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Deminers, Manual Demining & Personal Protective Equipment
The United States Humanitarian Mine Action Program: Helping Countries “Get on Their Feet”

Since 1998, the U.S. Humanitarian Mine Action Program (formerly Humanitarian Demining Program) has been involved in mine action efforts around the globe. Much has been written about the U.S. Humanitarian Mine Action Program over the past few years; it is useful to review the program’s fundamentals if only to remind ourselves of its policy and procedural aspects.

Agency for International Development’s (USAID’s) Leaky War Victims Fund holds primary with respect to U.S. assistance. The U.S. Humanitarian Mine Action Program seeks to reduce human suffering while promoting U.S. interests, with the objectives of reducing civilian casualties, creating conditions for the safe return of refugees and displaced persons to their homes, fostering regional stability, facilitating economic and social recovery, and encouraging international cooperation and participation. By the end of Fiscal Year (FY) 2003, the United States will have provided over $700 million (U.S.) to support mine action initiatives in 44 countries.

Obtaining U.S. Demining Assistance

When a mine-affected country desires the support of the U.S. government, it generally requests assistance via the U.S. Embassy. If the Embassy endorses the request, it is then submitted to an interagency process headed by the National Security Council (NSC). Participating in this process are the Department of State (DOS), the Department of Defense (DoD), the Joint Chiefs of Staff (JCS), USAID, the Central Intelligence Agency (CIA) and the Centers for Disease Control and Prevention (CDC). Upon receiving a U.S. Embassy endorsed request for assistance, the interagency process leads to a DOD determination as to whether to conduct a Policy Assessment. Visit to assess the nature of the U.S. Mine Action, the requesting nation’s commitment to solve the problem and the suitability of U.S. assistance. Based on this assessment, the interagency process may lead to the establishment of a formal program for the country.

Categories of Assistance

U.S. mine action support encompasses four traditional pillars identified by the international community: MRE, victim assistance, mine detection and clearance, and humanitarian mine action. Surveys conducted to determine the socioeconomic impact of mines and UXO. The United States does not fund stockpile destruction, believing that stockpiles do not pose an immediate threat to safety and health.

A typical U.S. program might consist of assisting in the establishment of a mine action center (MAC), an MRE program, and a mine detection and clearance program. As a country develops its mine clearance capabilities, the United States, again relying on the interagency process, will periodically evaluate the development of mine action programs with needs and its capacity and to determine when a country achieves sustained—the point when the host nation has demonstrated an ability to manage and coordinate all aspects of its humanitarian mine action, including using its own resources to finance mine action activities. When a country nears sustainability, U.S. support naturally diminishes, although replenishment of equipment and the provision of periodic technical assistance might still be necessary.

U.S. Funding and Participation

The vast majority of U.S. funding support for humanitarian mine action comes from the DoD, the DoD and USAID. Until recently, CDC involvement had focused primarily on MRE, but there are indications that the CDC in the future will engage more in survivors’ assistance initiatives as well.

DOD funding is provided under the National Defense Authorization Act (NDAA) account, principally to support training and equipment. USAID funding is provided under the U.S. Military Assistance Program (MAP) account, principally to support training and equipment. USAID funds for mine action are provided under the U.S. military assistance program (MAP) account, principally to support training and equipment.

The DoS funds humanitarian demining activities from its Overseas Humanitarian Disaster and (OHDA) account, principally to support training and equipment.

The DoD funds humanitarian demining activities from its Overseas Humanitarian Disaster and (OHDA) account, principally to support training and equipment.

United States Humanitarian Mine Action Program

Programs in the Bureau of Political-Military Affairs. These funds support both commercial and non-governmental organizations (NGOs) mine action initiatives in a specific country. NADR funds are also used to support programs implemented by international organizations such as the United Nations and the Organization of American States (OAS). NADR funds can also be transferred to the Global Health Initiative (GHI) and the Country Operations Board (COF), and the U.S. Congress enacted the Export Control and Foreign Operations Appropriation for FY 2003, providing $55.6 million for NADR mine action.

The DoD funds humanitarian demining activities from its Overseas Humanitarian Disaster and (OHDA) account, principally to support training and equipment.

Quick Reaction Demining Force

Based on lessons learned from the Kosovo experience, the United States established a Quick Reaction Demining Force (QRDF) to respond to immediate post-conflict situations. Presently based in Baku, the QRDF is deployed to conduct emergency or special demining operations to assure the safety of refugees and internally displaced persons (IDPs) or to facilitate the peace process. When the teams are not deployed in short-term, predefined missions, they perform demining missions in Mozambique.

Established in 2000, the QRDF executed its first deployed mission in Sri Lanka and Sudan in 2002. As of November 2002, the force had returned 122,348 square meters of land to safe use in Sri Lanka, destroying 980 mines and 141 pieces of UXO in the process, and allowing thousands of IDPs to safely travel throughout the country as they return to their homes. In Sudan, the QRDF conducted operations for close to six weeks, creating safe conditions for the public and reducing the number of casualties due to landmines.

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Mine Detection Dogs—Working for the Government

The term “man’s best friend” takes on a different connotation when dogs are placed in mine-affected countries. “Man’s best friend” can be construed to be “man’s best hero” because mine detection dogs (MDDs) offer another means for the reliable detection of landmines and UXO. Mine and UXO clearance operations occur in a wide variety of climates, over a broad spectrum of terrain and under the influence of many different cultures. While no demining technique will be successful in all scenarios, combinations of detection technologies and demining methods generally increase safety and efficiency and contribute to high-quality, productive mine clearance executed in accordance with international humanitarian demining standards developed by the United Nations. There are approximately 620 MDDs around the world conducting operations or in training; 162 of these dogs are in Afghanistan. The U.S. Humanitarian Mine Action Program has provided dogs to 18 countries around the world: Afghanistan, Albania, Angola, Armenia, Azerbaijan, Bosnia-Herzegovina, Cambodia, Costa Rica, Croatia, Eríne, Honduras, Lebanon, Mozambique, Nicaragua, Oman, Rwanda, Somalia and Thailand.

**Country Program Accomplishments**

Since 1993, the United States has established humanitarian demining programs in 44 countries and will likely add more countries in 2003 and beyond. At the same time, a number of countries will “graduate” from the U.S. program, having achieved sustainment status. The United States, other donors and mine-affected countries can take pride in a number of significant accomplishments as described below.

**Afghanistan**

Among the very first of its kind, the Mine Action Program for Afghanistan has become known as an effective demining program. A total of 90 dogs have reached over 9.5 million people: the landmine casualty rate has been reduced by 50 percent; Afghan deminers have cleared 1,171 square kilometers of high-priority mine-infested land and destroyed 210,000 landmines and 985,000 pieces of UXO, and 1.5 million refugees have been able to return to their homes.

**Cambodia**

Except for an ability to finance in own operations, the humanitarian demining program in Cambodia is now in sustainment, with a fully trained staff of 2,400 Cambodians, 35 foreign technical advisors and six UN staff members. Deminers working under the auspices or direction of the Cambodia Mine Action Center (CMAC) have cleared 97,662,889 square meters of land, destroyed 159,789 landmines and 680,627 pieces of UXO, and reduced landmine casualties by almost 70 percent.

**Guinea-Bissau**

Since January 2000, the NGO HUMAID has cleared over half of the entire suspected mine-infested land in Guinea-Bissau, rendering 257,178 square meters mine safe. Nearly 3,000 mines and 13,533 pieces of UXO have been destroyed. Due to these efforts, much of the land has been transformed for productive use. Over 49,000 square meters are under cultivation for crops including cashews, beans and manioc. Homes are being built, schools are being rehabilitated and there is access once again to major industries such as the Guinea-Telecom Center.

**Jordan**

Since 1997, Jordan has proudly established an effective national mine action program, which has resulted in significant lowering of casualties. As present, Jordan is conducting technical surveys of minefields along the Syrian border. As of January 2003, Jordan’s Royal Corps of Engineers had cleared 86,123 landmines from about 200 minefields, restoring more than 3,064 acres of land to safe use.

**Lao**

U.S. Special Operations Forces soldiers have trained more than 1,200 Laoacians, creating an indigenous capability to clear UXO and also the ability to train additional clearance technicians. Personnel at UNDO LAO (the Lao National UXO Project) have destroyed more than 363,000 pieces of UXO and cleared more than 32,700,000 square meters of land, which now has been restored to productive agricultural use. UNDO LAO personnel have also conducted mine/UXO awareness visits in more than 2,400 villages. More than 300 Laoacian medical staff members have received training in emergency rehabilitation or laboratory services.

**Latin America**

Costa Rica already has declared itself “mine safe.” Three additional Central American countries—Guatemala, Honduras and Nicaragua—are nearing that plateau. To date, in Nicaragua, approximately 26,240 landmines have been found and destroyed by Nicaraguan deminers, allowing the government to declare 24 Nicaraguan municipalities and 168 kilometers of international border mine safe. In total, approximately 1.9 million square meters of land have been cleared in Nicaragua. Costa Rican deminers cleared 100,000 square meters of land. Honduras and Guatemala are expected to declare themselves mine safe within 12 to 18 months.

**Mozambique**

Since 1992, mine clearance personnel from NGOs and the Mozambican military have removed more than 17,000 landmines and 29,000 pieces of UXO, and opened more than 4,500 kilometers of roads, facilitating post-war resettlement of agricultural land and reconnecting nearly one million people with their local economies. Demining operations have also played a vital role in Mozambique’s overall development strategy. For example, the Massingir Dam project will supply electricity and irrigation to approximately nine million square meters of land, and mines and thousands of pieces of UXO. Landmines and UXO fatalities dropped from 108 in 1994 to three in 2000. Some 400,000 refugees and 200,000 IDPs have returned to their villages.

**Conclusion**

The United States’ assistance, and that of other like-minded donors, has led to some impressive results throughout the world. Many countries are at or near sustainment, able to remove landmines on their own. Working in partnership with other donors and international organizations, the U.S. Humanitarian Mine Action Program’s efforts will allow the citizens of many mine-affected countries to once again walk the earth in safety.
The U.S. Department of Defense Humanitarian Demining Research and Development Program

In 1994, the United States initiated a research and development (R&D) program to develop new, internationally shareable technologies for humanitarian deminers and for U.S. troops performing peacekeeping and stability operations. The Humanitarian Demining (HD) R&D Program is part of the overall U.S. effort to assist with the global landmine problem.

by Sean Burke, U.S. Army Night Vision and Electronic Sensors Directorate

Introduction

The Countermine Division of the U.S. Army Night Vision and Electronic Sensors Directorate (NVESD) executes the R&D program for the Office of the Assistant Secretary of Defense for Special Operations and LowIntensity Conflict (OASD(SO/LIC)). From the Pentagon, OASD(SO/LIC) provides funding, guidance and management oversight to the program. The NVESD Countermine Division is well-equipped to execute this program due to its extensive countermine engineering expertise, coupled with a world-class fabrication facility and access to excellent test facilities.

The HD R&D Program tests, demonstrates, and validates equipment for immediate use in various international landmine missions and environments. The goal is to transition new technologies to both military and civilian demining organizations. A key component of the program is to develop demining technologies and then to provide equipment to the international demining community to assess its capabilities in actual demining conditions. The program focuses on R&D technology development that reduces the time and cost associated with demining while improving operator safety. This is accomplished through adapting commercial-off-the-shelf equipment, integrating mature technologies and taking advantage of R&D activity in tactical countermine and UXO clearance. The program aims to improve on existing technologies for mine and minefield detection, mechanical and vegetation clearance, mine neutralization, individual deminer protection, and individual deminer tools.

The Annual Requirements Workshop

At the heart of the development of demining equipment is a multi-year investment strategy driven by an annual requirements workshop. Each year, the HD R&D Program brings representatives from mine-affected nations together to identify and update their most critical needs. The annual HD R&D Requirements Workshop is one of the most important events of the program because it documents required capabilities that truly represent current deminer needs.

The most recent workshop, conducted in August 2002, included representatives from 12 governmental mine action organizations and five non-governmental organizations (NGOs) from Africa, eastern Europe, the Middle East and southeast Asia. The Organization of American States (OAS) and the Inter-American Defense Board (IADB) represented Central and South America. Workshop participants gave presentations on the current humanitarian mine action situation in their countries, received talks and briefings on the U.S. R&D Program, and witnessed demonstrations of several prototype developing technologies developed under the program.

The result of the workshop is a clear picture of where the HD R&D Program should focus its development efforts. With this knowledge, the Program Office structures its execution plan for the future and submits it to the Pentagon for approval. Once approved, design and development of prototype technologies begin. This is done inhouse using the NVESD Prototype Fabrication Shop as well as by awarding contracts to industry and academia. International market surveys are also conducted to help identify commercially available items that could be used or adapted for HD applications.

Upon completion, prototype items undergo developmental testing to ensure that all design requirements are met. If test results identify engineering modifications that will improve the system's performance, the changes are made and the system re-tested.

Operational Field Evaluations

Selected systems then undergo in-country operational field evaluations. Host nation-conducted operational field evaluations are one of the most important parts of the HD R&D Program because the equipment undergoes testing in actual mined areas. There is no better way to test the effectiveness and suitability of a prototype item. In-country field evaluations are extremely beneficial to the HD effort. They also assist host nation demining forces. They provide information needed to determine the prototypes suitability and effectiveness given the unique demining environment where the test occurs. The demining community is afforded the opportunity to "test drive" new equipment and technologies in their environment prior to making procurement decisions. The outcome of these field evaluations allows the demining community to formulate cost-benefit analysis data to justify new technology procurements to the donor community. The demining environment includes the weather, variety and type of mines; terrain; weather; and infrastructure. The evaluations provide the R&D Program Office "lessons learned" information that may result in system improvements for future funding. Evaluation reports also provide information to the entire demining community that could lead to further evaluations or procurement.

An operational field evaluation begins with a host nation request to the Pentagon, OASD(SO/LIC). The Pentagon then requests a site assessment. The Site Assessment Team, which includes representatives from the R&D Program Office, will assist the requesting nation to determine the most appropriate prototype equipment given the country's specific situation. The assessment team will make recommendations of the most suitable prototype and a decision to support the evaluation. Evaluations typically last six months to one year.

An important part of the HD R&D Program is the opportunity for support nation to participate in the development of a specific technology from design through field evaluation. When a new development project is determined to be the best solution to meet the capability needed by a specific country, that nation has the opportunity to participate as the user member of the development team. The national mine action center will be kept up-to-date on the system's development progress and will be welcome to participate in meetings and observe development testing. In return, the host nation agrees to conduct an operational field evaluation of the system. This host nation benefits by being part of a technology development designed specifically for their problem. The R&D Program benefits from the information and experience gained by the operational evaluation.

Technologies Developed by the Program

The HD R&D Program is responsible for keeping the military countermine and humanitarian mine action communities informed of its technology developments. The Program Office does so in several ways. Technologies developed are listed in the Developmental Technologies Equipment Catalog available on the internet, in hard copy and on CD-ROM. The Catalog is updated approximately every two years. Test results can be made available to organizations and individuals in the international demining community for consideration in making equipment decisions. In addition, the HD R&D Program maintains a website at http://www.humanitariandemining.org.

The HD R&D Program spans a wide range of technologies, encompassing mine and minefield detection, mechanical mine and vegetation clearance, mine neutralization, individual deminer protection, and personal protective equipment (PPE) for deminers. There is only enough space to describe a few of the technologies developed by the HD R&D Program to date. For more information, refer to the information sources described above.

Current detection projects involve improved electromagnetic (EM) detection, various forms of ground penetrating radar (GPR), infrared cameras and chemical detection of explosive vapor from buried landmines. In the detection arena, the HD R&D Program has invested in a remote-controlled aerial sensor platform for wide-area detection. The Camcopter is a rotary wing unmanned aerial vehicle that can carry a variety of sensors for minefield detection. The R&D Program has used the Camcopter with infrared, optical and GPR systems to detect mined areas and off road.

Although it is a handheld metal detector, the GEM-3 is a significant improvement over standard metal detectors used to find mines. The GEM-3 is a broadband digital sensor with target recognition software capable of not only detecting a mine, but also discriminating it from clutter.

Energy-Focused GPR (EFGPR), the Mirage Synthetic aperture radar (a 40-lb. unit mounted on the Camcopter) and the NIITEK Wichmann systems are all exploring various configurations of GPR to detect mines. The Handheld Standoff Mine Detection System (HSTAMIDS) is a dual sensor system consisting of a metal detector and GPR. This is one of several
developments in which the HD R&D Program and military countermeasures programs work together. The HSTAMIDS will soon become the U.S. Army's new standard hand-held detector. Its outstanding performance will benefit humanitarian deminers as well as soldiers.

The Mine Detection and Detonation System (MDDS) is a Lion II mine-protected vehicle integrated with a three-meter metal detection array for area reduction.

Two successful mine neutralization technologies are Liquid Explosive Foam (LEXFOAM) and the HD Flare. These systems are alternatives to using C4 or other explosive means to destroy mines in place. LEXFOAM is a nitro-mercuric based stock solution and mixture of propellants that is packaged, stored and transported in two aerosol cans as Class 3 flammable liquid. It is not explosive until operators combine the two units and dispersions the material on the mine. LEXFOAM is a blat-caps sensitive foam.

The HD Flare, using production excess smoke rocket jet fuel, is an effective low-order neutralization (by burning) device against thin-cased land mines. New individual mine neutralization technologies are now in the early stages of development.

The HD R&D Program has placed a significant emphasis on developing technologies for mine and vegetation clearance. Examples of some of the developments in this area are the Rhino Earth Tiller, the Mine Clearing Cultivator (MCC), the Mine Clearing Sifter, the Tempest, the Survable Demining Tractor and Tool (SDTT), the Rotor, and the Mini-Mulcher (MAXX).

The Rotor Earth Tiller is a remote-controlled, redeployable mechanical system used for large-area AP mine clearance. It neutralizes mines buried up to 30 cm and can also operate in areas of heavy vegetation and small tree cover. It can withstand any AP mine blast and is repairable from AT blasts. The Rhino has been in Croatia since July 1998, and has undergone operational evaluations in Cambodia, Jordan, Israel and Korea. It is now being readied for its next deployment to Azerbaijan.

The MCC is a remote-controlled mechanical mine clearer for uncovering AT landmines on roads and in large open areas. Designed and fabricated at the NVESD prototype facility, the MCC mounts to a modified 200-hp class commercial bulldozer. The Mine-Clearing Sifter, which mounts to the same bulldozer, clear AP and small AT mines from previously scoured soil and loose sand. The MCC and the Sifter are now undergoing an operational evaluation in Angola. Although the MCC is a solution for large open areas and roads, it is less suitable for small or hilly areas, or for vegetation-covered terrain.

The Tempest, a small, remote-controlled AP mine blast-protected system designed to clear AP mines from off-road areas inaccessible to large-area mine cleaners like the MCC. The Tempest is an excellent example of how an operational evaluation can lead to improvements that realize the potential of a prototype design. The Tempest began an operational evaluation in Thailand in January 2001. Although it was effective at clearing vegetation in mined areas, Thai operators identified overheating problems. The unit's promising performance warranted the investment of funds to improve the system. The resulting Tempest Mk. V is now a much more reliable and powerful system. The Tempest is produced in Cambodia, thus representing a regional capability in Southeast Asia. The Thailand Mine Action Center (TMAC) continues to use the system, along with another mechanical assistance success story.

The SDTT is a modified commercial farm tractor used to support demining operations and quality assurance in heavily vegetated areas with AP mines. Steel wheels and eight attachments—including vegetation cutter, a roller, earth cultivator, a bucket loader, a rake, a magnet, a mine gripper and a tree extractor—make this a versatile system. The SDTT has also been operating in Thailand for nearly two years.

The SDTT and Tempest have been an important part of TMAC's development of an integrated mine action program that encompasses manual demining, mine detection dogs, mechanical assistance and mechanical area reduction.

The Rotor is an area preparation multi-tool for vegetation reduction and soil softening in landmine-suspect areas. Introduced to the R&D Program by the demining NGO Mencheien gegen Minen (MGG—In English, People Against Landmines), the device has proven highly effective at removing mines from loose soil, particularly berms and piles. Mamin mounted the Rotor onto an 80-hp Caterpillar backhoe tractor. The R&D Program is testing the utility of Rotor with other host vehicles. One operational evaluation is currently underway in Mozambique. The HD R&D Program is mounting the device on a larger excavator as part of a mine clearance solution for Honduras and Mozambique.

Finally, the MAXX is a small remote-controlled vegetation clearer that can operate in very tight areas. The vegetation clearance attachments fit onto an articulated boom that can be extended and rotated 360 degrees around the unit. This allows the device to cut vegetation without having to enter the suspected mined area, saving the cost and weight of adding armor protection. Additional attachments are being considered for the MAXX system, as is planning for operational field evaluations in Rwanda.

Space does not allow the description of all prototype systems developed under the HD R&D Program. To learn more, visit the Department of Defense (DoD) HD website at http://www.humanitariandemining.org, or contact the NVESD Information Office at 703-704-1288.

Benefits

The HD R&D Program has to date deployed equipment to nearly 30 countries. Besides providing valuable performance data to demining organizations and the R&D Program, these deployments have had a direct impact on the slow but steady progress being made to remove post-conflict landmines. The story of the Tempest and SDTT in Thailand is a prime example. In March 2002, the Thai government officially released cleared land along the Thai-Cambodia border to the civilian population. The HD R&D Program was an integral part of this important success. U.S. troops also benefit from the HD R&D Program. First, when military units deploy for peacekeeping and stability operations, they move into areas where fighting has just ended and the danger of landmines is significant. They need the means to detect and clear all landmines in these areas. In addition, it is important to be able to detect re-mining activity by former warring parties. Some pieces of equipment developed by the R&D Program may be effective tools for peacekeeping and stability operations.

In order to examine the military utility of this equipment, the Army established the Joint Area Clearance Advanced Concept Technology (JAC-ACTD). Several HD R&D technologies are now undergoing extensive demonstrations under the JAC-ACTD. Depending on the results of these demonstrations, the potential exists for introduction of this equipment into the U.S. military.

Also, U.S. soldiers are key players in establishing sustainable indigenous mine action capacities in supported countries. As part of the overall task of guiding the host nation to establishment of a national mine action office and conducting demining training, they can recommend technologies developed under the HD R&D Program. The HD R&D Program also benefits the Army as a whole because its efforts contribute to solving the humanitarian mine problem while assisting military countermeasure research.

The HD R&D Program continues to develop new technologies to improve the safety and efficiency of demining. The unique system of annual requirements workshops, the NVESD in-house design and fabrication capability, worldwide technology development and field evaluations has proven to be an excellent formula for success.

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International Mine Action Standards: Future Development of PPE Standards

This article explains developments since the issue of International Mine Action Standards (IMAS) 10.30 in order to illustrate the potential amendments to IMAS 10.30 over the next two years.

by Adrian Wilkinson, Head of Technology and Standards, GICHD

The current issue of IMAS 10.30 for Personal Protective Equipment (PPE) was developed during 1999 and 2000 by a Working Group that reported to the IMAS User Focus Group. The report of this group was summarised in an article by Alastair McAlpine and Keith Feigenbaum in Issue 2 (Summer 2000) of James Madison University's Journal of Mine Action.1 This article will build on the previous journal entry to explain developments since the issue of IMAS 10.30 and the potential amendments to IMAS 10.30 over the next two years. PPE is the final protective measure after all planning, training and procedural efforts have been taken to mitigate, or at least significantly reduce, the risk to the individual deminer. IMAS recommends that a formal risk reduction analysis should be conducted in accordance with the processes contained within the International Standards for Standardization (ISO) Guide 51. The standard recommends the various levels of protection necessary from blast and fragmentation, based on the work of the IMAS PPE Working Group.

The only other PPE standards in existence at that time were those of North Atlantic Treaty Organization (NATO) Standardization Agreements (SAs). It was accepted by the PPE Working Group that IMAS 10.30 was not an ideal standard, but was based on the best available information at the time.

Test and Evaluation Standards

IMAS 10.30 PPE states that a Technical Note for Mine Action (TNMA) will be developed in the future to lay down the test and evaluation protocols to be followed during the test regime of PPE. This aspiration is being actively pursued, but it quickly became apparent that the funding necessary for development of such test protocols by the humanitarian demining community alone would be prohibitively expensive. Therefore, synergy with other research projects was examined.

Centre European Normalisation Working Group 126

The Centre European Normalisation (CEN) is the European standards body that operates parallel to ISO. In 2002, the European Commission Mine Action Initiative issued a Programming Mandate (M/306) on the standardisation of mine action technologies for acceptance by CEN. This was accepted by CEN, who created Working Group 126 (WG 126) to examine the issues.2 Membership of CEN WG 126 is open to all interested parties; the CEN process is open and consultative. Regular attendances include Duinizar, the Danish Demining Group (DDG), the Department for International Development (DFID), the European Union (EU), the Geneva International Centre for Humanitarian Demining (GICHDI), the Joint Research Centre (JRC), the Royal Military Academy Belgium, the Swedish Explosive Ordnance Disposal Demining Centre (SWEODC) and the United Nations Mine Action Service (UNMAS).

