in resolving the landmine problem today than we were only a few years ago, and at present we estimate that less mines are being laid than are being removed.

There are, however, two sides to the story. The Ottawa Treaty commits the member states to work towards a "mine free world" by 2009, but there is no realistic relationship between this goal and resources available to meet it. While one solution is to dramatically increase mine action funds, it is also clear that even a tenfold increase of funds will not solve the landmine problem by 2009. Without significant improvements of mine action techniques and efficiency, we must accept that the mine problem will be long-term–perhaps even into the next century. This is unacceptable and vast sums are being spent on developing new technologies, to help speed up the process.

Although mine action technology is more than just clearance technology, I will mainly focus on the latter. We have always realized that current demining techniques are inadequate, and we have aimed for great leaps forward. More than $300 million (U.S.) has been spent on research into faster ways of demining, but the results of all this large-scale research effort are, to say the least, minimal. Why is this? Perhaps we should look at the past to identify how and where we should invest our resources in the future.

Past Research Trends

Program managers in the field have every reason to feel confused and disappointed by the lack of progress. In 1994, shortfalls in current technology had been recognized and researchers were promising new miracle technology within five years. Landmines were recognized as a major humanitarian problem, and there was a build-up of funds and interest to combat them. Research organizations, many of which were already involved in related research, jumped on this wave of public opinion and found easy access to funds. While exploiting this opportunity, they argued strongly among themselves as to who should be funded. Existing research programmes and obvious duplication were often "forgotten" in proposals and many research organisations distorted reality to convince donors. Research into Ground Penetrating Radar (GPR) is one example. A rough estimate suggests that about 50 research organizations have been involved in developing GPR systems for landmine detection in

Demining technology development has in the past been incoherent and funds have been wasted as a result. There has been no single entity, but multiple pockets of uncoordinated establishments with their own research agendas. Many donors have either been naive or too swayed by national interests. The demining community has also been unable to provide coherent advice. If technology development had been more institutionalized between field and R&D establishments from the beginning, we could have seen more focused research and less duplication of efforts, and thus less waste of funds. In the future we would benefit from having an organization of specialists who could advise and report coherently on all demining technology – completed, in progress or ready for the field. No real authority would be required, but a mandate by the United Nations (UN) would strengthen the efficiency of work by such an organization. It could become a focal point for donors, researchers and demining organizations on issues related to demining technology. It is important to objectively analyse the mine action sector and provide expert advice on likely trends and development steps.

Europe alone. Was this necessary, or was it a waste of funds? It is of course too easy to put all the blame on research organizations. Many of them were commercial organizations who were jumping on the bandwagon to survive the post-cold war reduction in orders. Donors bear some responsibility, as national interests and "selfishness" sometimes became more important than real achievements. Eagerness to fund national efforts sometimes prevented an objective examination of the research market and the requirements of the field. The same has applied when some donors have funded demining programs or donated equipment "in-kind".

In the past there was limited interaction between researchers and field operators. Many international conferences have, however, attempted to change this and the distance between them is now less. Today, most researchers better understand field requirements and challenges. However, during many of the conferences that I have attended, I have met ignorance from some researchers who seem more preoccupied with defending their own research than listening to end users. In their turn, researchers have often complained about conflicting messages from the field. The great dissimilarity in opinion among field staff makes it difficult for the research community to fully understand the real requirements.

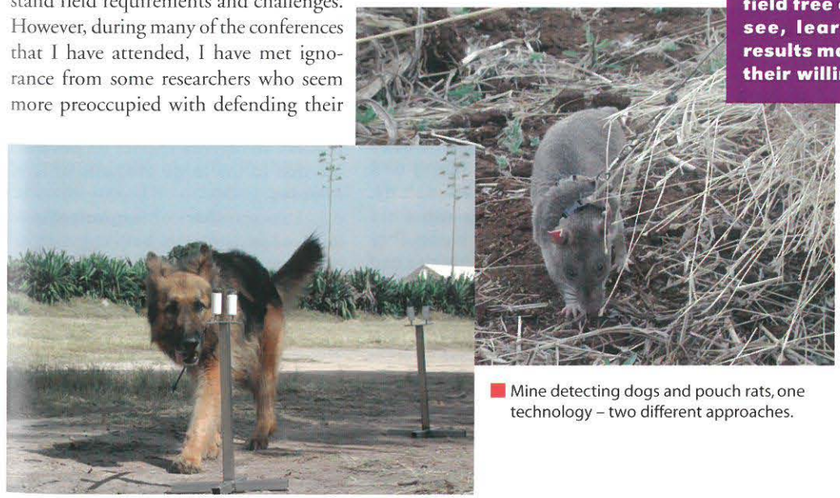
Obstacles To the Use of New Technology

Vast amounts have been spent on technology development. By far the largest proportion has been spent to develop military technology, little of which has an application in humanitarian demining. A major part has also been wasted in unrealistic schemes where the lack of results could have been predicted and avoided. However, there have been some targeted and seemingly successful research efforts. We therefore have to ask where those results are, and why those technologies have not appeared in the field.