CEN WG 126 has established a number of ad hoc groups to look at developing CEN Workshop Agreements (the lower tier of European Standard) in the following technical areas:

• Text and evaluation of metal detectors
• Text and evaluation of semi-assisted demining equipment
• Competency standards for humanitarian mine action
• Test and evaluation of PPE

Further work by CEN WG 126 established that there were existing groups within CEN with responsibility for industrial PPE:

• CEN Technical Committee 162: Protective Clothing
• CEN Technical Committee 159: Head Protection
• CEN Technical Committee 85: Protection Equipment

CEN WG 126 has asked these Technical Committees to provide any relevant information they may have in the development of test and evaluation standards for mine action PPE. Unfortunately, although the progress of the other CEN WG 126 activities is going well, standards likely in 2003 for metal detectors and competency standards, amendments in PPE are likely to be slow. Demining is not a priority for the other Technical Committees, whose workload is concentrated in the industrial sector. The CEN WG 126 continues to try to resolve this delay. It is not all bad news, however, as alternative work has been progressing at pace within NATO.

NATO Human Factors and Medicine 089/Technical Group 024 (NATO TG 024)

NATO TG 024 is responsible for the development of test methodologies for PPE against APMs. This work has been ongoing since early 2001 and is well-advanced. Coincidentally, it also includes some of the individuals who participated in the initial IMAS PPE Working Group, so they are well aware of the issues involved in humanitarian mine action. Membership of the group includes national research organisations, national and test evaluation organisations, commercial companies, and medical representatives.

The NATO TG 024 is primarily concerned with the impact of APMs on military personnel and how to protect them against the effects of blast. It is and has been currently actively progressing towards "test guidelines" to be a first step towards standard test parameters across NATO nations. As a significant proportion of humanitarian mine action PPE is also produced in NATO countries, it would seem appropriate that a common standard be adopted to ease development and production costs.

The final meeting of NATO TG 024 is planned for May 2003, after which a final report will be published. This report will be published in order to ensure a wide distribution. GICHD aims to introduce NATO's work during the CEN process in order to develop a complementary CEN Workshop Agreement and TNMAs.

Conclusions

The selection of test and evaluation methodology by an interested organisation will depend on budgetary constraints and the scope of tests to be conducted, whether tests are developmental in nature or for acquisition trials. The work by NATO and CEN provides an excellent opportunity to obtain information for appropriate detailed test and evaluation protocols that can be developed for some of the PPE currently used in humanitarian demining at little direct financial cost to the global mine action effort.

References

2. NATO Human Factors and Medicine (TNMA) D-29-30-2000 from 3,200 kg of TNT; 2002, NATO Protection (Facial/Ear) from 200 kg of TNT at 64 cm. Fragmentation Protection (Body) to STANAG 2920 V3.0 Rating (Dy) for 1.102 kg fragments at 450 m/s.
3. For example, no fragment data was (mean, velocity and kinetic energy) on a particular type of mine would require around 90 repeated firings to ensure statistical validity. Each firing would require extreme use of data current and standard pad or an estimated cost of $25,000 (US) per firing at an internationally accredited test establishment.
4. Terms of Reference are in Resolution BT C/20/ 2980 (2001) 01-11. Details available from Secretary CEN WG 126, Car-Michael Dingle (email: fdulke@di). http://www.centro.it/standardization/ tech_bodies/working_groups/TNMA.htm.

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A Fresh Approach to Road Clearance Operations

UXB International has employed a combined approach to clearance activities in the Temporary Security Zone (TSZ) between Eritrea and Ethiopia. The author discusses how his organization uses this unique method of mine clearance.

by Roger R. Hess, Africa Regional Director, UXB International

Introduction

Many groups have inquired about the large number of hectares being searched and cleared by our small team assigned to the Route Verification and Clearance Program in Eritrea. While the approach we are using is unique, it is not completely original. Various clearance organizations have employed combined methods, and many have produced good results; ours simply takes the combined approach a couple steps further.

The objective set out for our team were straightforward: search and verify the roadways in the TSZ clear any signals encountered along the way; and do it in a manner that complements the capabilities of the Mine Action Coordination Center (MACC). The expected search rate of the Route Verification Team (RVT) was to be 15-20 km per working day while being able to detect a Russian TM-57 AT mine at 70 cm and a 100-mm piece of UXO at 100 cm.

UXB had already developed some rapid wide-area search techniques for site characterization projects on formerly utilized defense sites (FUDS) in the United States; however, we needed to adapt the equipment and methodology to meet the challenges of the TSZ.

Infrastructure

The difference between Asmara and the TSZ is night and day. In both infrastructure and ambient temperature, Asmara is the capital city of Eritrea. It sits at 3,000 m above sea level, has modern facilities and good infrastructure, and was relatively untouched by the war. The TSZ is a 25-km wide stretch of land designed to separate the warring parties. To say this area is lacking development would be a severe understatement: the primary activity in this region for the last 30 years has been war.

The drive into the western sector of Asmara is less than 200 km, but it takes six to eight hours, depending on traffic and weather. En route to the western sector, you pass through the cities of Karen and Beratun. One can find the basic food supplies to help sustain a field operation here, but potable water and any major equipment repairs or spare parts are simply not available and need to be brought in.

Upon leaving Beratun, you enter one of the poorest regions of the world. Small huts constructed from rocks, mud and straw make up the most of the structures. In spite of the hardships the local population endures on a daily basis, they remain extremely friendly and sociable.

Roadways

The TSZ has various mountain ranges weaving through it, and being a desert environment, washouts are extremely common during the rainy season. Beratun is the last city that has anything resembling pavement. The roads from here on out vary from extremely steep, four-meter mountain passes to fairly flat, nine-meter-wide main supply routes (MSS). In the last 18 months, there have been more than 20 accidents involving AT mines on these roads, claiming the lives of locals and UN personnel.

Prime Movers

The vehicle used as the prime mover for this project needed to be very robust, highly mobile and mine-resistant. Eritrea has a severe shortage of spare parts and trained maintenance technicians for modern vehicles, so the less complicated the vehicle is, the better suited it becomes.

For this, we selected the South African "Samll" series of vehicles. They were widely used in southern Africa and are still readily available to meet the ongoing demand. Like other systems built in South Africa, the vehicle was designed to work in harsh environments. A Deutz air-cooled, normally aspirated diesel engine powers the vehicle, and while it is very "agricultural" to drive, it is extremely mobile in off-road conditions, very reliable, and well-suited for this environment.

Detection System

UXB designed the Kinematic Induction Magnetic Survey (KIMS) system as a modular detection platform for the site characterization projects in the United States. To meet our scope of work, we decided to use the UPEX 740 wide-loop deep-buried landmine and UXO detection system made by Ebinger.

The antenna portion of the UPEX is made from a flexible coil similar to coaxial cables. This allows the operator to change the loop configurations between 1 x 1 m to 1 x 2 m loops, depending on the detection requirements.

Each configuration has its own unique characteristics and detection depths. The cables themselves are extremely lightweight, which allowed us to use the locally available materials such as standard PVC pipe to fabricate the carrier system. We had excellent success with the UPEX in a "Mag & Flag" role searching for deeply buried landmines and UXO in Southeast Asia over the past four years, and we were very confident that it would meet or exceed the requirements.

Differential Global Positioning Systems (DGPSs)

A DGPS is incorporated into the KIMS to accurately track, record and relocate the suspect signals. The KIMS was initially designed to search wide areas such as open fields, so static RTK transmitters with a "moving" receiver mounted on the detection platform were previously employed. This provides reacquisition capabilities of less than 20 cm; however, the drawback is the limited range. Depending on the terrain, the Rover can only travel four to six km from the static transmitter. Beyond that, the transmitter must be relocated and recalibrated.

To improve our range and productivity, we incorporated a wide-area DGPS system from Omnis Star, which is commonly used in large-scale agricultural and marine applications. This does not require a static base station, and while the accuracy is only rated at ±0.100 cm, the system is reliably tracked anywhere in Africa.

Computers, Software and Peripherals

To keep everything as commercial off-the-shelf (COTS) as possible, normal Panasonic "Toughbook" laptops were used and standard Pentium II port expanders were installed. The detectors are timed and

https://commons.lib.jmu.edu/cisr-journal/vol7/iss1/1
Mounting Systems

The design of the system allows for a great deal of flexibility in how it is mounted, which proved to be one of its largest benefits.

Prior to our arrival in country, we planned to use a flexible-led design to tow the detection array. However, upon conducting operational assessments of the area, it was decided that the material of the roadways would destroy the slats as fast as we could assemble them. We then decided to go with the traditional fiberglass trailer employed on previous KIMS.

Upon joint operations arrived, we found that the undeveloped roadways in Eritrea were too much for the materials used. The flex of the fiberglass beams caused a severe amount of bouncing, limited the search speed to two to three km per hour and began to stress cracks even prior to our deployment.

To correct these problems and increase our search speed, a suspended, front-mounted carrier was fabricated using the fiberglass beams from trailer and other locally available materials. This design provided a six-meter wide search path and included "wings" on either side that could be raised and lowered from the inside of the vehicle to allow for traffic and right-of-way.

Heavy-duty hinges were mounted to the front of the vehicle and barge-wheels were placed on the carrier frame, allowing it to flex upward when making contact with the road while crossing rivebeds and washouts. In spite of its crude appearance, the performance of this carrier was by far the best. The speed was increased to eight to nine km per hour, and the wider search path of the carrier allowed the KIMS system to scan over 35 km/210,000 m2 per day. This was a major accomplishment for the team, but it was only half the job. The next task is to clear the suspected signals located by the KIMS.

Mapping

Once the data is processed and analyzed, maps like the one in Figure 1 are printed for the clearance team. The blue path displays the total search swaths, while the black lines show the individual search coils (three coils were used during the scan shown below). The red areas show the estimated boundaries of the suspect items and the yellow dots indicate the estimated center (or centers) of mass.

Combined Clearance Approach

Upon receiving the maps, the clearance teams begin planning their tasks. Areas that show very few signals obviously go very quickly, but most of the roadways produce a large number of signals, so the work becomes more intensive.

As the teams are working on roadways, the AP mine/epitrophi threat is non-existent and freedom of movement is quite good. This allows for a great deal of flexibility in adjusting the approach.

Reacquisition

To accurately relocate the suspect targets, the location of each signal is transferred from the computer into a handheld DGPS/GS unit with a backpack-mounted antenna. The reacquisition person then guides the team within two m of the suspect item and indicates where the point should be. Even though the accuracy of the backpack is rated the same as the vehicle DGPS (+/- 1 m), actual clearance operations, the reacquisition person has commonly achieved +/- 30 cm while relocating the signal.

Once in the area, the deminer sweeps with the detector, looking for any signals. Surface scrap normally accounts for 80 percent of the items located, so once that is carefully removed, the area is rescaned for subsurface signals. Should one be present, the area is immediately marked for a mine detection dog (MDD) search.

Mine Detection Dogs

The MDD handler checks the area with both of the dogs. The area will be marked as hot from a single "positive" signal by either dog. However, if both dogs indicate no presence of explosive, then the signal is marked as "no explosive hazard" and the team moves on.

This has reliably eliminated an additional 80 percent of the subsurface signals remaining after the reacquisition team has moved on.

Mechanical Assistance

Trying to uncover a suspect signal buried deep in a sun-baked, dirt, clay and gravel roadway is simply asking for trouble. If done safely, only small gardening tools could be used, making it extremely tedious and time consuming. Picks are actually needed to break through the rough surface, but this is unnecessarily dangerous for the deminer. So to counter this situation, mechanical assistance is brought in to help with the task.

The team has a 5.5-ton armored mini-excavator, which performs 90 percent of the work in just 24 m of a transit. It greatly improves the speed and safety. A mine-protected vehicle is also parked at the site, allowing the team leader to observe the situation and moving safely as near as possible proximity should an accident occur.

Small signals comparable to those of a 66-mm mortar or a hand grenade are simply swept up in the bucket and spread out for inspection by the manual team. Larger signals comparable to an AT mine are marked with a crossed circle. This tells the plant operator to dig on each side without touching the circle itself. This gives the manual team good access to the sides of the suspect item without applying any pressure to the top.

Quality Control (QC) Checks

An additional benefit of this approach is the ability to conduct verifiable QC checks using "seeds." These ensure the system is operating correctly and the depth of detection is being met.

A "seed" is an identical copy of what is being searched for (i.e., TM-57 AT Mine, R2-mm Mortar, etc.). They are free from explosive (FPE) to ensure safety but are otherwise identical to the threat munitions of the area.

The Team Leader or Quality Assurance (QA) Inspector buries the seeds in randomly selected areas that have been scanned and directs the KIMS to rescan the site.

This can be used to compare against the other signals that have been located, or can be used in areas that show no contamination to verify that nothing is actually present. The system is fairly fool-proof: it either shows up constituting a "pass," or doesn't show up, which means it has failed and the area must be re-searched. To date, no seed has ever been missed.

Management Assistance

As mentioned before, the tracking and mapping system used for the KIMS can be directly transferred into a GIS. This can also be overlaid onto geo-referenced satellite images or aerial photography to give accurate information over topographical details that are only two to three months old.

This provides the mine action manager an effective tool that can accurately track the progress and clearly show what is now considered safe.

Performance Data

Manufacturers often claim their systems "can, might or could" accomplish "X" number of sq m over a set period of time if the right conditions apply. However, the bottom line of "What has it done?" is not often answered with 100 percent accuracy.

The combined approach we are using in Eritrea has produced the following results in less than four months of operations:

- The KIMS scanned over 388 km/2,700,000 sq m of roadway. This was done in 19 days of scanning with a single vehicle and a four-man crew. Daily progress varies between 15 and 35 km per day, depending on traffic and satellite reception. The remaining time was spent processing the data and doing a map to produce maps for the clearance team.
- During this period, the single Manual Clearance Team using the combined approach cleared over 112 km/785,000 sq m of the roadway scanned by the KIMS. This single team is comprised of only five personnel.
- Within the 112 km, 2,167 suspect signals were recorded during the scan. The combined approach eliminated 2,090 of those signals without intrusive actions (i.e., digging).
- The remaining 77 intrusive actions produced one Russian-made PDM-6 AP mine, a Czech model 34 hand grenade, and various bomblet fragments with explosive residue at depths ranging between 10 cm and 75 cm.

In comparison:
- Another clearance organization working in a nearby country with a much smaller team used conventional manual/MDM methods to clear 11 km of roadway. This project took 12 months.
- The numbers speak for themselves. While the system is still in its infancy for mine action, this combined approach of geophysical searching, topographical mapping, and following with manual, MDD and mechanical assistance has already proven to be fast, accurate and very cost-effective. As with any system, improvements can be made, and given the results produced so far, those improvements should not be too far on the horizon.
Protecting Deminers From APLs: A Review of U.S./Canada Cooperation in R&D

Since early 1999, the Canadian and U.S. organizations responsible for delivering science and technology to the humanitarian demining community have cooperated on several research and development (R&D) programs in the area of personal protection equipment (PPE). This paper presents an overview of the work performed cooperatively, focusing on key lessons learned during this joint effort.

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Introduction
This paper gives an overview of the R&D work performed by Canada and the United States since 1999 to improve the personal protection of deminers. It should be said that this is still "work in progress" and that more contributions will be made in coming years. For clarity, the paper is divided in several parts that correspond to three broad phases within the overall program. First, work was done to understand the injuries to the lower extremities due to blast mines and the basic protection mechanisms that footwear should provide, and to define a test methodology to support future development of mine-protective footwear. The second phase saw the development of a test protocol to evaluate how well PPE protects the upper body of a deminer during excavation drills and applied this protocol to compare existing PPE. The third phase identified that small changes in body position could have a significant effect on the forces transmitted to the body. This led to the idea of mapping out the blast field of buried landmines and measuring the forces transmitted to the human body shape so that recommendations could be made to improve body position during excavation drills, or at the very least to advise deminers about what positions are detrimental. Finally, there was need to determine the physiology of the injuries to the upper body, since this was poorly documented.

Mapping Out Field Injuries
In 1998, through the United States-sponsored consultation process, representatives of the humanitarian demining community wanted to look into the issue of PPE for deminers. It was suggested that priority be given to blast mines for accidents against the foot while walking or against the upper body during excavation drills. However, there were few solid facts to justify spending the limited R&D dollars in this way. There was a need to quantify the problem in terms of threats, activities most likely to cause a mine accident and the resulting injuries. It was necessary to map out the situation that actually prevailed in the field. Fortunately, one individual, Mr. Andrew V. Smith, had been gathering demining injury information. In 1998, the U.S. Humanitarian Demining R&D Program decided to fund the efforts of Mr. Smith by contracting him to assemble the limited information he already had and to gather additional information. The resulting database1 consists of contributions from organizations in nine countries on four continents, totaling 232 accidents that resulted in 295 victims.

The deminer injury survey demonstrated that gathering field data was difficult, often because the data had not been acquired in the first place. The database nevertheless provided a much clearer picture of what was happening. The database indicated that the threat was definitely from APLs. APLs were involved in 79 percent of all accidents, accounting for 78 percent of all injured people and 81 percent of fatalities. The results from the survey definitely provided support that the R&D effort should focus on the APL threat.

Another important piece of information relating to the threat distribution was the ratio of APL accidents involving blast versus fragmentation landmines. Blast APLs were involved in 83 percent of the accidents, but only seven percent of the victims died from them. On the other hand, 38 percent of the victims from fragmentation APLs died, nearly six times more than for blast APLs. This reflects the different nature of blast APLs. Blast APL is designed to maintain its victims, thereby inflicting psychological as well as physical trauma to opposing forces. On the other hand, a fragmentation APL is designed to kill its victims and maximize the damage to opposing forces. This has a strong influence when selecting suitable PPE to defend against these threats. Another important fact regarding the deminer injury data was the very high incidence of the PMN blast landmine, which was involved in 66 out of 153 (43 percent) blast APL accidents. This ratio is unusual and is likely an artifact of the large contribution from organizations in Afghanistan to this database rather than a reflection of the prominence of this particular mine throughout the world.

Figure 1 provides some insight into the activity that was taking place at the time of accident, which was documented in over 94 percent of the cases. Excavation and Misled are accounted for 34 percent and 37 percent of all accidents, respectively. It should be noted that Misled Mines is not an activity on its own; it indicates that some mine clearance or misfield survey activity had not resulted in an area that was declared safe. This reflects either a failure of the detection equipment or human error in marking the extent of the minefield. It is useful to look into the type of injuries associated with the two categories that result in the most accidents. In particular, Misled Mine accidents yielded 3.5 times more leg injuries than Excavation accidents. This suggests that most of these accidents occurred as a result of stepping on a buried landmine and that injury could be reduced through better protection of the lower extremities. The data from Figure 2 also shows that a victim was 3.6 times more likely to suffer injury to the ears during an Excavation accident than during a Misled Mine accident. Injuries to the eye, posterior neck and back were also from 1.6 to 2.6 more likely with Excavation accidents. This data suggests that special emphasis should be put on better protection for the upper body during excavation drills, particularly in the terms and head.

Figure 3 shows the position of the victims at the time of the accident. It is immediately evident that this information is not always recorded, since body position was Unknown for 39 percent of the victims. It is interesting to correlate the numbers for body positions to the 78 Excavation accidents (34 percent of 232 accidents) that were reported.

The position most recommended during excavation is lying prone, but only 11 victims (37 percent) were reported to be in that position at the time of accident. The database indicates that deminers were 1.5 times and 3.2 times more likely to be kneeling or squatting at a time of accident respectively. This agrees well with the information coming back from the field that deminers prefer the more upright positions because of comfort, better field of vision and generally because of improved ergonomics in carrying out prodding and soil-removal tasks. There might also be some cultural bias, as squatting is widely used in countries such as Afghanistan and Cambodia. The design of PPE must take this fact into account.

The survey results confirmed and quantified the feedback that had been coming from the field. It led to two main decisions in regards to the U.S. and Canadian R&D programs. First, the work would continue to concentrate on the blast APL threat second, the two principal areas of work would be addressed: protection of the lower extremities while standing and protection of the upper body when lying prone, kneeling or squatting during excavation drills. It was felt that focusing the R&D on those needs would yield the most benefits to deminers.

The Lower Extremity Assessment Program

The Lower Extremity Assessment Program (LEAP)2 was born in 1998, before completing the deminer injury survey. It was designed to answer questions about the effectiveness of existing mine-protected footwear, but more importantly to document the process of injury to the lower limb due to landmine blast. It was generally agreed that by documenting and understanding this process, insight would be gained that might yield clues towards designing better protective footwear. LEAP was quite bold in its approach because it was proposed to use human cadavers for this research. The LEAP data formed the most complete dataset about landmine injury to the lower extremities.

The LEAP tests used three blast APLs representing mines with a small (M-14, 20 g), medium (PM-2, 180 g) and large (PMN, 240 g) explosive content. A small but representative range of footware was tested. The unprotected references included an improvised sandal and the standard U.S. Army Combat Boot (CB). Two representative mine-protected boots were used: the Welco® Blast Boot (BB) and the BFR-40 boot. These boots have blast deflector in the rear portion of their sole while the forward portion of the sole is unprotected. Finally, two boot supplements were also used in the test program. The Welco® Over Boot (OB) consists of the BB sole containing a blast deflector but mounted on a Kevlar®

1 16
2 17
3 10
scarring system so that the OB can be worn over another boot. The second boot supplement is the Med-Eng Spider Boot™ (SB), which consists of a platform supporting a distributes the load 10 cm above ground by four legs that protrude fore and aft of the platform. The SB differs from conventional boots as it is designed to cause the point of impact to be moved away from below the foot. The fracture patterns observed during LEAP correlate well with reports from the field about landmine injuries to pedestrians. The extent of injury clearly depends on the amount of explosive contained in the landmine, but also on footwear. One challenge that the medical staff involved in LEAP had to overcome was to define a scoring system that would adequately describe the medical outcome from each test while retaining sufficient sensitivity to capture differences in performance due to footwear. The result was the Mine Trauma Score (MTS), as listed in Table 1. The MTS consists of nine distinct scores built from a number from 0 to 4 that describes the amputation level, from no injury to above-knee amputation. In addition, the letter A or B indicates the level of soft tissue contamination. Using the numbers 1 and 2 without a letter refers to an injury where there is no visible break or laceration of the skin, albeit there might be internal bone fractures. The letter A refers to an injury where the skin is broken but contamination from external agents has been minimized because the footgear was not breached. The letter B refers to an injury where the footgear was breached and external agents such as dirt or the detonation products visibly contaminate the wound. It is useful to summarize the knowledge gained from LEAP. First, this program provided much-needed insight into the process that takes place during mine blast injury to the lower leg. LEAP showed that using mine-protected boots on their own did not provide any advantage as compared to unprotected footwear. Only when some form of standoff was introduced, with the OB or the SB, was there any significant difference in outcome. The OB results suggest that this protective equipment can make a difference, but only for the smallest mines. More standoff, or at least a different protective sole is required to extend the benefit of the OB to larger landmines. The limited number of tests with the SB showed that this might be an effective means of limiting lower extremity injury, but there are many pedestrians who are reluctant to use this footgear because of its ergonomics. 

### Tools to Assess Footwear Performance

The strength of the LEAP dataset is its high degree of fidelity because it used human cadavers. Paradoxically, it is also its main weakness because the use of cadavers for this type of test can only be conducted at specialized institutions within a strict legal and ethical framework, making them very difficult to work with. Recognizing this, the Canadian Centre for Mine Action Technologies (CCMAT) decided in early 1999 to look for a tool that can replace cadavers but still produces results in terms of the MTS score without involving medical staff and facilities. The answer was a product called the Fragile Surrogate Leg (FSL), which was then under development at the Defense Science & Technology Organisation (DSTO) in Australia. The FSL is a reproduction of the human lower limb in a series of foams that uses geometrically accurate bones cast from synthetic materials with x-ray visible. As of early 1999, an early version of the FSL had been subjected to explosive tests but there had been no focus to calibrate its mechanical response against landmine injuries to human limbs. Thus, the main objective of the CCMAT program was to purchase FSL specimens, subject them to the same test conditions as in LEAP, compare the results and develop a correlation through MTS scores. Close cooperation with the personnel that performed the LEAP tests ensured that the test conditions were reproduced as closely as possible. The FSL program did not attempt to duplicate all LEAP tests. Only 16 of the 18 tests were the LEAP tests. These were with CB, BB and OB footwear against the M-14 and PMA-2 landmines. The MTS scores and details of the soft and bony tissue damage were compared between the LEAP and FSLS models. Figure 6 displays the MTS values from the tests involving the M-14 mine against an unprotected combat boot, which revealed that none of the main differences between the FSLS and LEAP models is in the soft tissues. The LEAP tests produced MTS scores of 3 and 4, while the FSLS model produced consistent MTS scores of 2B. This limitation with the soft tissues does not discount the usefulness of the FSL model to assess the effectiveness of protective footwear. The level of bone damage was similar for the two models with complete traumatic amputation of the foot up to the ankle level. The foot portion of the foot was severally, severing the forward portion of the foot, which was still recognizable. The tibia and fibula bones remained intact over most of their length for each model. Figure 7 displays the data for the M-14 mine against the CI/OB combination. This combination produced a roughly even split between amputation and salvageable limbs, making this dataset particularly useful to assess the fidelity of the FSL model. The OB absorbed or reflected sufficient blunt energy to preserve the structural integrity of the inner footwear, thereby preventing gross contamination of the injury; none of the MTS scores had a B qualifier. Comparing the bone damage data, the behavior of the calcaneus and talus bones was identical for the LEAP and FSLS models, i.e., these bones were fractured each time. The differences in bone and soft tissue behavior were documented and do not curtail the usefulness of the FSL model.

Figure 8 shows the MTS scores for the PMA-2 mine against the BB/OB and CB/ OB-footwear combinations. All scores were either 2B or 3 and the scores for the three models overlapped. Flash x-ray photography showed that for this mine/footwear combination, the heel and ankle literally blunted, severing the forward portion of the foot, which was still recognizable. The tibia and fibula bones remained intact over most of their length for each model.

### Test Protocol for Upper Body Protection

In late 1998, representatives of the humanitarian demining community were asking questions about the effectiveness of PPE during excavation drills. An opportunity for help had just opened with Med-Eng Systems, Inc., a specialist in personal protection with a long history of working with the explosive ordnance disposal (EOD) community (both squads). Med-Eng had won funding from the Canadian and U.S. programs to develop a protective ensemble for
humanization of dementia. This led to a very successful three-way partnership that advanced the understanding of mine blast injuries to the upper body and how to better protect against these injuries. When describing injuries to the upper body, demining organizations were talking about burns, fragmentation and blast injuries. These three injury mechanisms are closely connected with the physics of APL explosions; thus, it is important to understand the physics of the APL threat to properly quantify the injury mechanisms. 

Perfect work to that effect has shown that the soil has a considerable influence on the explosion, confining the expansion of the detonation products to a conical danger zone above the ground, as shown in Figure 9. This figure depicts three stages in the development of a buried mine explosion. Early during the explosion, the hot gas pushes hard on the surrounding soil, propelling particles from the soil cap directly above the mine to great speed. The hot gas breaks through the surface and jet upward at supersonic speed. In the process, it pushes the air ahead and creates an air shock, which is visible in the second frame of Figure 9. The gas slows down as the expansion develops. The initial push of the gas on the soil creates soil ejecta, a stream of soil particles that flow with the flow of the gas, and the ejecta has a very high speed. The third frame of Figure 9. It is useful to define this conical zone in terms of the angle A above a line perpendicular to the soil surface. The angle A = 0 corresponds to the direction along this perpendicular. 

Let us come back to the two injury mechanisms, starting with burns. The fireball from a typical shallow-buried (less than 10 m) API blast lasts about 1.5-30 milliseconds, but its temperature is certainly high enough to cause burns. When a mine is deeply buried, the hot gas is more strongly compressed and slowed down, creating fresh air and chemical reaction cannot be sustained. The result is a dark cloud. 

Injury mechanisms from a buried APL result from the collision of high-speed soil particles, small pebbles or rocks, mine-casing fragments and broken tool parts with the victim. Let us consider soil particles in the first place. Individual soil particles have a small mass, which limits their ability to penetrate the human body, but their large number has an enormous effect: it can injure the skin and sensitive organs such as the eyes. Larger fragments from mines, casing and tool parts can also penetrate and penetrate the body. The wounding mechanisms for these larger projectiles are fairly well-understood by the medical community. From the perspective of protection, these fragments need to be stopped with armor, a process fairly well-developed for bullets and other high-speed projectiles. 

The third injury mechanism to consider is blast, which is not as well understood as the other two. There are, in fact, at least two physical sources for blast injury: the air shock and the jetting of the detonation products. The physics of air shock has been extensively documented elsewhere for large blast weapons (tens to thousands of kg of explosive). The passage of a strong air shock results in a sudden change of local pressure, a change that the human body is ill-equipped to cope with. Immediately after the passage of the shock, the air starts to flow outward from the source of the explosion. The flow from a large explosion can literally propel a person. The second source of physical blast injury is due to the high-speed flow of the detonation products. The conical shape of the flow zone is such that the surrounding gases often impinge on the upper body. Even if the detonation threat can be repeatable and showed good fidelity in terms of mass and geometry. A decision was made to build upon decades of research by the automobile industry and adopt their crash test dummies, the Hybrid III mannequin. The Hybrid III mannequin was found to be sufficiently robust for the task, although special care must be taken to protect the rubber skin and the neck, particularly when the mannequin is used in an unprotected configuration. These components are susceptible to damage from sand particles. This mannequin possesses repeatable and reliable results for a given threat level and a given body position relative to the blast source. Another advantage is that this mannequin is available in a range of sizes that have mass characteristics similar to the human body they represent. Handling the mannequin requires work, but they can assume the kneeling and prone positions in a repeatable manner with the help of a positioning fixture. The Hybrid III mannequin can be instrumented with a broad range of sensors for automotive testing, but not all of these sensors are relevant to the mine blast scenario. For example, it is not appropriate to use a load cell when data from the field indicates that most of the trauma is to the upper body. Table 3 lists the instrumentation used to develop the current test methodology.

Most of the instrumentation proved robust enough for the application. The devices were used to assess whether or not several automotive injury criteria applied to mine blast trauma. The following are the findings for the two positions and threat levels used in this study. 

The Head Impact Criterion (HIC) should not result from coupling the IMI and FSL scores to the following equation for larger mines. However, questions remained about applying this automotive injury criterion to mine blasts. The HIC requires filtering of the acceleration signals with a 1500-Hz low-pass filter, but a significant portion of the energy from mine blast injury resides in frequencies higher than 1500 Hz. The study therefore recommended that a limited number of tests be performed with an injury model under blast loading to determine the boundaries of applicability of this injury criterion. The neck sensor showed loads similar to those seen in automotive impacts using the N, blunt impact injury criterion. The data was repeatable and showed good differentiation between mine threat levels. 

The thoracic loads measured in terms of chest displacement and chest acceleration did not produce injurious values in terms of blunt trauma, even for an unprotected dummy. It is questionable whether or not this criterion should be used in future tests. 

The burn sensors used on the hand and chin registered only small increases of temperature due to the very short duration of the event and the depth of burial selected. This indicates that there is only a small risk of serious burns, with the caveat that this applies for these mine blast scenarios. 

The pressure transducers are not part of the regular instrumentation package for the Hybrid III. They were added to measure the likelihood of eardrum rupture and blast lung. The latter is a physiologically normal response, with poorly designed torso armor, as reported for British operations in Northern Ireland. However, it was found that the loads generated by an APL for the body positions considered were well below the threshold required for blast lung injury. On the other hand, ear pressure was found to be fairly well-understood. 

The positioning fixture was essential to the test methodology. It greatly decreased the physical work required to position a mannequin and produced a positional accuracy better than ±5 mm. Tight control over position demonstrated the importance of the position of the body within the blast zone. Two positions were selected for the mannequin, kneeling and lying prone, as depicted in Figure 3. 

![Figure 6: Sequence of frames from high-speed video of landmine detonation showing different stages of event.](https://commons.lib.jmu.edu/cisr-journal/vol7/iss1/1)
Comparative Testing of PPE Performance

The test methodology described in the previous section was applied in a landmark series of tests in October 2000. More than 100 tests were done at the Aberdeen Test Center, Maryland, USA, to measure and compare the protective performance of four commercially available PPE outfits. Some key characteristics of the four ensembles are listed in Table 4. These five PPE systems represent a range of protective equipment available to the demining community. All ensembles provide some form of protection to the face and torso, although there are significant differences in the implementation of these protective measures, e.g., extent of the facial coverage of the visor. These ensembles also offer protection to the groin area and there use a helmet to further protect the head.

The test position was set so that the nose of the mannequin would be located 70 cm from the mine on the A = 25° line for the kneeling position and 45 cm from the mine on the A = 45° line for the lying prone position. The mannequins were positioned first and any head protection gear was added afterward. Each piece of PPE was exposed three times to the blast from 100- and 200-g C4 charges for each combination of body position and charge mass. Additionally, two pieces of PPE were exposed two or three times to the blast from the PMN mine in order to validate the use of the 200-g surrogate charge; the blast field from these two explosive devices was found to be very similar, but there remained questions about fragmentation from the thick Batelle casing. The data was recorded in accordance with the test protocol. No damages to the PPE were noted from inspection and the physical response of the mannequin was recorded. The instrumentation records were post-processed and compared to injury criteria reference values for head injury, cardiopulmonary and neck injury.

The structural integrity of the equipment was generally good. The aprons and vests remained in place for all tests, although abrasion of the materials, typical of some partial penetration were often observed, particularly for the 200-g and PMN shots. Fasteners often failed and Velcro® straps became loose, but the equipment generally remained in position on the mannequin. The combination of kneeling and lying prone positions with sand on the soil medium meant that the lower trousers and pant components were never really challenged during these tests. The ensemble components that proved most susceptible to damage were from blasts. The PMN shots were the most severe, and the soil blast and soil blast ejecta were helmets and visors. All visors were covered with dust and dirt, and most were pitted by high-speed soil particles. The pitting was most prominent on the upper portion of the visors, and in some cases, on the helmet as well. Visors failed to remain in place for a significant portion of the tests, either in a consequence of damage to the visor itself or failure of the retaining system on the headband or helmet. Table 5 shows that this phenomenon increased with the threat level.

There was also a dependence on body position with the lying prone position resulting in more severe conditions. The data should note that the two positions were selected on a basis of body dimensions and ergonomics, not to generate equivalent challenges. Each position subjects the headgear to different loading conditions. The lying prone position is 25 cm closer to the source of the blast, which increases the strength of the blast loading and exposes the equipment to a greater cross-section of soil ejecta. This is a region where the soil ejecta velocity increases and the angle of incidence is higher. For the kneeling position, the upper section of the headgear is closer to the A = 0° line where soil particles travel at a steeper angle that likely explains the prominence of pitting on the upper part of the visor. The difference in damage to the equipment highlights the importance of taking into account all damage mechanisms (i.e., blast, ejecta and fragmentation) when designing PPE.

The differences in visor/helmet performance were noted from one PPE design to the next. The PPE with large facial visors retained by a headband remained on the mannequin only three times out of 28 tests (11 percent). When the visor was attached to a helmet, it remained in place 31 times out of 42 tests (74 percent). In regard to structural failure, one PPE failed 67 percent of the time and the type of failure was the visor itself breaking into several large pieces. The second worst performer failed 28 percent of the time with most of the failures involving the visor breaking into several large pieces as well. The reader should be careful in interpreting the structural failure; it does not mean that the visor did not perform their function. With one exception, none of the tests resulted in a "clean" perforation of the visor with resulting damage to the mannequin face. In other words, it appears that the visors performed their primary function, i.e., to stop penetration of the facial area by fragments. The extent of pitting on the upper portion of the visors also attests to the importance of this function, and without it, sensitive organs such as the eyes would be worsted.

In addition to soil ejecta and case fragments, the head is also vulnerable to the blast of the shock and the following high-speed gas flow essentially deliver a blow to the head, which is akin to a blunt impact. Figure 10 shows the HIC results as a function of PPE, threat level and body position. The onset of severe head injury occurs at a HIC value of 1000. For the 100-g charge, the mean HIC value was 379 for PPE1 in the kneeling position, which indicates that this threat level is unlikely to produce severe injury through blunt trauma to the head. The largest mean HIC value for the 200-g charge was 3756 for PPE1 in the kneeling position, which indicates a definite probability of severe injury from blunt trauma to the head.

It is interesting to note that for the kneeling position, the visor design for PPE1 increases the probability of head injury from blunt trauma relative to the unprotected mannequin. Another important aspect of the HIC data is that the heavy helmet of PPE5 combined with the lower projected area of the visor never produced a HIC value greater than 100. In the kneeling position, the headgear with greater mass generally resulted in lower HIC values while the two headband designs with lower mass and larger area produced larger values. In the prone position, only PPE5 resulted in a significantly lower HIC value. This behavior can be partially explained by the fact that a visor/helmet combination increases the projected area of the head against which the air shock and the transient flow from the expanding gas can push, thereby increasing head acceleration.

Increasing the mass of the headgear has the opposite effect of reducing head acceleration. Of course, the air shock and the transient gas flow are only responsible for part of the overall loading on the headgear. Impacts from soil particles also play an important role, but the relative contribution of these three loading components of mine blast mechanisms further understood.

Another aspect of head protection that should be considered is its effect on the probability of ear injury. For an unprotected mannequin, the sensors mounted on the side of the mannequin head record a signal of the Friedlander type, characteristic of free-field in-air pressure. The presence of headgear affects the shape of the pressure pulse, indicating a more complex flow around the visor and/ or helmet. Figure 11 shows the average peak pressure measured as a function of PPE, body position and charge size. It is seen that it is the threshold of cardiac rupture is reached easily, even for the 100-g charges. The effect of PPE design is relatively small for all 100-g tests and for the 200-g tests in the prone position. However, the 200-g tests in the kneeling position showed a significant increase of peak pressure for the PPE utilizing open-style helmets. It is speculated that for the kneeling position, an open helmet captures a part of the streaming flow, acting as a reflector to increase pressure at the ear.

Injury to the neck due to blast trauma is either due to a direct impact on the neck or due to relative motion between the head and chest. During a mine blast, the head and chest are subject to different accelerations as a function of their location within the blast cone. The probability of injury due to blunt impact can be evaluated from the forces and momenta imparted by the neck sensor and the N2 criterion. A value of N2 = 1.0 corresponds to a 22 percent probability of severe neck injury. Figure 12 shows the results as a function of PPE, body position and charge size. That data is missing because the neck was one of the two mannequins used for testing because became loose during the test program. With the highest value of N2 being 0.95, it is apparent that none of the test conditions resulted in a high probability of severe neck injury. The values of N2 are generally larger for the unprotected mannequin, indicating that the use of PPE reduces the probability of neck injury. The larger changes generate larger values of N2. The values of N2 are also larger for the lying prone position, consistent with the closer distance to the blast. It is suggested that the same factors that influence head acceleration (i.e., visor surface area and helmet mass) play a similar role with respect to neck injury.

Table 4: Mass characteristics and visor/helmet projected area for the four PPEs

<table>
<thead>
<tr>
<th>PPE Type</th>
<th>PPE 1</th>
<th>PPE 2</th>
<th>PPE 3</th>
<th>PPE 4</th>
<th>PPE 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body armour mass (kg)</td>
<td>2.6</td>
<td>3.2</td>
<td>4.1</td>
<td>4.0</td>
<td>4.5</td>
</tr>
<tr>
<td>Trouser armour mass (kg)</td>
<td>3.6</td>
<td>3.6</td>
<td>3.6</td>
<td>3.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Helmet/visor mass (kg)</td>
<td>1.0</td>
<td>0.77</td>
<td>1.3</td>
<td>2.6</td>
<td>2.4</td>
</tr>
<tr>
<td>Total ensemble mass (kg)</td>
<td>3.6</td>
<td>4.0</td>
<td>4.0</td>
<td>4.6</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Table 5: Statistics about loss and structural failure of visors (all PPEs)

<table>
<thead>
<tr>
<th>Threat</th>
<th>Kneeing</th>
<th>Lying Prone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lost</td>
<td>Failed</td>
<td>Lost</td>
</tr>
<tr>
<td>100g</td>
<td>4/15 (27%)</td>
<td>2/15 (13%)</td>
</tr>
<tr>
<td>200g</td>
<td>8/15 (53%)</td>
<td>4/15 (27%)</td>
</tr>
<tr>
<td>PMN</td>
<td>4/4 (100%)</td>
<td>2/4 (50%)</td>
</tr>
</tbody>
</table>

The data indicates a number of occurrences out of a total of numbers only two of the five PPEs were tested against the PMN mine.
Body Position Versus Probability of Injury

While developing the upper-body test protocol, the mine-to-chest (d) and mine-to-nose (d) distances were measured for each test to provide a rough measure of body orientation. These parameters were varied to assess their effect on mannequin response. As more test data were coming in, it became clear that body position relative to the blast cone has a strong influence on the transfer of force to the mannequin. Our measurements indicated that the head acceleration often reached levels indicative of a high risk of blunt trauma injury. Nerenberg et al. examined the relation between head acceleration, the distance d, and the location of the nose within the blast cone, i.e., the angle A mentioned earlier. They demonstrated that injury severity could be improved through better position during evacuation. Low-kneeling results in a larger value of A than high kneeling, as illustrated in Figure 13. By avoiding the blunt cone position, the implication is that small changes in body posture can have a large effect. Further work is underway to map out this zone, and the results will be published in the near future. This might lead to safer body positions during evacuation drills. Quantifying these injury-producing mechanisms should lead to improvements in PPE design.

Conclusions

To solve personal protection issues, the scientific approach was applied, first to identify the cause, then to study the basic injury-producing mechanisms and second to develop into appropriate protection strategies, working with manufacturers that had expertise to contribute towards practical solutions. A large portion of the work concentrated on the development of new tools so that protective products could be evaluated objectively. These test methods were then used to determine the performance of a few footwear products and five PPE entities designed to protect the upper body. The results from these tests were published, and it is expected to contribute these test methods to organizations such as the International Test & Evaluation Program (ITEP) for their consideration.

The IEP study produced several outcomes, including the developments of a specialized MTS for the lower extremities and a detailed epidemiology database for blast mines. Tests with the IEP and comparison of the results against those from LEAP generated a validation of a new tool for use. Test results from the two programs demonstrated that existing mine-protected footwear did not perform any better than unprotected footwear unless additional standoff from the mine is added. This can be achieved through the use of an overboot or a raised platform such as the Spider Boot. Through our test programs, the injury mechanisms were largely quantified, and this new knowledge is already being used to develop better footwear. It might soon be time to conduct a new impact study of high-speed gas flow around the body, soil ejecta, and fragments from mine casings or other sources. Burns can also occur under some conditions. The existence of a conical zone where the risk of injury is greatly increased has also been demonstrated experimentally. The

References


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https://commons.lib.jmu.edu/cisr-journal/vol7/iss1/1
Manual Demining in Lebanon

MinTech International has been tasked with clearing 1,300 square kilometres of land in southeast Lebanon. In the space of nine months, MinTech deminers have disarmed and destroyed 23,300 mines, clearing 2.2 million of the total three square million square metres of land. As MinTech approaches the end of this first major task in Lebanon, MinTech Project Manager Max Dyck and Team Supervisor Moses Sibanda present their perspectives on the challenge.

by Max Dyck, Project Manager, MinTech International

Introduction

In May 2002, MinTech deployed 10 manual demining teams, 10 mine detection dog (MDD) teams, survey and explosive ordnance specialists, and ground-penetrating machinery to southeastern Lebanon. Our task was to clear some 200 minefields from a substantial area of southern Lebanon, stretching south and west from El Qaa in the north down past Kafar Kela to Bayr Yahun in the south. Having received confirmation of the project, our team had deployed and set up a first base camp within 10 days. Accreditation from the project supervisors, the United Nations Mine Action Coordination Center (UN MACC) in Tyre, came just three days later. Our ground clearance machinery then took 10,000 minute metres and our manual deminers cleared 6,500 square metres from the first minefield before the end of day one.

The momentum created by the rapid deployment has been maintained, clearing on average 23,300 of the AP and AT mines cleared by that time. Over the period, we have further strengthened our resources, bringing in local deminers—United Nations (UN) and Lebanese army personnel trained by MinTech to UN standards to operate as demining units under MinTech management.

Mine Density

What is unique about Lebanon is the density of the minefields; they are probably as dense as any that have been encountered anywhere in the world. Some extend over many kilometres, forming great belts. Many have standard patterns laid in four rows with a mine every 40 centimetres. The majority of the targets have been Israel No. 4s, but a few tank mines, a mixture of M24, M113, and M6A2s have also been found along with 451 pieces of UXO. The mine density makes it impractical to deploy dog deminers effectively, and while machines and dogs have a crucial secondary role to play, virtually all of the mines have been cleared by hand. On the plus side, however, the mines have been laid uniformly in rows with end-of-row markers—very irritating the occasional rogue mine laid out of line and sequence to each somewhere in the middle.

Productivity and Performance

While the manual demining teams have been the primary asset in the clearance of the mines, the overall productivity and performance figures achieved reflect the integrated use of all three—man, machine, and dog. The ability to deploy all three resources has had a major impact on the performance of the manual demining effort. In the majority of the fields, we have used all three assets, usually employing manual demining as the primary resource supported by one or both of the secondary resources, which substantially speeds up the clearance process. Both dogs and machines have been used with great effect for area reduction, verifying the existence (or non-existence) of UXO and consequently has a high level of metal contamination. On the ground, each piece of metal detected must be treated as if it is a mine until proven otherwise.

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Personal Protective Equipment

PPE is the most loathed piece of equipment for a deminer. Despite the fact that everyone respects the vital importance of wearing this gear, in the baking heat, at 40°C, it all just seems so cumbersome. It is, literally, a piece of running gear, with each PPE kit manufactured with the knowledge and expertise of external designers. The PPE kit is manufactured in Zimbabwe to international standards and is used widely by other international demining organisations. In Lebanon it has been fully put to the test in two particular prodding incidents, both of which have resulted from the presence of mines, and the direction from which the deminer then proceeds.

Three such mines have existed in the target area. MinTech has been working on, but the resulting injuries have been minimized due to the effectiveness of the PPE, visor and body spray. On all three occasions, with explosions just 50-60 centimeters from a deminer’s face, fairly minor hand injuries have occurred when, without the PPE, major injuries would have been sustained.

Another safety initiative particularly suitable to Lebanon has been the introduction of rubber knee pads and leather elbow pads, which have been developed specifically for this terrain and are very effective. Their use is a matter of choice for the deminer. The most widespread use of the pad on restriction on manoeuvrability, but in general, they have rethought what would otherwise have been many knee and elbow injuries, and as a bonus, has prolonged the life of our field uniforms.

MinTech anticipates it will destroy a further 10,000 mines in the next three months, by which time we will have completed our first major task in Lebanon. Despite the challenges, the initiative has already directly cleared 200 square kilometres of land for pasture, agriculture and development—land where farmers now have the confidence to allow animals
to graze safely. Many hectares of former agricultural land are already back in cultivation, several quarries have been reopened and a major pipeline in the Talakush area has also been re-opened.

At MineTech, we believe that mine action should be seen as a short-term obstacle to development, as opposed to a long-term job opportunity. Understanding this means understanding us. Ignore it and you’ll see us as hard, uncompromising, anti-social and pretty different. Lebanon has been very rewarding, but hard work and the team’s achievements are impressive. We look forward to further challenges in this theatre.

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My Lebanon Experience by Moses Sibanda

Moses Sibanda, 27, has worked with MineTech since leaving school and is now a field supervisor. His experience spans Mozambique, Somalia, Bosnia, Kosovo and now Lebanon.

First Impressions
Our deployment was pretty fast. I was expecting to head for Iraq, but it was quicker, so I’m glad the boss put me on the plane for the Lebanon job. On arrival, we deployed south to our first camp where the advance party had set up our first base. I noticed that the terrain looked a bit tougher—similar to Somalia. It was rocks, rocks and more rocks. Although it was the end of winter, I still found it pretty cold and there was still quite a bit of green vegetation around. This was going to change soon because in Lebanon, boy, does it get hot!

Targets
Our camp was up, team leaders and supervisors were in Tyre to the Mine Action Centre (MAC) to receive our introductions to Lebanon and get familiarized with what to expect here. The targets were mainly the Israeli No. 4 AP mine. I checked it out and was quite chuffed as it was a huge lump of metal in size—it was easy to find. But then we were shown the rock mine. This was well made and disguised as a rock. If you see it out there you’ll squat on it for a rest.

Activity in the Field
Three days after our arrival, we were accredited to begin operations, and by the fourth day I was finding mines. My job in the beginning was to deploy with manual teams and help the recently appointed leader come to grips with his team. Did we find mines or did we find mines! Hundreds were found and dismantled in days. I was the first to disarm a live mine here and that first day I disarm. 76 No. 4s, and after that, hundreds. We stopped dismantling when we discovered too many unstable mines. From then on we bearded and destroyed in situ. This is a bit slower, but we’ve got a good drill going, and now we blow whatever we find in a day without having to work long extra hours in the minefield.

UNMACC
The UNMACC people are a good bunch of guys and we get along great. They speak very strangely not their fault though, they come from down under! All the plans officer is famous for running up and in his funny accent saying to the guys, ‘Hey guys, just gotta a little job for you.” That’s when we know it’s going to be a real challenge. We do them all, though—no problem.

Accidents
We’ve had a few accidents here in Lebanon, but we’ve found few mines, so it’s pretty good record. I think nobody goes out planning to have an accident, but you know it is dangerous work, and if you do not realize that sometimes there are mistakes, then you need to wake up. We are not selling candy at a candy store. We are dealing daily with lots of dangerous objects and now and again, something will go wrong. Right now, I am the quality assurance (QA) supervisor, so it’s my job to check all the systems and processes being implemented to minimize mistakes and keep all the guys safe and, of course, ensure we do a good job for the people of south Lebanon.