Researchers test ideas and develop concepts. Their role may not include product development and field-validation. In addition, equipment development is costly and requires a defined user "market". The demining "market" is unlike other industrial markets in many ways. Specifically, it is small and highly artificial, with market forces driven by other than economic agendas. For example, the prospect of increased efficiency and reduced costs are not always enough to ensure the purchase and use of the equipment. This may be a result of four factors:

1. A demining program is planned by the program manager in-country, and is individual in approach. Many program

There has been limited understanding about the size of the user market and internal mechanisms controlling the acceptance of new technology into the field. There is a distinct difference between what researchers, manufacturers and donors believe is the user market, and what it actually is. The demining industry is small, and there are limits as to how many machines and sophisticated sensors will be required. Making new and promising technology available to users may not result in immediate major changes. That said, we should perhaps think "new and controversial" if we want to see a real impact of new technology in the field. There are many mechanisms working against field take-up of technology. The end user reluctance is generally high. It may be necessary to introduce new technology and concepts in the field free of charge for demining organisations to see, learn and gain experience. Proven field results may also convince donors, thus increasing their willingness to support new approaches.



Mine detecting dogs and pouch rats, one technology – two different approaches.

Technology At a Glance

Twenty three years after the first international effort to clear landmines, in Afghanistan, small-scale demining efforts still take place in that country. The problem has, however, been reduced to a minimum, and will soon reach an "acceptable" level. The global situation has also improved, but there is still a medium-term demining effort in front of us. The Mine Ban Convention has now modified their goal to reducing the landmine problem to a tolerable minimum by 2020. Activists still argue about the term "tolerable minimum" but the states parties are reluctant to clarify this definition. Currently, the Convention has more than 200 signatory states.

Machines have found a definite role in mine and UXO clearance and area reduction. Norms have been established on how to apply mechanical support and the required level of quality control behind them. Mechanical mine clearance machines are integrated into most demining programs. The machines are smaller and cheaper, and demining organizations are more skilled at making selective use of them. Most of the mechanical mine clearance machines are remotely controlled, thus reducing the need for heavy armouring of cabins. Each machine type has been placed in a clearance category and there are norms and standards on how to use machines from the different categories.

Vapour detection has become one of the most important detection technologies. Vapour detectors are available for direct detection, but there are problems with real time detection. Moreover, the portable units only marginally increase the clearance speed in most areas as operators still depend on other search techniques for tripwires and brush cutting. Consequently, mine dogs and rats continue to play an important role; the technology has improved much since 2002 and the application is wider. Most of the environmental factors are fully understood and incorporated into computer modelling systems - accessible via Internet, and usable in the field. Organizations using rats, dogs or vapour detectors can 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. An important element of the computer modelling system is the mine leakage library, an assessment of the vapour leakage of every known mine type, which was a development breakthrough when it came into being some years ago.

The Remote Explosive Scent System (REST) has been recognized as a very cost effective area reduction tool. It is far more efficient than any other approach. However, is has proven to have limited application in obvious combat areas due to the presence of UXO and contamination from bomb/mortar explosions. Many organizations use the system now, although there are only a few specialized filter analysis centers. This has proved to be more cost effective than establishing analysis centers in each demining theatre.

Metal detectors are more sensitive and have a better discrimination rate. They are still preferred in some areas, especially within national programs in countries with low labour costs. Every demining program has a manual demining component, but it is typically small.

The Ground Penetrating Radar (GPR) technology has been developed but field deployment is still slow. The detectors are too expensive, and they break down too often. The clearance speed gained by using them is also less than anticipated in 2002. However, they have proven useful for road clearance, mounted on mine protected vehicles, and are used where totally non-metal mines are suspected or found. There has been some success in combining GPR and metal detection technology. Detectors with combined sensors are better than GPR detectors alone. They are, however, even more expensive and few organizations use them.

We now have a clearer understanding of the life span of a typical national program. Less effort is put into the development of large national manual demining programs. We have realized that only fractions of these capacities will typically become a national capacity when support from international communities is withdrawn. Thus, the creation of national capacity at any cost has been replaced with selective training and integration of national elements into existing national infrastructure. The reduced investment necessary has increased the overall efficiency of mine action programs in developing countries.