Being a Deminer
I have been with MineTech since leaving school and have travelled a lot—Mozambique, Somalia, Bosnia, Kosovo and now Lebanon. I started at the bottom and I found and destroyed hundreds of mines. I am now a supervisor and one day I want to be a field manager. Many people thought we would struggle to do what we have done here in Lebanon because we had the toughest areas with the biggest minefields. I’m proud that we’ve done it; it’s a good job and I wouldn’t swap it.

The Design without Borders (DwB) programme was initiated and is led by Norsk Form, the Norwegian Centre for Design and Architecture. It aims to use designers’ creative and analytical skills to create solutions for developing countries and areas of emergency. DwB aims to create meeting points between problem owners and professional problem solvers, and to be a catalyst for cooperation and development of new products and services. Our demining work is carried out in close collaboration with Norwegian Peoples Aid (NPA).

by Anders Isbye, Design without Borders

Introduction
Manual demining is a key component in the humanitarian demining projects run by NPA. Currently, significant resources are invested internationally on issues such as mine dogs, mechanically assisted demining and ground penetrating radar. However, none of these technologies replaces manual demining—each only complement. Despite this, manual demining receives relatively little attention. Manual demining is very resource-intensive. NPA has found that a day’s work for a deminer can range from as little as 0.5 sq m to up to 100 sq m in different projects. If we can improve the working conditions for deminers without compromising safety, so that more projects can manage 80 sq m/person/day and fewer 0.5 sq m, our effort will make a difference for all demining operations! DwB has joined NPA in this effort, providing knowledge in product design issues such as ergonomic/human factors, materials and manufacturing processes.

Analysis and Field Study
In order to gain a proper understanding of the challenges of manual demining, it was necessary for DwB to carry out an extensive analysis, including a field study. This work was partially funded by the Norwegian Agency for Development Cooperation (Norad). Three professional product designers were chosen for the task, carrying out the analysis and a 10-day field study in Tetu, Manica and Sofala provinces in Mozambique.
The study concentrated on the deminer’s work situation, tasks, protection equipment and personal tools (except the detector)—and especially their mutual interaction. These equipment and tools were chosen because they are bought and used in sufficient numbers to also make them commercially interesting. NPA has been manufacturing a range of their products and other hand tools locally where possible. The field study investigated local manufacturing possibilities, such as to see if local manufacturing could be further utilised for other products. The full report is published in pdf-format on the Internet at http://www.norskform.no/dug/ rapport_fast.pdf.

**Potentials for Improvement**

First, the demining operations all seemed well run. The equipment and work operations were overall held to be satisfactory or good, but not without scope for improvements. The results from the field study and analysis are summarised in figures showing potentials for improvement in six important categories. This is done for each piece of equipment that has been considered, and forms the background information for our project proposals. Generally (and unsurprisingly) the protection against landmine blasts appears to be adequate. Usability, both in terms of comfort and performance, seems to be less considered. Also, safety and health beyond explosives protection issues are in need of attention. Dehydration and overheating are consequences of working with heat and non-ventilated protection gear in hot climates. This rarely has major direct effects on human health, but besides being uncomfortable, it will certainly influence demining concentration and operation time, which are crucial. Interventions with deminers support that this is a problem to be taken seriously.

**The Vest**

The vests studied in the field were developed for NPA by the Norwegian manufacturer RoFi. The dialogue between NPA and RoFi is good, and hence the most recent vests are functioning very well as they are modified and improved according to NPA requirements. However, there are some issues that are not solved satisfactorily:

- The deflector/overlap between vest and visor restricts mobility and adds weight away from the body. Also, we must bear in mind that the visor is not worn completely down in each and every operation.
- The weight of the vest and the materials used restrict the ventilation of the body. Heavy perspiration leaves the deminer completely soaking wet after one hour of work. Some deminers claim that this results in colds when they are staying in the waiting area.
- Possibly as a result of the points above, the deminers have a tendency to "sag" the vest slightly, leading to body area not being covered as intended.

**Cleaning, maintenance and replacement parts are not properly catered for, reducing the lifetime of the vest and making it difficult that sharing of vests is quite unreasonable.**

Some of these problems are not easily solved, and there may be a need for a complete rethink of how the vests are designed. It may be more appropriate to look into animal life for inspiration, using biotics thinking, rather than the evolution from the human vein. A solution like the Armadillo vest will enable both ventilation and protection.

**The Visor**

The visor, a second-generation design by Security Devices in Zimbabwe, was clearly more problematic. While worn correctly, heat will get trapped behind the polycarbonate glass, causing the deminer to get overheated and the glass to steam up from the breath of the deminer. Many quoted the need to stop work and open the visor in order to cool down, but in some cases, deminers are known to continue working without wearing the visor fully down.

The visors also scratch easily, obstructing the deminers’ most useful detection device—the human eye. The visors are changed frequently, but not frequently enough; deminers were observed lifting their visors for a better look during their work in minefields. Quality problems also affect visibility through breaks and slippage of the visor. This is a result of heavy weight and constant readjustment of the straps when two people share a visor. Concerns were also made on the rather cumbersome opening and closing mechanism.

When considering a new kind of mask, this must be done together with the vest in order to ensure overlapping protection. Insulation and knowledge can be taken from masks developed for other demanding applications, such as the baseball catcher, the ice hockey goalie and the smoke diver masks. Most air from the breath can be channelled away, and a combination of materials may be used for the same protective effect the full-face polycarbonate provides today. The polycarbonate part may be smaller, able to retrace into the mask for scratch protection, and easily replaced without needing to discard the rest of the mask.

**Vegetation Cutters**

Deminers may use more than half of their time clearing vegetation. Considering this, we were amazed at the low level of vegetation cutting tools. The tools could be observed used, such as the furniture saws issued to cut down trees of low quality and badly maintained, such as the pruning scissors, or just misused, such as the machete and axe largely would be.

Demining Tools

NPA uses locally manufactured prodders and excavators. Bayonets have also been used if available. These tools are crucial to demining and are identified as the tools that are most likely to cause damage if used incorrectly, but at the same time, these tools may be hard to improve beyond the work that is currently being done by others. Knife- and sword-smiths’ skills, such as creating a sharp, hard edge on a soft steel blade, should be investigated for use on demining tools.

Ergonomically, there is a lot to gain by redesigning these tools. Today, fine, precise muscles in the hand and wrist are used for operations requiring a lot of force. This quickly induces fatigue during operation and makes the tools more difficult to control. Larger muscles should provide the power, preferably by pulling...
An Interview With Colin King

Colin King is a graduate of Sandhurst. He served 14 years in the British Army, gaining extensive knowledge of explosive ordnance disposal (EOD), and served both as an instructor at the British EOD School and as the sole EOD analyst for the Ministry of Defense for six years. He founded an EOD consultancy company, which conducts assessments, training and operational trials worldwide. He is also the editor of Jane’s Mines and Mine Clearance.

by Margaret Busé, Editor

Margaret Busé (MB): Can you tell me about training the Afghan deminers?

Colin King (CK): I think it was really the first major UN demining initiative. The deminers were all mujahideens, and they were sent to one of two training centers. I led one of two teams based in Quetta, which was just on the border in Pakistan in the southern desert region; then there was another center in Faisalabad to the north. Looking back, the program was very basic. It was mainly focused on training people to remove mines, UXO and booby traps. There was really no attention to the other aspects of mine action—and none of the support functions or quality assurance; none of that was really thought about in those days.

MB: Who did your assessments when you went in?

CK: This program was purely about training deminers for mine and UXO clearance. There was little thought at that time as to which areas they would be going into, prioritizing tasks or what equipment they would use. They were basically sent in with a bag of hand tools, a kid’s $10 Radio Shack metal detector and not much else.

MB: When did you start your demining efforts?

CK: My first experience with mines was the Falklands. The actual Falklands war was in 1982, and I went there two years later. Then two years after that, I commanded all bomb disposal operations on the island, including responsibility for the minefields. We basically tried to keep

the casualties built up during the post-war clearance in the Gulf. Paul was the first major British casualty among the clearance teams, and that incident made a lot of people stop and think.

CK: To me, one of the most obvious changes is the adoption of PPE [Personal Protective Equipment], which just wasn’t a prominent issue when I first started. It was available, but in the army, we mainly wore protective equipment for terrorist bomb disposal; we rarely bothered with it for anything to do with mines. We didn’t wear it at anytime during operations in the Falklands, and I didn’t use PPE for many years afterwards. It wasn’t really until my friend Paul Jefferson got severely injured in Kuwait that the issue was properly highlighted.

MB: PPE was not used for military clearance or humanitarian demining?

CK: It just wasn’t something that people recognized as a significant consideration in the early days. That changed, I think,

as the tool rather than pushing it, in order to maintain maximum control. The smaller muscles should then be left to perform the tasks requiring maximum sensitivity.

Redesigning Personal Protective Equipment

Following discussions, the results of the analysis and feedback from the field, NPA and DwB have decided to pursue development of a new set of PPE as our first project. This PPE will be seen as one integrated unit consisting of several parts. Manufacturing will take place with existing suppliers, but also in the local market where possible. We are currently in the process of financing the project, which should run throughout 2003. Discussion partners are most welcome in this project.

Our Vision Ahead

We are all sharing the dream of a mine-free world. But in the process of getting there, we want all deminers to be provided with effective, safe and comfortable equipment at a reasonable cost. We want to help develop this equipment, employing our user-oriented
design methodology. And we want this equipment to improve and speed up manual demining operations.

In the process, we also want to create positive developmental side effects. We can do this through facilitating local business opportunities, learning from others and transferring skills amongst other things. When demining operations eventually cease, these skills can be used for other purposes. We have started on the crucial area of manual humanitarian demining. Gradually, we aim to cover more and more of the areas where we as designers can make a difference.

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All photos courtesy of the author.

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All photos courtesy of the author.
highlighted the issue from a common-sense point of view. Also from a legal perspective, it was now clear that employers could be held liable not only for their own employees but also for their subcontractors, which tended to protect their employees adequately.

MB: Do you think there is more coherence between military and humanitarian demining than when you started back in the 1980s?

CK: Well it’s strange how demining has evolved, because in the very early days it was the military who taught it, and it was all based on the military principles of minefield breaching. Humanitarian demining techniques didn’t really exist at that time. You simply had military engineers trying to teach civilians how they were trained to clear mines, although many had no real experience of doing so. Then gradually, as people realized that wasn’t appropriate—and that it was completely impractical—humanitarian demining started to split away from military breaching and you ended up with a radically different approach. Now, from a technical point of view, we have come together again; the military are becoming far more engaged in humanitarian operations, they are working with and learning from the demining NGOs [non-governmental organizations]. Meanwhile, the humanitarian demining community is taking advantage of the rapid clearance options used by the military, and seeing what might be useful to them.

MB: What do you think are some of the challenges of training deminers?

CK: I think even in the days of the Afghan programs, you could recognize that some people had more aptitude than others. Some people were really scared by explosives—those people in situations where they would be dealing with live mines or demolitions was just the wrong thing to do. Some people had no natural ability and that’s not exactly ideal in work like this. Either people just don’t have the ability to absorb the training, and then sometimes you will see a person with absolutely no formal education that just has natural aptitude—good manual skills, common sense and the ability to be innovative. What I think is very difficult is to screen out the right people before the training begins; you have to be prepared to drop people from a training program if they are unsuitable. I also think there is a significant difference between the qualities you are looking for in a deminer and an EOD technician. EOD demands lateral thinking and innovation; deminers often have to follow a repetitive routine, and the last thing you want is for them to start being innovative.

MB: How have you seen the tools that the deminers use evolve over the last 20 years?

CK: It all started with what military tools were available, still primarily the metal detector and the probe. In many cases, the probe would be the bayonet, and there are still a lot of military units that favor using the bayonet. What we have seen is the evolution of protective equipment, metal detectors, probes and other tools for cutting vegetation or clearing surface mines, that have developed into something more like protective body equipment, and so on. That’s why we use the equipment.—We’ll use it. “That doesn’t happen in many programs. As far as the international humanitarian demining community goes, certainly there are a number of different tools and techniques available. But although each program will try to get their own likes and dislikes, and if they can afford them, they tend to stick to those that are best for them. At the moment, the true “tool-box approach” happens if you have a number of demining agencies operating in a region and swapping resources among themselves. If the program is big enough, the mine action center (MAC) may also have some centralized assets to loan out.

MB: There are a lot of new technology that’s emerging—everything from the ground penetrating radar to the bees and so on. Where do you see the new technology going? Do you think that’s money wasted or do you feel that’s money spent in a good direction?

CK: I think there has been a tremendous amount of money wasted. But it’s not bad science; there has been a fundamental misunderstanding of the needs of the deminer. It’s unfortunate that there was such a gap between the scientific community and the operational community. Too much has been done with the end in mind, and not the means. But the right technology should be useful and have real place in the field or have little prospect of any operational application. Whether some of that research investment will pay off in the long term is difficult to say, but from the operational perspective, high technology hasn’t contributed a great deal. It hasn’t fulfilled some of the promises it made or, perhaps, the expectations that people had for it, and that’s a shame. What I think is likely to happen is a gradual, incremental trend—as we’ve been seeing—towards better detection sensitivity combined with selectivity, more mobility, better performance from the enhancements of existing tools. At some point, perhaps, we will get usable multi-sensor detection, which might just be the big step forward that everyone has been waiting for.

MB: You mention that there has not been a lot of communication from technologies on down to the field personnel. How do you think communication between users and the R&D (research and development) community can be improved?

CK: There have been a lot of conferences and a very good annual user-focus workshop organized by the Department of Defense (DoD). The European Union has done similar work. But there is room for improvement. Communication is well-in-hand. At least, the equipment designers and program managers are getting out into the field and seeing there problems the faced by deminers.

MB: After 20 years, we’ve seen a variety of demining programs and mine action; what do you feel needs to be in place for an effective demining program?

CK: There are a lot of dements, really. Another thing that has changed over the last years is that mine action is no longer seen as a stand-alone activity. It has to be integrated into an overall regional development plan. There are the major issues such as political support, funding, international support and funding, but you get down to the fundamental issues of understanding the problem. The better you understand it, the more focused and realistic your approach to the solution can be. That requires large amounts of money, which is something else that has developed over the last 20 years—even though people don’t necessarily agree on what it means. What I agree is that it makes sense to have a regional overview before you launch into a program where you can’t see the wood for the trees. You have to have some good socio-economic impact data available in order to begin prioritizing tasks and allocating resources, and area reduction is critical to making the best use of those resources. In the last few years, we have seen that the survey side is absolutely fundamentally to mine clearance.

The MAC has to create a capable and well-supported indigenous capability. Rwanda is a good example, even though it’s a military program. There have been really high-caliber, dedicated people being supported within their own region and by the U.S. State Department. Many of the national programs rely on outside assistance from specialists who can channel their experience and resources into addressing problems. Having said that, one of the things I have a real problem with is a “one-size-fits-all” approach to different programs. One of the things I try to do in my presentations is that the diversity of the environment and the mine threat will determine the approach. There’s no point in training someone to probe in an area where a probe could not possibly be used, which is precisely what is being done in some of the programs. It just shows poor regional assessment followed by an inability to adapt to an obvious problem.

MB: Is it just too difficult or are there too many time and financial constraints for organizations to tailor their training programs?

CK: It tends to happen when non-specialists, like U.S. SOF [Special Operations Forces] teams, are given basic instruction and then sent to train people how to mine clear. When the situation no longer fits the template and they need alternatives, they won’t have the depth of knowledge or experience to fall back on. It’s always risky to be at one step ahead of the people you’re training. In some cases, the people they’re training have actually been demining for some time, and it’s the trainers who are behind the curve, because most have no practical experience at all. I have to say that the SOF trainers I have have been consistently high-caliber people who are clearly dedicated to their work, but they are sometimes put in an impossible position, faced with situations way outside their area of knowledge.

MB: I’m sure you’ve got a tremendous number of lessons learned in the amount of time you’ve spent in the field. Where do you think demining will and should go in the next 10 years?

CK: Mine action is being refined constantly. Lessons are being learned and it’s becoming more focused, more surgical. It’s also being better managed and there’s better integration. All of those trends seem set to continue. The international interest, the application of lessons from one region to another, the number of experienced people and the better integration. All of these trends will contribute to making steady progress and you will gradually see more and more regions listed as “mine safe.” There may be the odd technical innovation that makes a major contribution, but above all, the main thing will be the commitment of so many public and private sectors in the field. The important issue in this business is people, and there are still a lot of good people making steady progress.

"All photo courtesy of Colin King.

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Explosive Remnants of War: The Impact of Current Negotiations

"While there has been significant progress in reducing the scourge of APIs, the menace posed by unexplosited artillery shells, mortar rounds, hand grenades, cluster bomb submunitions and other similar objects must also be addressed." -ICRC President Jakob Kellenberger, 2002.

by Paul Ellis, GICHD

Introduction

The 1980 UN Convention on Certain Conventional Weapons (CCW) has become the focus for new measures of international law on the issue of explosive remnants of war (ERW), a category that includes UXOs and abandoned ammunition. The measures that have been and are going to be discussed could have major implications for the humanitarian impact of APIs and post-conflict clearance operations.

What is the CCW?

The full title of the CCW is the "Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects." The Convention seeks to regulate the use of certain conventional weapons in armed conflict to prevent unnecessary suffering to civilians and indiscriminate harm to civilians.

Negotiated in 1980, it was a by-product of the international conference of the 1977 Additional Protocols to the Geneva Conventions.

The CCW is a framework instrument containing rules on specific kinds of weapons. These rules are found in four protocols that ban or restrict the use of the following weapons: using non-detectable fragments; mines, booby traps and other similar devices; incendiary weapons; and blinding laser weapons.

Although 90 states are party to the CCW, not all States Parties have ratified the modern protocol individuals. This problem is further confused because while some states have ratified the amendment to Protocol II (APII), others have yet to do so and continue to follow the earlier Protocol II.

The CCW is an important instrument of international humanitarian law. It was in the 1990s that the treaty became a focus for activity, when it was seen as a possible vehicle to reduce the impact of APIs. The States Party to the CCW did negotiate an amendment to Protocol II, APII, which placed further restrictions on landmines. However, the widespread disagreement with these modern measures led to the diplomatic drive that produced the Anti-Personnel Mine Ban Convention (APMC).

The Emergence of ERW as an Issue

In recent years, the international community has concentrated on alleviating the humanitarian impact of APIs. However, for those operating in the clearance community, it is a fact that the work involves unexplosited or discarded ordnance as much as— if not more than—it involves landmines. The situation in Laos is one of the best known examples. Thus is the issue of ERW. The new authorities of the affected countries still regularly deal with

ministries from the First and Second World Wars. In Poland—which was severely affected by ERW after the Second World War—as late as 1990-2000, military engineers cleared 3,428,290 explosive devices, of which only 12,620 were mines.

It was the air war in Kosovo, however, that led to calls for international action on ERW. Based on its experiences in war-affected areas and its concerns about the problems caused by cluster bombs and other UXOs, the International Committee of the Red Cross (ICRC) commissioned a study, "Explosive Remnants of War—Cluster Bombs and Landmines in Kosovo.

The goal of the ICRC was to ensure that a discussion about ERW was included in the Second CCW Review Conference. Independent pressure to ensure such a discussion also came from other non-governmental organisations (NGOs). The Second Review Conference of the CCW

The Second Review Conference of the CCW took place in December 2001. The focus of states party to the CCW was divided among several topics. The main focus was to ensure an extension of the scope of application of the CCW to cover internal as well as international conflicts. In addition to ERW, there were other issues under consideration, including mines other than APIs, measures for compliance and small arms.

Overall, despite the various proposals, the largest part of the time was spent discussing the issue of ERW. This was very much an educative process, as while some states were very aware of the issue, others were being introduced to the issue for the first time. It was never going to be possible to conclude a new agreement on ERW at the Review Conference. However, there was wide recognition of ERW as an important topic that needed to be examined further. To undertake the work, a Group of Government Experts (GGE) was established to discuss ways and means to address the issue of ERW. The group was to "consider all factors, appropriate measures and proposals, in particular:

- Factors and types of munitions that could cause humanitarian problems after a conflict;
- Technical improvements and other measures for relevant types of munitions, including submunitions, which could reduce the risk of such munitions becoming ERW;
- The adequacy of existing international humanitarian law in minimizing post-conflict risks of ERW, both to civilians and to the military.

ERW in the CCW during 2002

The GGE met three times during 2002 for a total of less than five weeks. In reality, many of the diplomatic delegations remained unchanged from the Second
clearance could identify the major problem munitions, there was insufficient data to perform an empirical analysis. The second paper, ERW—Undetected Explosive Events in Annamont Storage Areas, provided an understanding of the potential threat from abandoned ammunition stockpiles and poor ammunition management practices, which were areas of discussion in the GGE. The UN Mine Action Service (UNMAS) sent the former Program Manager of the UN Mine Action Programme in Kosovo to the GGE. His paper, presented to the GGE in July 2003, was one of the few written contributions based on actual field experience in however, were not designed to examine the minutiae of the issues or to negotiate a protocol, but to examine whether measures to address the problem were feasible and whether a new agreement should be negotiated. Overall, there was widespread recognition of the problems caused by ERW, and although the process sounds drawn out, many states spoke in favour of moving quickly to address the issues and what measures might be negotiated.

The Next Step

At the December 2002 meeting of States Parties to the CCW at which the work of the GGE was discussed, it was agreed that actual negotiations on an instrument on ERW would start in March 2003. The mandate agreed on by the States Parties is broad. Interestingly, it states that the implementation of existing principles of international humanitarian law and to further study, on an open-ended basis, possible preventive measures aimed at improving design of certain specific types of munitions, including submunitions, with a view to minimise the humanitarian risks of ERW. Exchange of information, assistance and cooperation would be part of this work.

In the context of the activities described above, meetings of military experts can be conducted to provide advice in support of these activities.

There was some criticism of what was left out. In particular, a disagreement on the next led to the deletion of the explicit reference to civilian assistance, much to the annoyance of several NGOs. The South African delegation stated that they would agree to the deletion only on the assumption that victim assistance would be discussed under assistance and cooperation.

The Implications for the Mine Action Community

Many in the mine clearance sector are not involved in the current diplomatic work, perhaps in part because of a perception of too many priorities. However, discussions on ERW will go ahead in 2003 and may potentially have a profound impact on future post-conflict clearance operations. For existing programmes, the impact is likely to be small. It seems unlikely from the discussions of the last year that States Parties will agree to retrospective action, although this issue will be raised. The greatest potential is for future programmes in which the potential impact on military operational effectiveness is considered. The financial implications and deciding on responsibility for clearance are also areas likely to see careful discussions. States Parties are wary of measures that would leave them with open-ended commitments. To field operators, the GGE process may seem slow and bureaucratic process, which it is, but it is currently the only mechanism available to conduct these negotiations and achieve an international agreement.

It is up to individuals and organisations what action they take to influence the debate. The GICHED is committed to producing papers that assist the discussions. Through our work, we hope to help States Parties to decide on practical, achievable measures. The States Parties are not seeking a panacea for ERW. Ultimately, the technical aspects of clearance programmes will remain unchanged. Existing programmes would seem unlikely to benefit, but eventually the negotiations in 2003 could lead to many of the questions the clearance community asks when a conflict has occurred and the question of what and how much? What and where are the problems? The clearance community sometimes looks outside their area of activity for ideas on how to approach their work. Perhaps the CCW offers a model that may be a little—too—easy in the future.

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Focal Points

Review Conference and few delegations included technical experts in clearance. States naturally relied on their own expertise, which usually consisted of a military officer and sometimes a military engineer with some experience of battlefield area clearance, but not of clearance for humanitarian reasons.

The Geneva International Centre for Humanitarian Demining (GICHED) participated by providing technical advice that would be interrelated. As part of this contribution, the GICHED published two papers. The first paper, ERW—A Threat Analysis, attempted to provide a quantitative analysis of which munitions were a particular problem. It concluded that while qualitatively, the

A destroyed BM-21 in Afghanistan.
TMAC: Conquering Thailand's Unique Mine Problem

The Thailand Mine Action Center (TMAC) faces a number of challenges in coping with the country's landmine situation, but the organization is making progress, one step at a time. For more insight into TMAC's operations, Mr. Dave McCracken, Chief Technical Adviser of TMAC, recently shared some of his views on demining, including the successes and challenges, the use of personal protective equipment (PPE) and what lies ahead.

by Nicole Kreger, MAIC

Background: A Unique Mine Situation

Unlike many mine-affected countries, the bulk of Thailand's landmine problem does not stem from a recent civil war or other internal conflict. The country's problem is concentrated on the border areas, mostly on the Thai-Cambodian border. At first, because the problem was basically limited to these areas, it was thought to be easily manageable using military resources. However, an impact survey conducted in 2001 revealed over 900 contaminated areas that left more than 2,500 square kilometers unsuitable for fear of mine contamination.

On top of a widespread threat, several other factors make mine clearance in Thailand a daunting task. The country's tropical climate makes working outside for long hours almost unbearable, especially with work as painstaking as demining. Additionally, the terrain often causes problems. Much of the contaminated land is not flat and is dense with jungle vegetation, which means "mechanical demining technology is not an option, but an absolute necessity." 1

Tackling the Problem

TMAC Takes the Reigns

Originally, the Royal Thai Armed Forces were solely in charge of managing Thailand's mine problem. After Thailand ratified the Mine Ban Treaty in November 1998, however, the Royal Thai government had to establish a focal point for the country's mine action activities. A National Mine Action Committee was created, which created TMAC in 1999 to act as the country's coordinating body for all mine action efforts. In 2001, TMAC set up three Humanitarian Mine Action Units (HMAs) along the Thai-Cambodian border with the help of the Thai army and navy. Each unit is composed of approximately 100 people responsible for mine awareness, detection, clearance, victim assistance and support.

Unique Solutions to Unique Problems

In order to cope with its mine problem, Thailand has had to blend several techniques used in mine action. As Mr. McCracken puts it, "Thailand has married the use of mechanical assistance, manual clearance and mine dog units. 2 Mechanical methods are necessary for area reduction and especially for vegetation clearance. Once the machines have identified contaminated areas and paved the way, a combination of mine dogs teams and manual deminers go to work. This "marriage" helps operations run smoothly and enables more efficient clearance.

The Role of PPE

PPE is a standard tool in today's demining operations. Using PPE is pretty much a matter of common sense—Mr. McCracken says, "You don't go into a wood workshop without wearing your safety glasses, just as you don't go into a minefield without protective equipment." 3 Yet, he explains, its value cannot be overstated: "Dampening the effect of the explosion for the deminer who is within one meter of [a] detonation is very significant." 4

TMAC's deminers use visors and body vests in their operations. As Mr. McCracken describes, deminers are introduced to the equipment from day one of their training. "We introduce it in the training cycle. The trainees start to wear it... and that transfers directly to the field, where you wear the equipment, so there's no change." 5 One of the main reasons that it is imperative for demining trainees to get used to wearing PPE as soon as possible is the discomfort associated with wearing the heavy equipment. In Thailand's tropical conditions, extra weight can make the work that much more arduous.

"Working in Thailand, there are extremely hot, tropical conditions, which can lead to discomfort, even [just] wearing standard clothes in the middle of the day," says Mr. McCracken. "It's extra layers, which [means] it can be greatly uncomfortable." 6

Overall, Mr. McCracken praises the value of PPE. "When a deminer who survives an incident has only suffered superficial wounds... his eyes are intact, his hands are intact, and his feet—then PPE has paid its dues." 7 Yet he recognizes that there is room for improvement: "We'd obviously like to see lighter, tougher, more durable, flexible PPE—everyone would like to have that." He also recommends minor changes to the visors. Often they tend to fog or get scratches on them while in use, and Mr. McCracken notes, "these affect the visibility of the deminer. While he is aware that these are difficult obstacles to overcome, he feels these improvements would be very useful.

Where PPE is Headed

So what lies in the future for PPE? In order to improve on the current equipment, "there'd have to be some very interesting new materials coming out [with regards to] the weight and the thickness," according to Mr. McCracken. Yet other than tweaking what's currently out there, he doesn't see many major changes to PPE on the horizon. "With the technologies that we have today, the materials that are available today, I think the level of protection of PPE is peaking, or has peaked already." 8

Addressing the Biggest Challenges

Location, Location, Location

We all know that the three most important things in real estate are location, location, location. Well, the same can be said of humanitarian demining, and Thailand is no exception. As Mr. McCracken puts it, locating the mines is "50 percent of the activity... Once they're located, getting rid of the landmines is relatively easy." When minefields are known and documented, this task is not that difficult. Unfortunately, Thailand doesn't have it so easy. "In this particular region, what we have instead of actual minefields is mined areas... with no particular patterns," Mr. McCracken explains. "If there is a minefield, then we know its pattern, we know how many mines there are, and we know its dimensions... If it's a mined area, we don't know any of that."

Thus, Mr. McCracken stresses the need for tools to help with area reduction. Hosing in on the actual mined areas within the larger suspected areas is a necessity for efficient clearance operations. Just as important is "eliminating areas that have no indication [of containing] landmines," says Mr. McCracken, as this then saves time and restores safe land back to productive use much faster. Mechanical methods are one of the best ways of performing area reduction, and as Mr. McCracken indicates, it is also good for "processing the terrain to allow for the follow-up clearance." In his opinion, more efficient area reduction equipment is the most-needed tool in the demining toolbox today.

So Many Mines, So Little Staff

Mr. McCracken acknowledges that the other major problem TMAC faces is not having enough staff to meet the program's demining needs. "At TMAC we have 300
Explosive Remnants
continued from page 39

The issue of ERW has not escaped the popular imagination like landmines and other SGBs which have been more actively involved in humanitarian operations. But there is a growing awareness that the situation in Thailand, in spite of the challenges, is organizing making strides and building on its successes. In its first two years of clearance operations alone, TMAC cleared 4,358 square meters of land, ridding the country of over 2,000 mines and more than 22,000 UXO. While the problem is far from over, TMAC is overcoming hurdles in hopes of making the land safe for the Thai people.  

All photos courtesy of Dave McCracken.

Endnotes

2. Telephone Interview with Dave McCracken


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IMAS and PPE Requirements

This paper explains the personal protective equipment (PPE) that a demining group must use in order to comply with the United Nations’ International Mine Action Standards (IMAS). The author was an active member of the User Focus Group advising the Geneva International Centre for Humanitarian Demining (GICHD) which helped to make the current IMAS revision. He continues as an elected member of the IMAS Review Board. The author has also maintained a database of demining accidents for five years, and uses the evidence of real accidents to inform his views on protection needs.

by Andy Smith, AVS Mine Action Consultants

In June 2000, I published a paper in this journal under the title “The Faces on Protection Needs in Humanitarian Demining.” In that paper, I explained how the results of real accidents in demining could be used to assess protection needs. That paper was intended to provide a check—^VVorking with a balance against a few PPE manufacturers who had seemed a market and shown considerable interest in this new profit. Today, the pseudo-academic hysteria continues and a new generation of potential purchasers may benefit from making the system safer and better protected.

My views in this paper are based on extensive field experience, the detailed investigations in the Database of Demining Accidents (DDA) and on the many follow-up interviews of accident victims that I have undertaken. Statistics quoted in this paper are derived from the latest version of the database, including data not included in the United Nations Mine Action Service (UNMAS) version released through GICHD last year.

Risk and Its Reduction

Anyone considering the risks in demining should be aware that demining accidents are rare. While I do not have all of the relevant data, I have been able to make some general statements about the incidence of demining accidents for some theatres in some years. To make this study you must have reliable information about the number of deminers and the operations actually working in mined areas, the hours worked and the accidents suffered. My limited investigation showed that severely disabling accidents occur at the rate of one for every 30+ person-years of actual demining. I believe that this is a worst case figure—and that accidents in most demining themes are much rarer than this.

However rare they may be, explosive accidents can inflict very severe injuries. For demining to be a commercially viable activity, there is an obligation for employers to acknowledge a duty of care and take all reasonable measures to reduce the injuries that deminers may suffer as a result of their work.

This can be pursued “procedurally” by seeking to reduce the number of accidents that do occur. It can also be approached by seeking to reduce the severity of injury by using PPE. The distinction between these two approaches is important. While many accidents were caused by procedural errors or omissions and could have been avoided, up to 25 percent of all accidents are deemed unavoidable. So while improvements in training, management and field supervision could prevent many accidents, some would still occur. The only way to reduce the impact of the unavoidable accidents is to reduce the severity of the injuries that result.

The Limits of PPE

A deminer cannot realistically be shielded against the effects of some mines and UXO. The worst possible accident would kill a deminer wearing the best bomb-suit. This kind of accident has happened when moving unstable UXO in an interior manner, but is very rare indeed. The worst kind of accident that a deminer might reasonably expect is to detonate a bounding fragmentation mine or a submunition that is very close to him. Deminers have done this when wearing heavy flak-jackets, helmets and visors, and when wearing no protection at all. The results of the tests and experiments are clear. The PPE offered no significant protection. It may have given the wearer false confidence.

Because the most common activity at the time of an accident is when “excavating,” digging or prodding to locate an AP blast mine. Fortunately, this is also the time when a deminer feels most vulnerable, and is most willing to accept the need to use protective equipment. The term “excavation” is used to cover the activity when a deminer is using a probe, probe/boyeau, scrapes, pick, see, how, trough or any other hand-tool to investigate a suspicious area of ground. The potential for harm is great and the injuries that occur are often from reading a dog-signal, a break in a perceivable pattern of mines or reliable information that a mine or other device is there. In almost all cases, the deminer will be squating or kneeling as he does this.

The most common mine to be detonated while excavating is also the largest common AP blast mine—the PMN with a 240 g TNT main charge. A deminer can realistically be protected against the effects of this when it detonates 30 cm (12 in) from his knees.

International Mine Action Standards and PPE

Section 10.30 of the United Nations’ IMAS has the title “Personal Protective Equipment.” PPE is a broad term as possible, the standard covers the use of a range of equipment and working stations
that should make it easy for the IMAS to be adopted by military deminers as well as humanitarian deminers in all mined countries. Throughout the IMAS, the terms “should” and “shall” are used with a very different meaning. When they write that something “shall” be done, it is obligatory. If it is not done, the demining group cannot claim to be operating in accordance with the IMAS. When they write that something “should” be done, it indicates the author’s “preference” and is not an obligation. If the term “may” is used, it is only “to indicate a possible method or course of action.”

Evidence from the DDAS was used to help determine the obligatory requirements. The only obligatory articles of PPE are frontal body protection and a long visor. Other “optional” equipment is mentioned. This inclusion was either as a result of pressure from “interested” bodies who advised the IMAS User Focus Group, or because of differences of opinion between group members and those who were canvassed during “outreach” in the field. The optional equipment included advice on what it would be appropriate to wear helmets, b) a preference for handtools to be properly designed as protective equipment, and c) an invitation that a reader “may” like to assess the use of blast-resistant boots.

**Body Protection**

To comply with IMAS, deminers must wear “frontal protection, appropriate to the activity, capable of protecting against the blast effects of 240 gns of TNT at 30 cm [1.2].” Notice that there is no standard agreement (STANAG) v50 cited. This is not fragmentation armour, but blast armour. Good blast armour will always provide some fragmentation protection, but it does not have to meet the STANAG North Atlantic Treaty Organization STANAG v50 of 450 metres a second. Under Section 4.3 “Protection fragmentaction,” the requirement is extended with the additional preference that body armour with a STANAG v50 of 450 m/s is used, but this is not an obligation. This is because the authors recognised that fragmentation mines had defeated the best PPE before they were used, so they decided that the risk from them should be minimised “procedurally” rather than by imposing an inflexible requirement to ensure one PPE that would be resisted in the field. The procedural approach involves promoting appropriate training, field discipline and the effective use of armoured machines for area protection when fragmentation mines are expected.

What this means to the end-user is that a demining group can wear armour with a v50 lower than 450 m/s—so long as that armour protects fully against the blast and environmental fragmentation associated with a PAIN AP blast mine at 30 cm. I know two internationally respected groups that do this—and have tested their armour. I say with confidence that it performs better against blast than many other designs with a much higher fragmentation specification. It also performs without any problem in at least 35 real accidents to date. The NATO STANAG fragmentation test was not designed to simulate a mine detonation and a “pass” does not prove that the armour will give suitable protection. But there is no other test standard to use at this time, so the IMAS compromise makes sense.

**Visors**

The obligatory IMAS requirements for visors is “eye protection capable of resisting integrity against the blast effects of 240 gns of TNT at 60 cm, providing full frontal coverage of face and throat as part of the specified frontal protection ensemble.” Five-inch thick polycarbonate visors have been worn successfully in this since the mid-1990s. If it had been given my way, the IMAS would state that, as a general rule, a visor in regular use shall be replaced every six months on the basis of if vision through the visor is restricted. Others disagreed, so this requirement was not included. There is, however, a requirement for all protection to be regularly inspected to ensure it is fit for use. Users should remember that polycarbonate is hardened by UV exposure and scratches very easily. To maintain protection and to ensure clear vision, they should be replaced frequently.

**Hand-Tools as PPE**

It is a credit to those at GICHD who drafted the IMAS that the available facts informed the requirements. However, other opinions and beliefs have been accepted, especially when persuasive evidence was submitted. As a result, the visor and blast-resistant visors are considered to be part of the protective equipment. However, other evidence suggests that it is for use. Users should remember that polycarbonate is hardened by UV exposure and scratches very easily. To maintain protection and to ensure clear vision, high-quality, regular maintenance is needed.

**Helmets as PPE**

The IMAS states that users “should” consider the use of a helmet if they believe that they have a 300% risk. Agreed, but I believe that a helmet would be preferable if there really is a risk to the head from behind. However, safety distances and safe working practices in fragmentation mine areas should mean that a helmet never has a 300% risk, and the available evidence suggests that this is really the case.

In 60 percent of recorded accidents, the deminer involved has been inside blast visors (they were not always worn). In 60 percent of these, the visor was attached to a helmet. There are no examples in the database where a blast helmet reduced injury in any significant way. By a “significant reduction,” I mean a reduction in the range of recorded injuries. For example, it is likely that a few fragments were deflected by the helmet pictured on the next page, but that did not prevent the wearer suffering very severe injuries. He died, but it was not considered of much importance to decide whether he died from his head wounds or from the extensive body penetration that he also suffered, despite his frag-jacket. There was even some argument over whether the helmet was being worn or not worn properly at the time, but the in-and-out damage tells us that this was irrelevant to the outcome for the victim.

It is important to note that a helmet should be held steady on the wearer’s head, and a helmet can be used to do this. This can also be achieved using one of many of the open head-frames that are used to support visors and are preferred by demining groups like MineTech, HALO Trust, and French Tech. The helmets are worn away at the blast-front passes. The blast is the visor first, and the passing blast front then takes the visor with it, ensuring that the wearer’s face and eyes are protected at the critical time.

In most accidents when excavating an AP blast mine in which the victim was wearing a visor without a helmet, the victim was torn away by the passage of the blast front. In many accidents when the victim was wearing a helmet, the visor and the helmet was not secured, the helmet and visor were torn away. The victims suffered eye injuries if their visors were

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**IMAS and PPE Requirements**

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The IMAS include the disclaimer that "although this standard lays down distances at which the PPE must be effective it must be emphasised that this does NOT imply to deminers that they will be safe at such distances." Given the unpredictable nature of blast events, this is wise. Also, the wearer’s arms are exposed and can be at a high risk if he is using an inappropriate tool as he works.

The IMAS PPE requirements informed by the accident record but took other things into account, such as deminer acceptability. Deminers do not want to wear protection that they believe is unnecessary, which is probably why the PPE requirements in the earlier issue of IMAS were widely ignored. If a group can afford it and it would feel safer using PPE with a higher specification, they should do so—although the increased weight and discomfort do not lead to the PPE being discarded as soon as the supervisor’s back is turned.

I recommend that any excess money in the budget is used to replace the visors regularly—because they get easily scratched and IMAS state "equipment shall be examined on a regular basis to ensure that it is suitable for use." If this had been done, fewer than 50% of the deminers who would probably have benefited. Further excess funds should be used to purchase new hand tools that have been designed to protect the user’s hands and arms.

**About the Author**

Andy Smith has been a hands-on demining researcher for the past eight years. His work has taken him into hundreds of mined areas in Angola, Mozambique, Cambodia, Zimbabwe, Namibia and Afghanistan—and less extensively in Kosovo, Croatia and Bosnia Herzegovina. He has derived and implemented equipment tests in several countries, developed new equipment and oversaw its technology transfer to developing countries, and been employed as a "subject matter expert" by research programmes, universities and many of the major players in humanitarian demining. Recent work has included producing country-specific training materials for deminers, surveyors and the general public. He began the DDA in 1998 and is currently negotiating its spoof for the UNMAS.

### References

1. International Mine Action Standards (IMAS), http://www.mincclearancesandstandards.org/


4. For a free copy, please contact Paul Ellis at GCHD plc, paul.ellis@gchd.co.uk.

5. All these tools are widely used and have features that make them efficient. In particular, Alistair McAlpin and Alan Broad.


8. A four-person team, led by Paul Ellis at GCHD plc, has led the implementation of these measures.

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**PPE: Effective Protection for Deminers**

This article briefly explains the work that Med-Eng Systems, Inc., has done on personal protective equipment (PPE) over the past few years.

by Jeffery Nerenberg, Jean-Philippe Dionne and Aris Makris, Med-Eng Systems, Inc.

### Introduction

Med-Eng Systems (MES) is the world leader in the research, design and manufacture of PPE for persons facing the threat of an explosive device. Since its inception in 1981, MES has become best known for its explosive ordnance disposal (EOD) suits and helmets, which are in wide use around the world by police and military units. As a natural extension of this line of protective ensembles, MES has chosen to design and produce various lightweight ensembles and equipment for demining. These efforts began in earnest in the late 1990s in collaboration with both the US Army Communications and Electronics Command (CECOM) Research, Development and Engineering Center (RDEC) Night Vision and Electronic Sensors Directorate (NVESD) at Fort Belvoir, and the Canadian Centre for Mine Action Technologies (CCMAT), based at Defence Research and Development Canada (DRDC)-Saffield. Aside from developing a wide range of PPE, these continuing cooperative efforts have allowed extensive systematic evaluation of PPE using real and simulated mine threats, new equipment technologies to be established, and the measurement of the effect of mines on the human body. This article briefly discusses the features of the created equipment, explains how the equipment was evaluated and provides an overview of test results.

### Designing for the Threats of a Mine Blast

Before delving into the specific components of PPE, it is useful to briefly review the threats posed to the deminer from the detonation of a landmine. This helps to explain many of the features that are built into the PPE. When facing a conventional explosive device such as a landmine, four threats are considered. The first is overpressure, or the sudden and drastic rise in ambient pressure as the blast wave emanates from the mine. When very close to the mine, such as a mine detonates while being stepped on or being handled, the overpressure levels may result in amputations. Overpressure levels decay rapidly with standoff distance; however, they can still cause ear drum injuries and can lead to hemorrhaging of the lungs and bowel when the deminer is in close proximity to the AP mine.

Fragmentation forms the second and most obvious threat from a mine. Pieces of mine casing, fragments, soil or stones can all cause punctures, lacerations and lethal injuries to vital organs. The third threat from a mine is impact. This is a result of the overpressure wave inducing violent levels of acceleration on the head of the victim, which in turn can cause a range of incapacitive injuries, depending on head positioning relative to the mine and standoff distance. The final threat is the range of heat and flame injuries that can result from the short-lived fireball released upon detonation.

While the four threats are each separate causes of injury, they rarely occur in isolation; rather, they operate together to create the overall level of injury. As a result, PPE design needs to account for all the threats from a blast in order to reduce the overall injury level. It should be noted that when a victim is injured by detonating a mine, the obvious open wounds are the ones that require immediate attention, though injuries that may be less visible could be more serious.

### Protection for the Torso and Body

Two lightweight protective ensembles for the torso and body of the deminer have been developed. The Lightweight Demining Ensemble (LDE) is a two-piece system designed to provide continuous frontal protection to the deminer from the lower legs up to the neck and over the shoulders (Fig. 1). The back of the system is left open to prevent the buildup of heat. A base packing of soft ballistic materials provides fragmentation protection throughout, while rigid ballistic plates in combination with a blast attenuation system are in place over the vital regions of the chest, abdomen and groin to provide added protection. The plate in place over the chest of the apron also serves the vital purpose of integrating with the visor of a protective helmet system, which provides a continuous layer of enhanced blast and fragmentation protection over the critical frontal torso region. The LDE system also comprises modular features that allow for the removal of the torso and arms of the deminer, if so desired.

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**Figure 1: Deminer equipped with LDE, VBS-200 helmet system, the OHP-100 on the hands, and a pair of Spider Boots protecting the feet. Available optional protective sleeves are also in place.**

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Figure 2: Deminer equipped with the Demining Apron, the LDH Helmet, a CHP-100 on the left hand, and an CHP-100 on the right. Note the integration between the visor of the LDH and the chest plate of the Demining Apron.

Figure 3: Test setup for full-scale blast testing. The mannequin equipped with the LDH, CHP-100 and CHP-100, is placed in kneeling position with a nose-mine standoff of 80 cm. The mine position is marked by the orange flag.

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The evaluation of the hand protectors was done by placing them on the hands of the anthropomorphic mannequins used in the blast testing described above (Fig. 3). During the over 240 tests performed, the protectors were placed as close as 15 cm from the simulated mines; however, the most common standoff distances were between 20 and 30 cm. Results of blast testing indicate that these doming hand protection concepts provide excellent protection and offer the potential to reduce and minimize injury to the hand of a deminer. Throughout the entire span of tests, the hand protectors were never penetrated by fragmentation, and in most tests, they retained their structural integrity. Figure 7 illustrates a typical result from a 200-g C4 simulant, mine, showing increased ripping of the outer shell, but with overall structural integrity intact. A note of caution, however: because these tests have been performed with mannequins and not biological specimens, a precise estimate of injury reduction cannot be performed, despite the encouraging results.

Protection for the Foot

If a deminer steps on a mine while wearing a conventional boot or even a typical "blast boot," the foot is usually in close proximity to the charge, as only a thickened or reinforced sole separates the foot from the mine. At such small standoff, the overpressure, fragmentation, and heat generated by even small mines overwhelm the integrity of most materials. The result is likely a traumatic amputation of the foot (or even leg, depending on mine size. To address this problem, the Spider Boot was developed. It consists of a shielded platform supported by four "legs" providing fore-and-aft and transverse (Fig. 1). A regular boot is attached to the platform through an adjustable binding system. The design of the Spider Boot is such that if a mine is triggered, it is done so by one of the pods, resulting in a much increased standoff distance between the exploding mine and the foot compared to conventional footwear. This results in the blast effects of the mine being allowed to dissipate substantially before interacting with the foot.

During the development of the Spider Boot, blast tests were carried out using a mechanical surrogate leg in collaboration with CCMAT, which demonstrated the effectiveness of the Spider Boot (Figs. Pa & 8b). By measuring various parameters on the surrogate leg, the forces transmitted by the blast could be recorded. The Spider Boot, with its built-in standoff, was able to reduce the effects transmitted to the surrogate foot by more than 90 percent compared to select commercially available blast boots.

Further testing was performed by the U.S. Army NVESS under the Lower Extremity Assessment Program (LEAP) to evaluate the performance of various types of mine-protective footwear. In these tests, the footwear— including the U.S. Army Combat Boot, two commercially available blast boots (with and without overboot), and the Spider Boot—was placed on the feet of cadaver specimens.

For the Spider Boot, no amputation was deemed necessary for two of the cases tested performed against the large PMN mine (249 g TNT). Moreover, in the only case that an amputation might have been the outcome, predicted, no contamination of the wound was observed, making the injury less severe.

In contrast, it was found that even for the small M-14 mine (28 g of explosive), the commercially available blast boots with overboots provided only limited protection, with three tests out of five resulting in traumatic amputation of the lower leg. The Spider Boot was not tested against the smaller M-14 mine, as it was deemed unnecessary, due to its proven superior protection for much larger mines. Against the larger mines (the PMA-2 and the PMN), amputation was always required with the blast boot/overboot combination. These limited tests are useful in confirming the important role of standoff in the design of a mine boot. There have also been several recent blast test series of the Spider Boot conducted by military scientists of the North Atlantic Treaty Organization (NATO) and other countries during 2002.

Summary

MES has developed a full range of PPE effective for demining. If so desired, the deminer can choose protection to cover the body, the head and face, the hands, and the feet. Moreover, the standoff distance—measured by the legs of the boots helps to dissipate the blast effect of the mine before they can interact with the foot of the user.

References


Contact Information

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Figure 7: CHP-100 after having been exposed to the blast from a 200-g C4 mine at close range. While superficial damage has occurred the overall integrity of the hand protector has remained intact. Note that the force of the blast severely bent the steel mine probe.

Figure 6: Photograph and schematic block diagram demonstrating conical region of increased threat created by mine buried in soft terrain soil to confuse and focus the blast effects. By remaining relatively low in orientation while still maintaining standoff distance, the response to this region can be reduced.