Donors still consider mine action as high priority, although less funds are available than before. Productivity of demining is, however, still increasing due to improved methods and professionalism. Ten year funding commitments from many donors and joint donor groups, introduced as part of a re-negotiation of the mine ban convention some years ago, have proved to be a great success, maintaining the momentum of the mine action at a high and consistent level, and ensuring funding continuity.

It has become increasingly popular to hire or lease demining capacity and technology instead of developing own capacity. It is now common to lease dog, rat and machine teams for shorter or longer periods. Some commercial companies and NGOs have specialised in the production of stand-by capacity for lease or loan to other organizations. This has made demining more professional and cost-effective.

It is well understood that area reduction and mine clearance may require different technological approaches. Recognizing this, researchers and manufacturers have targeted the two requirements differently. Area reduction has been given the highest priority as it has the highest immediate impact on people's life due to the large amounts of land released.

The number of organizations involved in demining, both commercial and non-commercial, has increased steadily since 2002–the trend is that each organization has smaller mine action programs than in the past. Thanks to the widespread introduction of international standards, ways of working are, however, more standardized and organizations almost always form part of a central national program.

managers are highly professional within the context of used and proven technology, but feel less confident in the context of new and untried technology. As program managers often receive credit based on the performance of their chosen technology rather than on how cost-effective the program *could* have been if other technology had been considered, it is understandable that there is some reluctance to make significant changes. Some program managers even seem willing to reject new technologies on principle.

2. There is donor reluctance. Many donors, while willing to fund research and aid programs, will not fund the essential development and trials of the technology, except in the case of well-proven demining concepts. New ideas in prototype form are avoided because they are of high risk. Yet these are the same donors that have committed themselves to rid the world of landmines by 2009.

3. Many demining programs have an underlying aim of building national capacity. This aim overshadows the need for faster demining. It may even be more important to establish a sustainable national demining capacity than to release land quickly. In many countries, this attitude can preclude the consideration of faster and more efficient demining approaches.

4. Choice of equipment is often governed by the country where the equipment is produced. Donors may give in-kind equipment to national or seminational demining programs – if the equipment is produced in the donor country. The end result is sometimes donation of assets that are more of a liability than a cost effective tool. The demining programs could of course reject such donations, but this could be seen as an affront to the donor. It may also be that the demining program manager considers that any equipment is better than nothing.

What About Existing Technologies?

Funds used to improve current demining techniques are many times less than funds used for the development of new technology. Yet improvement to existing technologies has been much more successful in improving current methods than the development of new ones. Despite known limitations, manual mine clearance, mine dog detection and mechanical mine clearance are the preferred techniques today. Manual mine clearance is slow, but it can be applied almost everywhere. Mine dog detection is faster than manual, but there are significant limitations to the application of dogs. Mechanical mine clearance is also fast, but most machines are either unreliable, impractical or both. However, these "old" approaches can be improved and this may be a more sound approach than investing all our funds in something new. I will use vapour detection as one example as, in my opinion, it is one of the most promising technologies.

Managers must beware of showing a passive attitude towards further development of current technology since the short, medium and even long-term effects may be much greater than that from new technology. There is major potential for improvement within most current technologies.

DARPA's "Dog's nose" program is aimed at developing a mechanical substitute for the dog. It would be unfair to say that this multi-faceted program has failed, but it still has not managed to develop a vapour detector that could replace the dog. Thanks to DARPA, however, we learned much about vapour, migration, degradation and environmental factors, which also affected the way of using dogs. Dog's or rat's noses are still far more sensitive than all current mechanical vapour detectors. Even if this was not the case, dogs or rats have the ability to discriminate between scents in a more efficient way than current vapour detection technology. This is not likely to change in the near future. There are problems with the use of animals for detection, but these can be addressed and minimized with some targeted research. Recent experiments with standard commercial machinery in support roles is another example. Several demining organizations have successfully undertaken inventive experiments aiming at making use of commercial products to enhance traditional demining methods. Many demining organizations believe that funds are better invested in the improvement of current demining technology than the development of new.

I believe that the approach here should not be "either/or", but there needs to be a balance between investing in the improvement of current technology and developing new. Let us not forget that there is nothing to suggest that current technology will be replaced in the near future.

Vision 2012

It is always difficult to predict the future. I have therefore dedicated the last part of this article to my vision for 2012. It is a mix of personal hopes and predictions. The reader is free to guess which ones are my hopes and which my predictions. ■

**All photos courtesy of the author.*

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