Figure 8a & 8b: Testing of Spider Boot on instrumented mechanical surrogate leg. First image shows a Spider Boot in place over a PMM-1 mine (200 g explosive). The second photograph was taken after the blast. The force of the blast has removed the front pods, but the standoff distance is maintained. The standoff distance is maintained by the legs of the boots helps to dissipate the blast effect of the mine before it can interact with the foot of the user.
Use of Multi-Criteria Analysis in Allocating EOD Teams in Humanitarian Mine Action

The author explains how a standard economic planning tool, multi-criteria analysis (MCA), can be used to help plan the allocation of mobile explosive ordnance disposal (EOD) teams between regions in a humanitarian mine action program and solicits comments on how the model could be developed.

by Robert Keelley

Introduction

Many demining programs face significant problems in attracting resources. There may be several reasons for this, but one that is commonly heard is that donors are not comfortable with the observed outcomes of programs. However, over the last few years, socio-economic issues have come to be a greater part of planning mine action programs, and, in particular, demining or area clearance projects. The reasons for this are comparatively clear: demining capacity is a scarce and expensive resource, and it makes sense to utilize that capacity where it can do the most good for local development. It may be that the use of socio-economic tools to assist in prioritisation of resource allocation will help alleviate donor concerns.

The publication "A Study of Socio-Economic Approaches to Mine Action" was one of the first to set out some of these issues, and the increasing emphasis of "impact" in the survey process also marks the increasing importance of such criteria. However, in focussing on the area clearance question, there has been comparatively little attention paid to the question of allocatable mobile EOD teams. The EOD teams do not clear land, so economic tools such as cost-benefit analysis (CBA) do not provide a means to prioritise their activities. Nevertheless, it is the contention of this paper that EOD teams are also a scarce and expensive resource and may help EOD planners to demonstrate that they are being used in an optimum manner.

Background

All readers will be familiar with MCA techniques, though the name is rarely used outside economic circles. In most trivial incarnation, MCA is the method consumer magazines use to rate items such as electrical appliances. For example, most people will have seen tables that compare digital cameras such as the one in Table 1.

It is worth taking some time to analyse this table. "Option" covers the choice open to the stakeholders (in this case, the five cameras available to the public that have been considered by the survey). In MCA, the options have to be discrete and distinct, i.e., option 1 is not the same as option 2.

"Attributes" are the attributes (i.e., criteria) that the surveyors have considered for the analysis (attributes also have to be discrete and distinct). The surveyors then score the options in terms of each of these attributes.

Note that there are different ways of scoring. The "zoom" question is comparatively simple: does the camera have a zoom or not? This produces a yes/no response that economists refer to as a "dummy." We will come back to this point of potential application of this yes/no filter later.

Memory is measured here in megabytes, and price in dollars. Finally, the more subjective attributes are scored in stars, with the camera with the "best" rating given five stars and the others ranked accordingly. Again, we will come back to the question of units and numbers later.

In this simple application, the MCA table does not attempt to select which camera is the "best" because the stakeholder, according to their need, will do this. For example, a potential buyer on a tight budget constraint may decide that the price criterion is much more important than the others. In economic parlance, the stakeholder will "weight" this criterion.

Use of MCA in Project Analysis

The use of such a simple model as an introduction to the MCA concept should not mislead the power of the tool, however. Indeed, governments regularly use MCA as a way of making choices about major development projects. Imagine a western government having to decide whether to expand the airport serving their capital. They may have identified three main options:

1. Do nothing, i.e., live with the level of air traffic at present.
2. Build a new runway at the existing airport (which is badly served by land transport connections).
3. Build a new airport on a green field site (which has access to motorway and international rail links but is in an environmentally sensitive area).

Each option has several advantages and disadvantages, and the application of the MCA process helps set these out clearly.

The first thing to note about this use of MCA is that it is possible to resolve everything in the same terms (i.e., in the same unit of measure). In this example, the government's economists could estimate the benefits of the extra flights and jobs and also the environmental costs. Substituting these figures into the table, it would be possible to work out the value in dollar terms of each option. In other words, by using common units of measure, the MCA process can actually produce a cardinal result—i.e., the options are automatically ranked and their relative values determined. In even more simple terms, MCA is a process by which we can compare apples and oranges!

Application of MCA Techniques for EOD Resource Allocation

It is suggested that MCA techniques can be used to divide mobile EOD teams between provinces in a national humanitarian program in an objective and transparent manner to achieve the optimum allocation of resources.

Selection of Criteria

For the purposes of EOD resource allocation, the following criteria are proposed:

- Size of province in square kilometers
- Degree of contamination reported in each province
- Number of reported casualties per province
- Population of province

These criteria fulfil the requirements of the MCA process in that they are (a) relevant and (b) distinct from each other. The list may not be exhaustive, and suggestions as to how the list could be expanded are welcome. The data for the MCA process should be easily accessible from the national government and the national landmine/UXO survey (providing such a survey has been carried out).

Options

Of course, there is only one option available (i.e., the provision of EOD services), but use of survey data means that, in this case, each province can be scored in terms of the criteria. Furthermore, by scoring on a percentage basis, the "large-numbered" attributes (such as area in square kilometers, which may be a five-figured number) will not overwhelm a "small-numbered" attribute (such as number of casualties, which may be in the low hundreds at the most). This generates an MCA table similar to the example in Table 2, based on a fictional country with five provinces.

At first, this appears to provide a simple ranking of each province, but at the moment this includes a score for province B, which in fact has no contamination. This is where the "dummy" technique referred to above comes into use. By simply multiplying the value of 0 (i.e., not contaminated) by 1 (has contamination) or 0 (does not have contamination) the scores can be amended to take account of this. This is done in Table 4.

Weighting

Weighting requires participation of stakeholders to make the process more inclusive. While this approach is more subjective than the earlier steps, which have been based purely on application of data, it is comparatively objective when that speed to simply "fly by the seat of the pants!"

For the purposes of this paper, it is suggested that, as the prime function of EOD teams is to save lives and prevent injuries from accidental detonation of UXO, the criterion that is most relevant to this function (i.e., the number of casualties) could be weighted.

In this example, the casualty figures are given a weighting of a factor of three. When this weighting is inserted in the table, it has the following effect (see Table 5).

Stakeholder Analysis and Sequence of Events

It is worth marking the point here that the MCA tool is at its best when used to increase transparency. This can be done in this context by involving stakeholders

Table 1: Example of Simple MCA Table

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Option</th>
<th>Zoom</th>
<th>Acme</th>
<th>2000 Yes</th>
<th>Delay</th>
<th>Yes</th>
<th>Superlight</th>
<th>No</th>
<th>El Cheapo</th>
<th>No</th>
<th>Bag Standard</th>
<th>No</th>
<th>Cost</th>
<th>$600</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td></td>
<td>32</td>
<td>64</td>
<td>8</td>
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<td>8</td>
<td>16</td>
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</table>

Table 2: Example of Typical MCA Used in Project Analysis

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Option</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of Flights</td>
<td></td>
<td>100%</td>
<td>150%</td>
<td>300%</td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td>Nil</td>
<td>+2000</td>
<td>+4000</td>
</tr>
<tr>
<td>Effect on local</td>
<td></td>
<td>Nil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect on local</td>
<td></td>
<td>Nil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect on local</td>
<td></td>
<td>Nil</td>
<td>+2500</td>
<td>+5000</td>
</tr>
<tr>
<td>house prices</td>
<td></td>
<td>Nil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of construction</td>
<td></td>
<td>$0</td>
<td>$400m</td>
<td>$900m</td>
</tr>
<tr>
<td>Net cost/benefit</td>
<td></td>
<td>XXX</td>
<td>XXX</td>
<td>XXX</td>
</tr>
</tbody>
</table>

Table 3: EOD MCA Step 1 (Initial Scoring)

<table>
<thead>
<tr>
<th>Ser (a)</th>
<th>Criteria (b)</th>
<th>Province (c)</th>
<th>(d)</th>
<th>(e)</th>
<th>(f)</th>
<th>(g)</th>
<th>(h)</th>
<th>(i)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Size in km²</td>
<td>14.36</td>
<td>32.65</td>
<td>17.28</td>
<td>16.51</td>
<td>19.20</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Degree of contamination</td>
<td>27.61</td>
<td>0.00</td>
<td>11.47</td>
<td>37.77</td>
<td>23.15</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Reported casualties</td>
<td>34.66</td>
<td>0.00</td>
<td>0.00</td>
<td>37.79</td>
<td>27.35</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Population</td>
<td>21.99</td>
<td>20.60</td>
<td>15.72</td>
<td>21.32</td>
<td>20.37</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Subtotal</td>
<td>99.62</td>
<td>55.23</td>
<td>47.47</td>
<td>117.59</td>
<td>95.07</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
in selection of criteria and decisions on weighting before populating the table with data, as this then means that the conclusions about resource allocation can be shown to have been done in a transparent and objective manner, which should help maximise donor confidence and thus help in the release of funds. It may also be useful to involve beneficiary groups (such as provincial government representatives) in the criteria selection and weighting process as it may help them buy into the way that teams are allocated. This is also in line with modern development approaches in that it encourages local ownership of the program at all levels.

Once the data is inserted in the table and the weighted scores obtained, the final score can be used as the ratio in which the EOD teams can be allocated. In this fictional example, imagine that the program has 24 EOD teams. Therefore, they should be allocated in the ratio: 169:44:190:114.

Dividing each score by 517 (the total of the scores), and multiplying the result in each case by 24 (the number of available teams) and rounding the result gives us the ratio to divide the teams. This is set out in Table 6.

Therefore, given the above data on the country and the extent of contamination, and the decision to weight the casualty data by a factor of three, the 24 existing teams would be divided amongst the four contaminated provinces in the ratio of 8:29:5:4.

**Effect of Time**

In general, the MCA process is used to assist in making irreversible decisions. One can imagine that a dissatisfied customer can return a digital camera to the store, but it is harder to imagine dismantling an airport! In both cases, the MCA process is a "one shot" analysis done to help make the decision about which option to adopt. However, when MCA to assist in EOD planning, we do have the ability to modify resource allocation on a periodic basis. In this case, given that the size of each province would remain constant (and assuming either a constant population or equal proportionate growth within each province), it would be simple to revise the MCA process armed with the most recent casualty data and re-calculate the most appropriate ratio. Of course, it would also be possible to change the weighting over time, and even introduce different criteria.

One can imagine doing this on an annual basis as part of the project cycle/annual budget allocation process. Figure 1 represents this process diagrammatically.

**Advantages & Limitations**

**Advantages**

There seem to be several advantages to this process. First, it is logical and easy to understand (and hence easy to explain to others in the planning process). Second, it allocates resources objectively, which, when reinforced by appropriate inclusion of stakeholders in identification of criteria and weighting, makes the process very transparent (thus helping with donor confidence). The use of the weighting mechanism also allows policy makers to intervene in a transparent and comparatively

**Limitations**

The MCA process relies on the existence of suitable survey data. While geographic information might be available from stakeholders, data on casualties and the extent of UXO contamination may not be so easily obtainable. It may be possible to use MCA without casualty and contamination data in the early days of an emergency program as a "least worst" approach. However, the development of structured landmine/UXO survey processes over the last few years has meant that there is more chance that the information may be available. If nothing else, the development of MCA as a means of allocating EOD resources may provide further justification for the timely conduct of such surveys.

One possible apparent limitation may be the need to involve stakeholders in the planning process. Although this makes the process more open and inclusive, it may at first require some education of stakeholders in MCA techniques in order to maximise their input, thus placing a further strain on timetabling—especially in the budget formulation season. However, the MCA process is not too difficult to understand and the good news is that many agencies already use it for other types of projects. Furthermore, including the stakeholders in this process helps "mainstream" EOD activity with general development activity. Different organisations will of course be best placed to deal with this issue in the way most appropriate for their own structures.

In its current format, the proposed MCA process is intended for use in developing countries emerging from conflict that are being assisted by humanitarian donor programs supported by external donors. As such, it is not optimised for EOD organisations operating in developed countries. However, it might be possible, through the substitution of criteria, to use this process to allocate EOD teams in developed countries. For example, the casualty figure could be replaced by the number of improvised explosive device (IED) incidents. Comments on this would be welcome from EOD planners.

**Summary & Conclusions**

In summary, the MCA process does seem to offer a means by which an established economic planning tool could be adapted for use in EOD resource allocation. It does, however, require availability of contamination and casualty data as well as active participation by stakeholders if it is to be made effective. When such participation is achieved, the MCA process seems to offer a means to increase transparency and hence donor confidence. Nevertheless, there may be other potential pitfalls in the process that are not readily apparent to the author, and input from readers would be very welcome at this stage.
Spoiled Soil

While it is necessary to remove explosive items from the land to facilitate repatriation, reconstruction and rehabilitation, it is crucial that in undertaking this action, the soil structure is not inadvertently damaged, creating short, medium and long-term problems for agriculture and the sustainable farming that supports vulnerable communities.

by Eddie Banks, Project Director, E and I, with technical assistance from Stewart Mair, Scottish Agricultural College

Introduction

Over the last few years, the increased use of mechanical equipment for humanitarian mine clearance has demonstrated that it can not only improve the safety of hazardous work, but can also vastly improve clearance productivity and be cost-effective. By adopting an integrated approach, incorporating manual clearance and explosive detecting dogs (EDDs), operational managers can select the best combination of methods to suit the wide variety of sites and environmental conditions.

Taken individually, management of these methods (manual, EDD and mechanical) requires very different skills, experience and knowledge. The level of knowledge and skills necessary for the effective management of manual demining teams can be easily achieved, especially by ex-military engineers with relevant experience and managerial experience. The knowledge and management of EDDS can be much more difficult to obtain, for many managers have little or no prior experience with dog use or dog management and must "learn on the job." Poor management of these two methods may well affect the overall performance, quality and safety of the clearance operation, but it does not affect the long-term condition of the ground.

However, the lack of understanding of the wider aspects of the use of mechanical clearance equipment has the potential to create considerable additional problems for the future while assisting in solving the mine contamination problem. Considerable damage can be inflicted on fragile soil ecosystems by the inappropriate application of mechanical methods changing the soil properties. Although some personnel may have a "general" knowledge of vehicles, few will have undertaken formal training in equipment management, and the vast majority will have no knowledge of or experience with soil management. It is therefore not surprising that some demining equipment designs, utilisation and superintendence, when not aligned against the principles of agricultural soil management, could be having a disastrous effect on landmine clearance.

While the use of manual and EDD assess for the removal of munitions will not damage the ground, poor equipment design and the inappropriate selection and use of mechanical assets can cause temporary, and in many cases irreversible, damage to the structure of the soil. A wide range of variables can affect soil fertility, drainage, rooting potential and water holding capacity. Mechanical damage may also initiate, or accelerate, topsoil erosion, creating problems that will affect vulnerable populations long after the clearance task has been completed. Since a primary function of most clearance tasks is to return land for resettlement, the methods used should not have a negative impact on subsequent land use, grassland or arable land, or reduce the future sustainability of agriculture.

Soil Erosion

Degradation of soil quality, in particular topsoil depth and soil texture, will markedly reduce the land's capacity to grow crops. Soil degradation will increase vulnerable soil susceptibility to wind and water erosion, which further limit land use and cropping potential in the short, medium and long-term. Structural degradation of heavier soils will result in increased water-lugging due to drainage limitations. In addition, damage to vegetation cover, including the roots, can have negative effects, further contributing to soil erosion.

While the damage that mine clearance equipment causes globally is small in comparison with other soil erosion issues, a careful consideration of the potential damage caused by local, economically important and sometimes critical areas, such as fertile agricultural land, is needed. It is therefore imperative to facilitate understanding of the damage that could be caused by such equipment, whether it is temporary or permanent, and what action should be taken to minimise damage and improve soil management.

When undertaking the function of removing hazardous material such as bombs and mines, it is necessary that any organisation using mechanical equipment ensure that the essential soil structure (including natural soil artificial drainage features) is not undamaged. While the destruction of munitions will cause some damage to soil properties, this is not considered to be a major factor. Poor soil quality—including desert conditions supporting limited indigenous plant and wildlife, land suitable only for the grazing of sheep, cows and goats, or land with very shallow topsoil—can be extremely sensitive and easily damaged beyond repair simply by the use of wheeled vehicles. Even good quality soils can be temporarily or permanently damaged by any vehicle using poor infiltration, compaction and soil mixing techniques. When considering the selection and use of vehicles, especially in sensitive soil conditions, it is important to consider what the objective should be the prevention of unnecessary damage to soil properties.

Equipment Design

It is rapidly becoming apparent that some mechanical equipment has already been utilised in such a way that it has caused excessive soil damage. The major reasons for this are:

- Working equipment. A lack of technical understanding available to assess and analyse soil mechanics relating to soil movement, stress regimes and soil particle interactions.

  • Equipment design. Many of the currently available mechanical equipment is based on wheeled or tracked vehicles, or excessively heavy machines (including Main Battle Tanks) that use full, matching or grinding attachments to remove vegetation by impacting the ground, rather than cutting. Three implementation problems:

  1. Selecting of tyres or tracks that will minimise damage.
  2. Ensuring that operations are conducted in an appropriate manner, on suitable ground and soil conditions, taking into account seasonal limitations and weather conditions.
  3. Ensuring that the implement utilised to remove or disrupt soil (in an attempt to locate and destroy munitions) does not cause compaction, smearing or soil profile mixing.

- Inappropriate selection and/or use of the equipment. This can include selecting the wrong type of equipment for the localised conditions, use in excessively wet soil conditions, in areas beyond the effective capability of the equipment, or in sensitive terrain or soil conditions where the mechanical action will damage or destroy the fragile soil structure, irrigation systems, etc. The outcome of such use may result in topsoil damage, erosion or decreased soil fertility. There is no requirement that such equipment be used, but the potential for damage has to be considered. Where appropriate topsoil mixing equipment has to be used, the equipment used should be the most suitable for the job, particularly in areas where the soils are very sensitive. In such cases, there is no evidence that selectivity caused by the use of less suitable equipment will result in any significant improvement in the topsoil condition, while more appropriate equipment may do a better job, but may be more expensive and less effective.

- Inadequate design and/ or implementation. Organisations actively address such issues as infiltration and deflection, tyre construction and traction aids, forward speed, loading tyre lugs and tyre profile. Despite the fact that many machines are tracked, the sheer weight of some of them will, in poor soil structure, have a detrimental effect on soil profile, cause serious and long-lasting damage. In addition, there is no evidence that organisations plan their operations in such a way as to reduce the potential for damage, or that they take remedial measures to restore any damage they have caused to the landscape. It has been found that vehicles based on wheeled vehicles are much less damaging than those based on tracked vehicles, especially in areas with a high density of landmines.

- Lack of technical knowledge. The majority of personnel (operational or managerial) who are involved with the use of mechanical equipment have no formal training in its use, or in soil management. It is therefore not surprising that mechanical clearance activities in unsuitable soil conditions are frequently undertaken. It is also not surprising that the potential for creating future problems is neither appreciated nor understood.

- Understanding of soil management. It is not realistic to expect that some formal course on soil management has been undertaken anywhere in the Balkan region for inspectors, equipment operators, team leaders or even mechanical equipment operators. This statement probably applies to the majority of programmes worldwide.

Traficking, Cultivation and Soil Damage

Based on the reasons outlined above, it is not surprising that mechanical equipment is being utilised with little or no consideration of the potential damage that can be unintentionally caused. Whereas the agricultural community is extremely careful about the utilisation and management of equipment, not creating situations that will damage, pollute or erode the soil, available evidence indicates that the mine action community is not.

To date, there appears to be no attempt by the mine action community to ensure the correct selection of suitable tyres and operational procedures that would reduce compaction and other soil damage. There is also no evidence that, by design or implementation, organisations actively address such issues as infiltration and deflection, tyre construction and traction aids, forward speed, loading tyre lugs and tyre profile.

Despite the fact that many machines are tracked, the sheer weight of some of them will, in poor soil structure, have a detrimental effect on soil profile, cause serious and long-lasting damage. In addition, there is no evidence that organisations plan their operations in such a way as to reduce the potential for damage, or that they take remedial measures to restore any damage they have caused to the landscape. It has been found that vehicles based on wheeled vehicles are much less damaging than those based on tracked vehicles, especially in areas with a high density of landmines.

When soil damage can be caused by the wheels of clearance vehicles, the vast majority of the damage is caused by the sharp edges of the clearance device itself rather than the vehicle utilised to disrupt the soil to a defined depth. In Bosnia-Herzegovina and Croatia, this depth is defined by the national regulations at 10 cm. This regulation takes no account of topsoil depth, which may be considerably less, or of damage to the underlying subsoil.

Spoiled Soil

A number of methods are utilised to disrupt the soil to depths in excess of 10 cm. These include ploughs, rakes, flat and rotovators and rolling rakes, with the most common being the flail. Flail machines utilised to "dig" to stipulated depths not only disrupt the soil they can also cause compaction of the soil at depth. Disrupted soil can be further compacted by the host vehicle that bushes the flail unit, now operating on top of a soft soil surface (compacted underneath), compacting a second layer on top of the first. However, if soil has to be disrupted, the use of chains is by far the most inefficient method of providing digging implement. The physical act of digging with heavy chains and swing weights pulverises the soil, while at the same time compacting the underlying the disrupted surface. Milling machines cause massive compaction, as does the "belling" of any heavy equipment while operating. Wheeled machines then cause considerably more compaction than vehicles that have tracks to spread the load. While all these actions cause damage, the compacting or compaction of the soil resulting from the requirement to dig to stipulated depths can, in certain environmental conditions, compound that damage.

Mechanical Equipment Regulations

A number of mine action centres (MACs) have produced regulations addressing the depth to which mechanical equipment may damage the soil, from the Mechanical Preparation of Ground, (part of Bosnia-Herzegovina's MAC Standards), to the United States Instruction for Technical Survey. While the figure required is stated as 10 cm, the majority of mechanical equipment and ground factors means that the actual depth achieved is considerably more. It can of course also be less, but as the regulation stipulates 10 cm, organisations will tend to disrupt soil to a

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by Megan Burke, Adopt-A-Minefield

Introduction

News from Afghanistan since January of this year has underscored the threat of landmines—both for the Afghans and the 8,000 U.S. troops who are currently stationed there. On January 18th, an American soldier was killed in Germany after stepping on a landmine at an airbase north of Kabul. An incident on January 21st left four Afghan soldiers injured while patrolling the city of Gaidar. One soldier lost his foot and the other suffered facial injuries.

Afghanistan is considered one of the most mine-affected countries in the world. This is the sad legacy of 23 years of near-continuous war—first against Soviet occupiers, then between rival Afghan factions. The majority of the population has not experienced a time of peace in their lives. According to the United Nations, between 150 and 300 people are injured or killed every month due to landmines or UXOs. Seventy percent of these accidents involve civilians—many of whom are returning refugees or internally displaced persons (IDPs).

The Adopt-A-Minefield® (AAM) Campaign of the United Nations Association of the USA (UNA-USA) began raising funds to support mine clearance in Afghanistan, working in partnership with the United Nations Mine Action Programme for Afghanistan (MAPA) in 1999. For the first two years, AAM raised funds through the “Adopt-A-Minefield” model, encouraging local grassroots organizations to “adopt” a specific mined area by raising the $25,000 (U.S.) to $30,000 needed on average to clear the area of landmines.

Within days of September 11, 2001, the situation in Afghanistan changed dramatically. International staff working for non-governmental organizations (NGOs) and the United Nations were ordered to leave the country in anticipation of military strikes and as a precaution for the inevitable erosion of security. A week after the attacks, the United Nations announced a temporary suspension of the demining industry. Nearly all the Afghan deminers left their mine detectors and returnees and returned to their families in Pakistan.

At the same time, the threat of coalition strikes and the delivery of food by air created a positive population movement, increasing the risk of mine casualties. Many people fled to Pakistan and those still within Afghanistan put their lives at risk by unknowingly entering minefields in search of food. This movement of people has continued through 2002 and into 2003 as refugees have begun to flood back into the country and IDPs have started to return to their homes. The United Nations estimates that about 100,000 people are on the move and about 25,000 of the homes they are returning to are contaminated by explosives.

AAM suspended its operations in the country following the United Nations’ temporary suspension. Within a short time, the United Nations resumed demining work with a radically different set of priorities. Demining teams set new priorities focused on emergency clearance, which included removing cluster munitions (the small bomblets within cluster bombs) as well as continuing their work of removing the pre-existing threat of landmines. The work was never-ending for the small teams deployed in response to villages affected by unexploded cluster bombs and mine accidents often relayed by word of mouth or through simple radio.

In Afghanistan, mines are everywhere. It is estimated that within Afghanistan, 2,000 deminers can manually clear one to 15 square kilometers of land per year. Manual demining work primarily with metal detectors and probing for mines. While metal detectors are able to identify mines, they do not work well in soil with a high metal content. In these areas, metal detectors create many false alarms, forcing manual deminers to act on each signal as if it were a landmine. In Afghanistan, metal is everywhere. More than 20 years of conflict have left more than just mines and UXOs in Afghanistan’s soil. Spent shell casings, bullet casings, and other bits of metal make up the strange archaeological of war, which makes demining
there more complex than in some other mine-affected countries.

It is now possible to manufacture landmines with a metal content low enough to go unrecognized by metal detectors, which further complicates the demining process. Despite these difficulties, manual demining remains the most effective demining technique available. This is the method used by most of the teams supported through Adopt-A-Team: the teams of ATC, OMAR and DAPA. While deminers in Afghanistan undergo extensive training, only a flak jacket, a helmet and patience protect them from an accident.

**Demining Organizations**

ATC, founded in 1989 by Kefayatullah Elbagh, its present director, is one of the largest and leading mine clearance organizations currently operating in Afghanistan. ATC began with only one 24-man team and 11 administrative and support staff to clear mines and UXO from high-priority areas. Within one year, ATC expanded to include 780 additional staff. ATC has continued to grow since then, and now employs nearly 1,300 Afghans. Teams #7 and #21, both "Adopt-A-Team" teams, received special training in the fall of 2001 to recognize and remove cluster bombshells that were deployed during coalition air strikes. These teams are mainly working around Kabul and Jalalabad.

OMAR was founded in 1990 and has since been a leading organization for mine clearance and mine awareness in Afghanistan. While OMAR’s mine clearance operations initially began in the western provinces of Afghanistan, operations have since been expanded to the southern and central regions of the country. Since 1992, OMAR has cleared over 18 million square meters of agricultural and grazing land, roads, irrigation channels and housing areas. Their efforts have resulted in the destruction of 888 anti-tank mines; 29,434 anti-personnel landmines; 24,307 pieces of UXO; and 10,545,904 fragments. An additional 7,020,614 square meters of battle area were also cleared.

The members of OMAR Team B, available through Adopt-A-Team, have been together for nine years. Since 1993, the 32 deminers of Team B have been demining mine-affected regions throughout the western provinces of Afghanistan. Most of the deminers worked in the army or were students before becoming deminers. Most of them support families of five or more living in Pakistan—a journey often taking several days from western Afghanistan. The urgency of demining in the west became more amplified after September 11, 2001. OMAR Team B has changed its work plans to respond to emergency mine threats such as UXO and cleared remaining hazardous areas in each region of the country. The main priorities include areas that are critical to the return of refugees and IDPs and agricultural land essential for reconstructing Afghanistan’s economic base.

DFA was founded in June 1990 to implement a United Nations Office for Coordination of Humanitarian Affairs (UNOCHA) demining project in the southwestern provinces of Afghanistan. DFA’s work is focused on demining throughout the southern region of Afghanistan. Most of their work is carried out in the provinces of Ghor, Helmand, Kandahar and Zabul. The majority of DFA’s resources are deployed in the high-priority areas surrounding the city of Kandahar. DFA operations are carried out through six site offices employing 12 manual clearance teams throughout the region.

DFA team #3, the AAM team, has been working on removing the threat of landmines and cluster bombs for residents of the southern provinces. This team has 24 manual deminers, the majority with 10 or more years of demining experience, plus various support staff and field paramedics.

**Mine Detection Dogs**

MDDs are an important component of humanitarian mine clearance operations because, once trained, they can smell the explosives in a mine. This enables them to detect mines with low metal content that cannot be found with metal detectors. MDDs are also particularly well-suited for the initial surveys used to establish which parts of a suspected area are mine-free and which are contaminated. This allows deminers to reduce the areas that must be checked manually. Dogs can work in almost all types of terrain but work especially well on the less vegetated land that is found in many parts of Afghanistan. MDDs are highly reliable and can clear land between five and 10 times faster than manual deminers alone.

Currently, Adopt-A-Team is supporting two MDC teams—#5 and #6—and we will soon be adding three more. MDC was founded in 1989 to address the problem of mines and UXO and return mine-free land to the people of Afghanistan. MDC was established with financial support from the U.S. government since 1995, the program has been receiving financial support from the German government and UNOCHA.

By using dogs trained to detect mines, MDC aims to provide a safe, quick and economically viable method of mine clearance that will ultimately enable Afghans to reconstruct and develop Afghanistan. MDC has one of the highest mine clearance ratios in Afghanistan. By using dogs in clearance operations, MDC has been effective in clearing roads, agricultural and grazing land, and residential areas throughout 14 provinces in Afghanistan. The average clearance rate of a mine dog group (MDC) is 4,000-5,000 square meters per day. The accident ratio is also significantly lower than that experienced by manual teams.

The men of MDC Team #5 and #6 have been together since 1994. The deminers come from diverse backgrounds: former members of the mujahedin, students, clerks, teachers and shopkeepers now all count themselves as deminers with MDC. Both teams use dogs as part of their operations, and they play an integral role in the demining process. Deminers from MDC work and train closely with their dogs, ultimately forming a strong bond between deminer and dog—a reality that prompts many MDC deminers to joke that they prefer to work with dogs rather than people.

**The Benefits of Adopt-A-Team**

The Adopt-A-Team program fills an important niche within mine action in Afghanistan. It provides additional and badly needed funds to the field so that Afghan deminers can work where they are needed, when they are needed. They can clear roads for returning refugees, make homes safe and also begin the critical work of clearing the land that will allow Afghanistan to rebuild its devastated economy. In addition, it provides jobs to nearly 200 deminers—many of whom provide food and money to an extended family of 20 or more people. Finally, it allows the United Nations to increase its demining capacity and thus the rate at which it can clear the highest-priority sites. The situation in Afghanistan is grave, but it is not without hope—the United Nations has a new intensive strategy that aims to clear all high-impact areas within five years. This is only possible with sustained donor support from governments as well as the efforts of individuals through AAM. Through efforts such as AAM’s Adopt-A-Team, the threat of landmines in Afghanistan can be

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The MINEX Center

This article highlights the efforts of the French Army Engineer School’s MINEX program.

by MINEX

History

Since 1978, in the scope of cooperation or defense agreements that link us to some countries (e.g., Chad and Lebanon), the French Engineers have taken part in overseas operations in countries that are greatly affected by the problem of mines and battlefield pollution, and that are no longer at war. Those sappers will acquire an experience recognized worldwide.

In the late 1980s, standard mine clearance techniques and to elaborate an acceptable training doctrine for all the military actions, the Joint Chiefs of Staff decided to set up a training center for post-war mine clearance within the French Army Engineer School in Angers called “Centre MINEX.”

The center stood out rapidly at the international level thanks to the quality of the teaching, experience of the staff, and constant innovations in developing pedagogic tools.

At that time, the French Army Engineer School received two orders:

- “Train Engineer officers and non-commissioned officers (NCOs) in post-war mine clearance.”
- “Collect and spread information concerning landmines and sub-minations.

In 1997, the process of the Ottawa convention and France’s ratification of it opened the door to a new step: putting to the abilities and expertise of French soldiers at the disposal of the countries and organizations that fight against antipersonnel mines.

The MINEX Center became “Département de Formation au Déméningage” (DFD), a training and information center on demining, and is still the only post-conflict mine clearance training center in France. The number of training requests is widely increasing. For this reason, the French Army Engineer School decided to create the National Center of Humanitarian Demining Training in 2001.

Training

The courses dedicated to engineer officers and NCOs are called MINEX. Following are brief descriptions of these courses.

**MINEX 1**

MINEX Level 1 corresponds to training on individual clearing techniques, which are dedicated to all the military staff in engineer regiments. The training is spread throughout all the engineer regiments and lasts about two weeks.

**MINEX 2**

MINEX Level 2 training is dedicated to all the engineer squad leaders-to-be, whose field of specialty is “combat and engineer techniques.” The soldier who has obtained the MINEX 2 qualification is able to command a squad for a mine clearance action or for an area clearance action and to take part in actions of demolition or neutralization of known and studied landmines, including landmines, subminations, demolition equipment and pyrotechnics. The training lasts about two weeks.

**MINEX Platoon Leader**

MINEX Platoon Leader training is dedicated to young engineer officers as well as NCO candidates for the BSTAT (Superior diploma for French Army technicians) assigned to “combat engineering” and “clearing” sections. The aim of this level is to train platoon leaders to organize and command under safety rules, mine clearing and clearance missions.

**MINEX 3**

MINEX Level 3 training is opened to engineer NCOs who have already obtained the first two levels—MINEX 2 and MINEX Platoon Leader—assigned in combat units and are volunteered to obtain the third level. The MINEX 3 graduate is particularly able to fulfill reconnaissance missions over polluted areas. He is also experienced enough to demolish or neutralize known landmines, especially landmines and attack landmines. The training lasts six weeks.

**MINEX Staff Level**

MINEX Staff Level training is dedicated to commissioned and senior engineer officers. The MINEX Staff Level graduate is authorized to serve within an army headquarters as a command adviser for the conception and execution of mine clearance missions, as well as in international bodies taking part in mine action programs.

**International Courses**

The French Army Engineer School proposes international courses for the MINEX Platoon Leader and MINEX Staff Level courses that would be open to foreign military specialists. For example, the center has been training officers and NCOs from U.S. forces for more than five years (twice per year). The School also trains foreign units before they are committed overseas.

Humanitarian Demining

Humanitarian demining is part of the action program against mines developed by the United Nations. It is a tool for social and economic development for civilian populations and nations suffering from mine and UXO contamination. It is also a factor for new development, since it allows populations to recover free use of economic and social tools (cultures, houses, etc.).

The implementation of an action program against mines requires several fundamental parameters. The very first action aims to increase awareness among populations of the danger that mines and other munitions represent. Mine risk education is completed by concrete assistance to the victims of mines among those populations, namely medical, surgical and orthopedic care.

Humanitarian demining remains the main action of the program and is composed as follows:

- The first stage consists of evaluating the threat and planning operations. Demining is a very complex, long and exacting task; a technical reconnaissance is conducted in order to determine with precision the contaminated areas and to optimize time dedicated to clearance operations.
- The second stage is dedicated to the removal of mines (neutralization and demolition) and to the determination of quality assurance (QA) (issuing an area clearance certificate before the area is delivered back to the population).

The major part of mine action program against mines is the training of all the officers implicated in it. The National Center for Humanitarian Demining Training created in Angers gives to those people all the experience and the know-how of the French Army for all demining operations.

National Center for Humanitarian Demining Training

The French Army Engineer School opens its demining training ministry to all the categories of staff, dealing with humanitarian organizations or working for mine action operations against mines. The School proposes trainings for different personnel, including management for demining programs and operations, instructors, advisors, inspectors for QA and specialists who will help increase the population’s awareness.

The training will be under the responsibility of a French company accredited by the French Ministry of Defense. The School, as a service provider, gives assistance in the form of offering teaching help, lending technical and infrastructure equipment and delivering a “Quality Label.” The trainings are in accordance with the International Mine Action Standards (IMAS) decreed by the United Nations and adapted to the very specific needs of a country or an organization. Moreover, the Center works closely with international agencies that deal with mine action.

Expertise

The training and information center for mine action (DFD-TICMA) provides:

- Conceptual expertise allowing for texts to be written (memos, rules, notes, studies).
- Technical expertise in research and development for new mine clearance technologies.
- Advice to the ministries and to the Parliament National Commission for the Eradication of Anti-Personnel Mines.
- The specialists working at the French Army Engineer School have developed a database containing more than 1,000 different types of mines and subminations used all over the world. This database, presented on CD-ROM, is an internationally recognized reference in that domain. The database gathers two kinds of information:
  - Technical information about characteristics and functioning of ammunition; this information can be widely distributed.
  - More confidential information about neutralization procedures. This information can only be given to accredited staff having all the technical abilities to use it.

Mine Risk Education

Awareness is one of the Center’s capacities recognized throughout the world; thus, DFD-TICMA also participates in several high-level trainings for civilians, especially for students in law and politics from the university in Aix-en-Provence (southern France), who are about to work for international humanitarian assistance and for Bioforce, an organization working with the World Health Organization (intervening in training, expertise and engineering).

The department also draws the attention of researchers, engineers and public or private agency technicians to the problem of mines and mine clearance within research programs in that field. The department also organizes sessions to increase awareness about this problem in the French Army schools and units and also for the French or foreign forces overseas.

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Low-Profile Disposal of U.S. Ordnance


by Frederick L. "Bart" Barthold, LEAI International, Inc.

The mission was simple enough: monitor air operations at Thurman Bombing Range from a safe distance, locate ordnance that did not detonate, ensure a positive identification of said ordnance and ensure a complete disposal of said ordnance is accomplished with the lowest profile possible. Through experience, if life could be so easy! The ordnance: MK82, 500-pound bombs using M904E point detonating new fusing with a M990 series, incendiary, and GRU-10, laser guided bombs (MK84) with an MK346 electric tail fuse. What normally would have been a "blow-out" took a brutal turn for the worse when a herd of camels followed by an entire tribe of Bedouins wandered onto the range. This simple act of random grazing blew the "low profile" right out of the window and led to a severe case of "man-pain in the tics!"

Normal "blow-out" situations consist of explosions of M60, M60U fuse fuzes and non-electric detonators. The idea is to find the duds, set the charge, allow enough time fuse to get behind a gelded Omani (I'm for "small"), wait for the boom, then move on to the next dud. The "random grazing" situation mentioned above emptied much monotony from the daily operations and thus two individuals should hear.

First, the Omani owns the range— he is in the desert by the coastline. We could do the work, but we could not kill a camel doing it! Evidently, camels are curious and have a highly developed sense of smell. As the follow explained, in very good English: "If they smell the time fuse burning, they will rush to investigate the source. [They] will be too close to the bomb when it goes off. Thus, they will be killed! Also, camels are a show of wealth and any decrease in the herd would be perceived as weakness and invite trouble."

Second, this requirement, as simple as it appears, became the pivot for the moment didn't really sink in for nearly 30 minutes. Without wheels, we were the mode of transport. The last thing I would ever choose to do willingly would be to carry several 1000 feet of wire, explosives, equipment and water over a desert bombing range. To the uninitiated, this may sound as absurd as it really is, but one can predict the topography of the desert with any great accuracy. There are not enough Band-Aids in two boxes to cover the burns and scaps two explosive ordnance disposal (EOD) Technicians will receive while un-spooling a mile of wire down hills, up hills, across off-roads (useful) and dunes, across broken flint Fords, etc. To make a very long story short, what should have been accomplished in two days at most (cleanup included) actually took up the majority of seven days to complete.

The wire that was laid out is still there. I believe, Ultimately, I'm not concerned. To almost positive the fellow we talked with either used it himself or sold it to some other technician.

This scenario never needs to be repeated. There is new, non-explosive technology available that burns ordnance in place. It uses light energy to initiate a chemical reaction to heat polycrystalline iron whiskens to 2000C within 0.5-1.5 seconds, which in turn ignites a thermite pack. The thermite is sufficient to burn through thin-case ordnance using one pack and thick-case ordnance when two or more packs are used. This technology is referred to as a Light Energy Absorbing Igniter (LEAI) and is currently being developed for underwater applications.

Introduction: New Equipment

The LEAI system is a non-explosive tool that was developed for the humanitarian demining industry. The system can initiate a burn or detonation of ordnance in place safely, quickly and efficiently. In addition, the system saves many man-hours by requiring less personnel and support equipment and operational use. The LEAI system does not require magazine storage, the purchase of explosives, Quantity/Density (Q/D) restrictions or lengthy shipping and handling times. Class One, Eye-Safe Lasers are used throughout surveying circles and the utilities industry with great and dependable accuracy and has been proven in rugged conditions for many years.

Environmental Characteristics

- Weight: 8.41 x 4.5"W x 7.5"H
- Weight:
  - 4.8 lbs. Each unit
- Operating Temp: +22°F to +140°F
- Storage Temp: -40°F to +176°F
- Humidity: 90% Non-condensing
- Environment: Water & Dust Resistant
- Display: LCD, 4-line X 20 Characters
- Keypad: Membrane Keypad
- Sighting Optics: Heads Up Display

Laser Rangelinder

Type: Semiconductor pulsed laser 904 nm
Eye Safety: FDA Class 1 (21 CFR 1040)
Accuracy: +/- 15cm / 0.50ft. (3 sigma)
Resolution: 1cm / 0.039ft.
Range: 5200 ft. (w/ prism)
Meas. Time: 0.33 sec. (0.64sec acquisition)
Distance: 0.1 mile (30cm / 100m)

* Atmospheric conditions may affect ranging capabilities

Ignitor

- Size: 5.25"L x 0.625"D
- Weight: < .5 oz.
- Active Ml: 3 grams glass sealed
- Temperature: 2500°C in 0.5 - 1.0 sec
- Burn Time: 1.5 - 2.0 sec
- Body: Metal

Description

LEAI International, Inc., developed the LEAI system in order to tremendously simplify the removal of landmines and other lethal devices from the ranges and battlefields of the world. The devices intended to help to narrow the EOD and UXO Technician safely and quickly manage the problem.

The LEAI system is very versatile for disposal of disposal. The actual grid clean-up and certification process is confined to the one-meter grid, which requires less man-hours for completion. The LEAI UN hazard classification makes it very efficient, for transportation is 4.1—"Flammable Solid"—and it has a minimum shelf life of 10 years. This same process can also be used to destroy a detonation by using an electric blasting cap or by connecting a non-electric

Grid-Quality Assurance/Quality Control (QA/QC)

- Burn time in place method also promotes a safer working condition for the entire site clean-up. Sweep teams are less fatigued when they can scan specific GPS location grids where the UXO was found, as opposed to scouring the entire work site for UXO residue that has been detonated. Site remediation is also much easier because the specific GPS location grids require less attention than the overall work site.

Assessment

The LEAI system has a solid foundation. The igniter whisker material has been in use for over 40 years with an outstanding track record for dependability and safety. The Laser Ranger Transmitter (LRT) has over 20 years experience in both the military and the utilities industry. Combustion, this system has achieved remarkable reliability during field testing. It is easy to use. A continuity check, a safety arming circuit and a firing circuit are built into the RCU, which permits the user to check the entire circuit. Then, the user can retract to the specified safe distance before the circuit is armed. The end user may elect to set up either a burn operation using the ignitor, or a demonstration operation using either an electric blasting cap or non-electric shock tube for the disposal operation. The LRT is then triggered to initiate the operation down range. An inherent safety ratio of 3:1 is designed into the circuitry.

Future Development

The LEAI system may be used for Force Protection of Navy ships. A number of operational tests consisting of non-lethal deterrent charges can be set in place around the ship at anchorage. Should fast-tracking boats or other intruders enter the perimeters, these non-lethal deterrent charges, such as the MK141, may be launched and operated in close proximity to the boat.

Grid is then mapped by the RCU attached to land-based perimeters using the RCU attached

https://commons.lib.jmu.edu/cisr-journal/vol7/iss1/1/
Spoiled Soil

greater depth in order to ensure compliance.

Manual deminers use provers and metal detectors and may be assisted by EDDs, but neither the detector nor the EDDs disturb the soil. While manual clearance and EDDs are accepted as "stand alone" clearance methods, machines are not. In many programmes, the use of machines requires subsequent checking by men or EDDs to achieve clearance quality standards: that being the case, and accepting that soil damage is a serious issue that may negatively impact vulnerable communities, it raising the question of why programme authorities demand that machines must disrupt the entire soil surface, regardless of soil conditions.

While it is accepted that the disturbance of the soil by mechanical equipment can increase safety, productivity, and cost-effectiveness, only appropriate designs of machine, operated correctly and only used in suitable conditions that allow disturbance without soil damage should be utilised.

Conclusion

There is no question in the minds of the agricultural specialists that damage is being caused by the use of mine clearance vehicles, but the full extent of this damage and the reasons for the damage—poor management, inappropriate equipment utilization, incorrect procedures, etc.—need to be scientifically assessed. It is also recognised that the use of mine clearance vehicles can improve safety and productivity. Therefore, the dual requirements of removing hazardous material without causing unnecessary damage to the soil structure have to be integrated.

The international demining community must ensure that in undertaking clearance activities, the soil structure is not inadvertently damaged, creating short-, medium- and long-term problems for agriculture, in particular to sustainable farming that is vital to the support of vulnerable communities. International standards should reflect the necessity to protect the environment while undertaking mine action activities.

Endnotes

1. In the cases of munitions explosions, the issue of chemical soil contamination should be considered, particularly in and around the bomb sites. In some cases, the amount of explosions (a few AP mines for example) makes this a minor problem; however, in cases where munitions are being conducted (such as stockpile destruction), consideration is necessary.

2. While many types of equipment have tracks, giving a greater spread of the vehicle weight, a large number of vehicles used worldwide are not. The weight of clearance vehicles can range from two to 56 metric tons.

3. Smearing - the spreading and smoothing of soil to destroy pressure. Composting - the effect of wheels or tracks (or vehicle attachment) causing compaction of the soil particles, closing the pore spaces that act as pathways for water, air and roots.

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The Swedish EOD & Demining Centre

This article introduces the Swedish Explosive Ordnance Disposal (EOD) and Demining Centre (SWEDEC) and illustrates its role and principal activities within both military and mine action contexts.

by Thore Bäckman, SWEDEC

The Explosive Threat and Swedish National Policy

Of critical importance to the delivery of services in the mine action sector is the Swedish national policy relating to mine action (and associated activities). Within the Swedish "Total Defence" initiative, the mandate for the standardisation and coordination of EOD and related activities clearly falls with SWEDEC. As the national centre of excellence for EOD and mine action, SWEDEC coordinates and directly supports the National Police Board (RSP), the emergency services within the Swedish Rescue Service Agency (SRSA), the Defence Material Administration (FMV), the Defence Research Agency (FOI), the Swedish International Development Agency (SIDA), and all land-based military explosive ordnance clearance and related activities, both nationally and abroad.

Swedish EOD and Demining Centre

SWEDEC was formally established in 1996 to provide a consolidated and comprehensive initiative for all military commissions and EOD training, EOD equipment and doctrine research and development (R&D), and the provision of technical advice in the development of national mine action policy.

Initially established around the nucleus of the Swedish EOD and Military Engineering Centre, SWEDEC's role was further expanded by the addition of the R&D Section and was granted responsibility for the coordination and maintenance of an international pool of qualified EOD and mine action personnel in support of rapid deployment initiatives. Most recently, the creation of a Mine Action Support Section (MSS) to provide additional support to national and international mine actions has further expanded the scope of SWEDEC's activities. As a result, it is one of the very few military establishments in the world capable of providing such a comprehensive approach to all explosive hazards within a single organisation. Additionally, it attained International Federation for Standardization Organisation (ISO) 9002:1994 accreditation for "Training, Information and Development concerning EOD and Mine Clearance" in January 2001.

Total Defence EOD School

To accommodate the ever-increasing range of explosive threats and associated operational requirements, the EOD School is continuously expanding the suite of courses being offered. To illustrate the current scope of training activities within the EOD School, the forcast training for 2003 extends to 30 different courses, totalling 5,155 training days. This suite of courses currently includes all facets of EOD, from introductory conventional munition disposal (CMD) through advanced improvised explosive device disposal (IEDD).

To provide a comprehensive and multi-disciplinary approach to EOD training, the EOD School utilises instructors and support staff from all branches of the Swedish Armed Forces, the RSP and the SRSA. Courses are subsequently tailored to the specific needs of both military and civilian client groups. To further enhance the delivery of courses, the EOD School is currently integrating competency-based assessment systems to assist in the recognition of practical experience gained by personnel.

The EOD School trains the Swedish Police Force, the Swedish Armed Forces and the SRSA.

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while deployed on operational activities throughout the world and the development of a national qualifications framework for all EOD disciplines and associated procedures to enhance the management and interoperability between respective national agencies. Current initiatives include the development of advanced elements in chemical, biological and radiological munition disposal (CBRD).

R &D Section
As well as assisting in the review and development of all demining and EOD doctrine, the R &D Section is responsible for the test and evaluation of new equipment and the development of new procedures.

The trials for Mechanical Clearance Equipment to support both military and humanitarian operational requirements have recently concluded. The trials subsequently resulted in the Swedish Armed Forces’ purchase of a Croatian DOK-ING MV-4 and the fitting of several Snatch 3500 machines. The substantial test facilities and procedures for repeatable testing have been internationally recognised and have formed the core of subsequent related standards development within the European Union (EU).

Currently underway is a comprehensive review of mine detection dog (MDD) search techniques and procedures aimed at both consolidating and enhancing current capabilities in this field, and investigating the role of mechanical clearance machines and MDD interaction. Additional research is investigating the neutralisation of mines through the use of thermite torches. The test and evaluation capacity is currently under expansion and will shortly be offered to international clients on a commercial basis.

EOD Information System (EOD IS) Section
Due to the ever-increasing volume of explosive ordnance-related information and the need for the efficient management of this information, the Swedish Armed Forces expanded existing IT initiatives to address this issue. As a result, the EOD IS was created as a stand-alone software package capable of both database and geographic information system (GIS) functions.

Currently in its second version, work toward the interface between the EOD IS and the Information Management System for Mine Action (IMSMA) software is at an advanced stage. The EOD IS is currently in service with the Swedish Armed Forces, RFSRSPA and the Finnish Armed Forces, and additionally, under evaluation by numerous international civil and military agencies.

Mine Action Support Section
Among the many activities allocated to the MASS is the development and management of a pool of EOD and mine action personnel to support rapid deployment initiatives. This pool currently comprises over 200 civil and military personnel trained in all EOD and mine action disciplines, including explosive detection dog (EED) handlers and mine risk education (MRE) specialists.

Central to the management of the international pool is the use of stringent psychometric testing of all candidates prior to acceptance, irrespective of civil or military backgrounds. This testing is conducted by the Swedish Armed Forces Recruitment Centre, based upon the Air Force pilot selection programme and refined to isolate those most suited to working in a cross-cultural context as well as in isolated and hazardous environments for prolonged periods of time. Personnel from the international pool have subsequently been employed in EOD and mine action programmes and projects in over 20 countries throughout the world.

The MASS is also responsible for conducting research into MRE and associated community liaison activities, which includes the development of doctrine and procedures to enhance national capabilities in this field. In addition to providing MRE training for military personnel, the MASS has developed a number of MRE training programmes for civil mine action staff, which has involved the participation of several prominent international mine action organisations.

Additionally, the MASS is making a significant contribution to international standardisation initiatives in mine action including the secondment of staff to the International Test and Evaluation Programme for Humanitarian Demining (ITEP) and the provision of support to the development work of the European Committee for Standardisation (CEN) Working Group 126 (WG126) to complement the existing standardisation work undertaken by the Geneva International Centre for Humanitarian Demining (GICHD) in support of the International Mine Action Standards (IMAS). Within these activities, MASS is directly supporting two of the three CEN WG126 workshops aimed at developing test and evaluation methodologies and procedures for mechanical clearance equipment and the creation of competency standards for EOD.

SWEDEC Operational Activities
Although not mandated to directly participate in the implementation of EOD or mine action operations, SWEDEC has a long-established programme for the secondment of staff to the United Nations, non-governmental organisations (NGOs), and commercial and entity army mine action programmes and projects. Most recently, Sweden has provided a staff officer to the Multinational EOD Cell within the Headquarters of the International Security Assistance Force (ISAF) Brigade in Afghanistan. Additionally, Swedish staff are currently serving within UN and NGO programmes in Bosnia, Kosovo, Afghanistan, Sri Lanka and Eritrea.

Worthy of particular note is the MDD program within the Cambodian Mine Action Centre (CMAC), developed in collaboration with SIDA. Established in 1996, the programme is unique in the world in that it is the only MDD programme ever established in Cambodia. Although the initial training of dogs and their handlers took place in Sweden, responsibility for this activity was soon passed to the national staff with the programme assets, including 50 dogs and a substantial training facility at Kampung Chhnang, which were subsequently transferred to CMAC authority in 2002.

Since its inception, the Cambodian MDD programme has attracted significant international interest due to the "Swedish" short-lead technique developed during this project. Once vegetation has been removed, this technique involves placing a length of rope at the border of a suspected mined area and having the dog search a 40-60 centimetre-wide lane immediately adjacent to the rope, with the handler remaining on the "safe" side of the rope. When a suspected mine or item of UXO is located, this item is dealt with by supporting EOD staff. The search process is repeated twice by different dogs and handlers, and when no threats are located, the rope is placed a further lane-width into the contaminated area. Significant in this process is an informal element of quality assurance (QA) by virtue of two independent searches of each lane and subsequently by the handler, who is currently walking in the dog's footsteps as the search is undertaken.

The Cambodian MDD programme has subsequently expanded to a total of five operational teams, each comprising of six dogs and associated support staff. In 2002, the combined MDD teams exceeded the monthly forecast clearances estimates of 80,000 square metres with an average monthly clearance result of 120,000 square metres.

Conclusion
As the national Centre of Excellence in EOD and Demining, SWEDEC is the focal point for inter-agency collaboration between the Swedish Armed Forces and relevant civil agencies. SWEDEC welcomes the participation of international organisations and NGOs in all aspects of its work and subsequently extends an invitation to all interested parties to contact SWEDEC for further information on any of the activities mentioned. SWEDEC intends to provide future articles to the Landmine Monitor newsletter to provide more detailed insight into specific SWEDEC activities and projects.
Ocean Group: Explosive Ordnance Disposal/Landmine Clearance Division

Since 2000, the Ocean Group Explosive Ordnance Disposal/Landmine Clearance Division (EOD Division) has been forming an extensive underwater clearance program by combining vast experience from different fields of mine action and by developing advanced underwater demining technologies.

In 2000, the company recognized a need for and set up a division to handle UXO/landmine clearance. Although the company derives from a commercially oriented background, they feel that this division represents a more humanitarian standpoint, which is necessary in order to fulfill the needs of the client. The EOD Division combines expertise from many different aspects of landmine/UXO clearance in order to provide an extensive demining program.

Projects

So far, the Ocean Group EOD Division has conducted multiple operations on the Valkenier River in Quebec as well as in Sorel, Quebec; Halifax, Nova Scotia; and throughout Russia. They have also collaborated on bringing a UXO-detection drone system, APL Drums, into the field of underwater demining. These APL Drums provide a safe, quick, and affordable method for identifying submerged objects and objects lying as far as 30 cm below the ground in both shallow and deep waters.

This newly developed sonar system has been designed to operate under various circumstances. In 2000, the Ocean Group began developing a method that involves suspending the APL Drums from a hydraulic crane and is geared towards shallower waters that are at least 0.5 m deep. Another method was also being developed for deeper waters (over 2 m deep) with strong currents. This method includes a remotely operated vehicle (ROV) designed by Boston Underwater Systems called a “Double Eagle,” which is used by marines to counter landmines.

Over the past year, the EOD Division has focused much of its efforts on research and development (R&D). As a result they “have pulled out all the stops and deep-water remote survey barge, remote harvester, remote transporter and demolition barge,” preparing them to conduct any necessary underwater operations. These new developments include a number of technologies such as sonar systems, a sub-bottom profiler, stereoscopic cameras, and a seven-function manipulating arm with multiple exchangeable tools. All of the equipment is controlled by satellites and is capable of being transported by airplane, train, truck or ship.

Conclusion

Although there are a number of organizations that include underwater landmine and UXO clearance in their work, Ocean Group is the first to focus specifically on this aspect of clearing. Since 2000, they have formed a skilled team and developed advanced technologies that function extensively in the clearance of flooded minefields, canals and other waterways. As a result, they are prepared to form the most qualified team with the most beneficial equipment for each underwater demining project that comes their way.

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Global Training Academy has been building Mine Detection Dog (MDD) capacities for years, even while they worked under skeptic voices and much criticism. Now, the academy serves as the main MDD sub-contractor for the Department of State (DOS), and has experienced many successes with their program.

by Dan Hayter, Global Training Academy

Overcoming Criticism

In the fall of 1989, RONCO Consulting Corporation, a U.S. contractor that manages Agricultural Development Programs (ADP) and community development programs for the U.S. Agency for International Development (USAID), and Global Training Academy (Global) teamed up in an effort to build indigenous MDD capacities. There were always skeptical voices and adverse reactions to using dogs in humanitarian demining. In 1998, RONCO and Global were the first to utilize MDDs. We began our indigenous training of MDD handlers in Afghanistan, and then expanded the program in Mozambique.

In 1993, Dr. Vernon Joynt of Mecmec, a South African commercial demining company, used dogs in a laboratory environment for testing samples collected by the Mecmec Explosive Detection Dogs System (MEDDS) in Mozambique. Today, this system is commonly referred to as the Remote Explosive Scent Tracing (REST) system by the Geneva International Center for Humanitarian Demining (GICHD). It wasn’t until the summer of 1994 that other organizations, such as Norwegian Peoples Aid (NPA), began to use the value of trained MDDs. In 1997, Colonel Lionel Dyck of MineTech, out of Zimbabwe, introduced MDDs into the country’s demining operation in Botswana.

The criticism of MDDs continued in subtle ways, such as the suggestion that the commercial demining organizations using dogs were doing inferior and unreliable work. It was seldom pointed out that manual demining operations could not match the clearance productivity of those operations utilizing MDDs. Moreover, demining operations that used MDDs had excellent safety records.

In the last 18 months, I have seen a broader interest in employing MDDs, and it is evident that the GICHD Demining Standards Group has done much to improve the usage of the MDD. Global supports the goals of the GICHD to develop standards and provide guidance to all bonafide users of MDDs.

The Beginning

Many training and search procedures have changed in the past 14 years since Global was requested to assist with supplying MDDs to USAID’s Humanitarian Assistance Program to Afghanistan in 1989. Global became partners with RONCO, who had a USAID contract to distribute food and humanitarian relief supplies to war-torn Afghanistan. Due to the isolated mountain regions in Afghanistan, RONCO was using a combination of trucks and pack mules to deliver the relief supplies. These mules were being trained at the Animal Holding Facility in Peshawar, Pakistan. During this period of time, Doctor John Ottenberg, a retired U.S. Army Colonel, was managing the Animal Holding Facility for RONCO, Doctor Ottenberg, the lead U.S. Army veterinarian during the early 1970s in Thailand, was involved in the turnover of MDDs from the U.S. Army to the Thai army.

The survey identified a concern of the MDD handlers that dealt with their original MDD search pattern.

Search Patterns

We originally used a search pattern known as the “figure-8 pattern.” This search pattern was used during the training package, and was always in the training mode. The handler was trained to look for areas of distant or suspicious areas. The handler would also be trained to look for areas of distant or suspicious areas.

In the fall of 1989, Global was contacted by RONCO, inquiring if we had the capability to provide the trained dogs and handler training. Global then began to put together a handler course and an MDD Program. The first dogs entered training at Global in the spring of 1990 and were deployed that fall. These original MDDs were trained on landmines and tripwires. The need for tripwire detection was due to the heavy use of POMZ bounding mines that the Russians had laid in the highways throughout Afghanistan. In December of 1996, Global completed the first MDD Handler Course. Our first 12 MDD teams were deployed into Afghanistan at the beginning of the Gulf War. Our next MDD course was started in mid-January 1991, but was delayed by USAID until mid-March 1991. After the return of the MDD Teams from Afghanistan, we conducted a survey of the handler as they returned to the Animal Holding Facility.

MDD Operations

Mozambique

In January of 1993, RONCO and Global teamed up in another joint Mine Detection Dog Program in Mozambique to assist USAID operations there. USAID’s goal was to assist in clearing the roads in Mozambique. The rural areas were inaccessible to the people. USAID wanted to provide safe travel routes for the rehabilitation of the farmlands. The road clearance also allowed the USA World Food Program to distribute a larger supply of food relief to the Mozambican population.

Between January 1993 and August 1995, Global and RONCO trained a total of 38 MDDs. 42 handlers, seven Para Vets and six MDD supervisors for Mozambique.

Rwanda

In January of 1996, a new Mine Dog and Demining Center was established in Rwanda. The program received funding through USAID and the U.S. Military Assistance Program. The objective was to clear open fields of mines as part of the Mine Action Center (MAC), provide training of manual deminers and establish a self-sufficient MDD Program. The objective was to make it safe for the rehabilitation of farmlands and the resettlement of rural villages.

From January 1996 until September 1999, Global trained 28 MDDs, 40 MDD handlers, six MDD supervisors and four MDD trainers for the Rwandan military.

Bosnia-Herzegovina

In the summer of 1996, Global, along with RONCO, received a request from Bosnia-Herzegovina, which was funded by the U.S. Department of State (DOS) to develop MDDs to each of the three entities within Bosnia-Herzegovina. Each of these entities—the Bosnians, Serbs and Croats—received a training package that included nine mine dogs and handlers, in conjunction with a manual demining capability.

Central America

In the fall of 1998, three additional MDD training programs began in Central America: Honduras, Nicaragua and Costa Rica. The MDD training was funded by the U.S. DOS and monitored by the Organization of American States (OAS). The original MDD handler training took place in Honduras with each country sending four potential handler candidates. The first MDD teams were deployed into the minefields in their respective countries in January of 1999.

The program within Nicaragua expanded to 12 MDDs due to the high infestation of landmines. The Nicaraguan military eventually developed the ability to train their own MDDs. This program was followed by the creation of MODs. They have trained two additional MODs and an additional five empleants in a training facility just outside of Managua. The MODs in 2005, Costa Rica was declared mine-safe in 2002 and Honduras is expected to be mine-safe in 2004.

During the summer of 1997, we made another proposed change in our training and minefield clearance procedures. This change came about due to our experiences in clearing landmines within Bosnian-Herzegovina and has improved productivity and safety within the minefield.

The new search procedure in the minefield is as follows: a minefield or suspect area is identified, it is divided into eight- to 10-meter square blocks. Safe lanes are made around each block. Dividing the minefield in this manner serves two purposes. First, it makes it easier for the manual deminer and/or MOD team to identify areas where tripwires may cross the minefield. Second, it makes it so that when there are drastic wind changes during a search, the handler can reposition himself and his dog safely around the block, ensuring timely completion of clearing an area without having to move throughout the minefield.


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Working With the U.S. Department of State

In the spring of 2000, the U.S. DOS/Office of Humanitarian Demining Programs (HDP) funded RONCO and Global to train six MDDs to work with an NGO, which receives funding through the United Nations. The organization is known as the Accelerated Demining Program (ADP) in Maputo, Mozambique. The ADP's program was the second instance in which HDP provided MDD access to a pre-existing demining operation. The first time was to assist the OMS in Central America. The ADP's program was the first where MDDs were specifically trained to work in minefields that had been prepared for demining use by flood machines. The use of MDDs in areas cleared by the flood has broadened the utilization of MDDs in demining operations.

In 2000, HDP funded a separate MDD (12 dogs) demining operation in Beira, Mozambique. This operation was to clear the railroad lines within central Mozambique in order to improve travel and trade. This project was completed in the fall of 2002.

During the year 2000, HDP funded RONCO and Global to accomplish the following tasks in Thailand:

• Establish a MAC and furnish technical assistance in training the Thai military to operate the center.
• Provide training and technical assistance in manual and mechanical demining procedures.
• Provide the Thai military Mine Dog Center (MDC) with training assistance in updating their MDD program. This program has provided 28 MDDs and handler training. It also has provided four MDD trainer instructors, who will complete their training in the summer of 2002.

In the spring of 2001, HDP established the Quick Reaction Demining Force (QRDF). The QRDF has eight MDD teams and manual deminers assigned. Their mission is to deploy to hot spots anywhere in the world that the United States has an interest in emergency demining. This group has been deployed to three locations in the last 18 months—Sri Lanka, Nigeria and twice to Sudan.

In 2001, HDP funded RONCO and Global to support humanitarian demining operations in the following countries, each of which was provided with MDDs:
• Overseas received six MDDs in 2001 and an additional six MDDs in 2002. All the dogs are fully deployed in the field.
• Oman received four MDDs in the spring of 2001, with all dogs being deployed in the fall of 2001.
• Lebanon received its first six MDDs in the spring of 2001 and a second group of seven MDDs in the spring of 2002. Lebanon is scheduled to receive an additional five MDDs by the spring of 2003.
• All MDDs are deployed working behind flags and conducting quality assurance.
• Azerbaijan MDD operations commenced in September of 2001 with RONCO initially providing two MDD teams out of Estonia. One of the dogs was replaced due to illness in the fall of 2001. These six MDDs were donated to the Azerbaijan Mine Action Clearance Program. RONCO and Global trained local nationals to handle the MDDs. The second indigenous MDD handler course, which commenced in the spring of 2002, consisted of seven new MDDs. A third handler/supervisor course was conducted in August of 2002, which added three additional MDDs later that year.

In late spring of 2002, HDP funded a humanitarian demining operation with the military forces of Armenia. The requirement was to build a MAC, provide training for manual deminers and establish an MDD program. Seven MDDs were entered into training, and in September of 2002, five MDD handler teams completed training. These teams were deployed with a manual demining group in October of 2002.

Conclusion

In summary, the use of MDDs has become a very important tool in safe and efficient demining operations. Even though Global received much criticism about the use of dogs in humanitarian demining, much success has come from the program. Dogs deployed to many minefields around the world have greatly enhanced the productivity of the local manual demining teams. Having proved the effectiveness of MDDs in support of humanitarian demining operations, Global and RONCO are now the main contractors for MDDs for the U.S. HDP.

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Remote Explosive Scent Training: Genuine or a Paper Tiger?

This article briefly discusses many of the research challenges presented by the Remote Explosive Scent Training (REST) concept. These challenges were reviewed at a recent workshop (8-12 February 2003), hosted by APOPO at the Sokoine University of Agriculture in Tanzania, and attended by all current players involved in developing or using REST for demining purposes.

by Håvard Bach and Ian McLean, GICHD

Introduction

REST is the process of taking scent from a source for remote analysis. The scent is obtained by using a pump to draw air containing sniffer dogs' sense particles from the soil surface through an absorbent filter. Filters are analysed using specially trained sniffer dogs or rats, or potentially any other name or artificial odour-sensing systems.

The REST concept was originally conceived and developed in South Africa. First used to detect explosives and weapons in confined units—cars, containers, houses—the system was adapted by Méchern, a South African demining company, for detecting landmines and UXO. Originally known as the Mechern Explosives and Drugs Detection System (MEDDS), it has since been given many names, although the official name in the demining arena today is REST.

Méchern used REST extensively in southern Africa from 1990 to 1996. Although not fully tested and verified, REST was used to search for landmines on roads and routes in Mozambique and Angola and along power lines in Mozambique. At least some of these routes had been inadequately cleared using manual techniques. REST proved to be fast and efficient, eliminating vast areas of road much more quickly and cheaper than any other known technology. Justification of its efficacy included finding anti-vehicle mines in previously cleared areas. At least some of these projects were funded by the United Nations, suggesting considerable faith in the capability of the system at the time.

In the mid-1990s, the humanitarian demining industry was rapidly evolving and there was a strong push towards increasing the speed and efficiency of global demining. It is thus surprising that a field-tested system that apparently offered both of these objectives remained isolated and essentially unknown in southern Africa. Despite its potential, REST cannot yet claim to have had a significant impact on the global demining process. On the contrary, it is fair to say that it has almost slipped into obscurity, as at the time of writing it is not being used operationally anywhere in the world. In early 2003, just four organizations had capacity for mine detection using REST. Two of these are research centres and have never undertaken operational demining, although REST offers both of these objectives significant potential for the future. Of the other two, Méchern is using its REST capacity to support a research contract, and Norwegian Peoples Aid (NPA) is rebuilding its capacity after the program had difficulties in 2002.

The Geneva International Centre for Humanitarian Demining (GICHD) runs a multi-disciplined program of research and operational support aimed at improving the overall quality of mine detection.
FEATURE

Mine Detection Dogs

The Journal of Conventional Weapons Destruction, Vol. 7, Iss. 1 [2003], Art. 1

Remote Explosive Scent Training

An animal is a complex detector that responds to a variety of substances (whether in a filter or elsewhere), some of which the trainer may be unaware of. A recent example: Mechem dogs trained on "pure" TNT responded to DNT at very low concentrations. Some researchers believe that an animal sensor relies on extensive practice and carefully constructed training schemes; it is impossible to guarantee that the animal sensor will detect exactly what we believe it has been trained for. The flexibility of animal detectors during the learning process imposes severe constraints on procedures for sampling, transport, storage and training—requiring rigid standards applied manuscript micromanaging those found in a sterile laboratory environment, double blind testing, standardised handling of all targets and carefully applied internal controls. Artificial analysis procedures do not have the same degree of flexibility, recognising traces of individual substances and degradation products more precisely than animals, although the requirement for similar laboratory standards may still apply. There are, however, no artificial chemical detection methods that can compete with the detection thresholds of dogs or rats. In simple terms, it can be said that animal detectors are sensitive but unreliable whereas artificial detectors are more reliable but less sensitive. "Reliable" here, is used in a limited sense to mean accuracy of detecting target odours. It remains to be seen whether artificial odour detection technology offers the same operational reliability as animal sensing systems.

Promising artificial detection systems currently under development include the Nominacs Fido Detector (USA) and the Bio-sensor (Sweden). Gas Chromatography-Mass Spectrometry analysis process when examining the components of REST. However, the analysis process depends on availability of a sensitive sample of high quality, suggesting the need for quality sampling procedures, quality equipment and an understanding of the effects of the environment on the sampling process.

Filter Properties

A good REST filter must adsorb molecules during sampling and desorb molecules during detection (analysis by animal). Filter design must optimise the balance between these two requirements. It is generally believed that the highest adsorption of target molecules is achieved when collecting particles rather than gas, in relation to varying circumstances as environmental conditions. Using complementary artificial detection, we may be able to identify clues that generate false indications by animals. We may further be able to link the availability of different substances to situations where the target substances may be missed, which is an essential objective in any calibration process. Of all the many technology options "developed for demining purposes", it is notable that the only device currently in regular use in minefields today is the simple metal detector. Minefields are routinely found in remote locations where artificial devices lack the mobility to respond adequately or to remain in place during adverse environmental conditions can be extreme. The need for similar detection technology with high reliability is imperative under such conditions. The requirements simplicity and reliability impose strong challenges on artificial odour detectors. For example, it is impossible to use the RBF concept also removes some of those requirements, because the detector is separated from the difficult conditions found at the minefield. If artificial detection systems ever achieve the detection capabilities of animals, the first direct competition could be in REST detection centres. On the other hand, it is also at such centres that the two technologies might first be used in a complementary way.

The Sampling Process

It is easy to ignore the sampling process which is a key part of REST. In some operational situations, the filter must tolerate long-time storage prior to detection testing. Some of these desirable properties are contradictory; and the optimal filter design must be found through balancing competing requirements. Testing of artificial detection materials has recently been undertaken by the Swedish Defence Research Agency (FOI) in Sweden and APOPO in Tanzania. APOPO tests compared detectability of explosive odours on the Mechem filter as a standard, with other filters, using rats as the detector. Results were similar to or better than the Mechem filter for all but two of the materials tested. The filters developed by FOI are primarily for research applications, and are unlikely to be used for operational detection in minefields. They offer the advantage of being tested using laboratory equipment such as the GC. Most or possibly all of the filters tested by APOPO were of commercially available materials that are not designed to be used in the GC—although extraction of explosive molecules should be possible from some of them. It was suggested at the workshop that "the Mechem filter works, so there is no need to develop alternative filters." This argument has some merit, although the cost of the Mechem filter—about $100 (U.S.), regarded by some as cheap and others as expensive—was a significant factor influencing APOPO's search for alternative filter materials. It may be that almost any filter material can be used when sampling is undertaken under optimal conditions, but conditions are not always ideal, and optimising filter quality could maintain detection reliability under sub-optimal sampling conditions. Different applications might allow different materials to be used. APOPO's application is for research—filters are tested within three hours of being produced and are immediately discarded. In this application, there is no requirement for long-term storage or multiple testing, which are two benefits of the Mechem filter.

Sampling Units

Sampling machines were originally integral units on mine-protected Casspir vehicles. The suction unit was in the vehicle and flexible tubes with filter holders where threaded through a channel system and lowered to the ground in front of the vehicle. The tubes were pulled back into the vehicle for every filter exchange. This design provided a safe operator platform, but the trade-off was limited control over the sampling zone, which was restricted to the immediate front of the vehicle. In response to this problem, portable backpack suction units with handheld flexible tubes were developed, allowing broader ground coverage, but introducing the risk of requiring the operator to walk through the minefield. On this note, the operator were able to walk in the vehicle tracks provided by a Casspir. However, this option is unlikely to support minimum safety requirements in heavily vegetated terrain, potentially restricting the application of REST technology for area renovation. Certainly, new concepts need to be developed for obtaining effective samples from open terrain while ensuring the safety of the sampling personnel. This issue requires further consideration and development.

The portable backpack suction device is a small two-stroke petrol engine (modified from a Husqvarna unit) driving a small pump. Results from testing by APOPO suggest that exhaust may cause contamination problems if the sampler does not move consistently upward. Constant machine juddering, high maintenance and the need to keep fuel and filters separated are other negative factors. An alternative battery-driven pump has been trialed by FOI and APOPO, but the trade-off is increased weight, short battery operation and long change times.

Remote Explosive Scent Training

Casspir with an integral sampling system, used in Germany. The filter cartridges are seen hanging to the front of the vehicle. This is safe for the operator but limits control over the sampling zone. Portable sampling units are used instead to ensure suction from vegetated areas.

• APOPO has started trials of different filter material. Seven different materials have so far been tested. The results show that satisfactory scores on all parameters. More testing is required to determine the full potential of these and other materials.
units are cleaner and quieter, but the disadvantages are likely to restrict their use for operational demining. If the sampling unit is mounted on a vehicle, then the vehicle compressor (which supplies power to the air brakes) could be used to power the pump. This option has been used in the past by Mechem for some applications.

There have been suggestions that under at least some conditions, a pump is unnecessary. Wind action and convection could bring enough molecules to the filter for detection to be successful if the filter is placed in the minefield for some period. A development of this possibility, a passive sampler, was demonstrated by IVEMA at the REST workshop. The principle remains unproven, but tests will continue.

Suction Pressure and Sampling Technique

Mechem originally decided to use a pumping rate of 60 litres/minute, based on the concept of emplacing all the air from a car in a short amount of time so that the car could be raised for explosives. Although this suction rate apparently gives effective filter samples (using the Mechem filter), higher or lower suction rates could give even better samples. Higher sampling rates allow the vacuum operator to move at a quicker pace, and/or change filters more frequently. Possible disadvantages are blow-through of target molecules (molecules passing through the filter without being trapped), and clogging in dusty environments. Lower sampling rates will likely have the opposite effects. Clearly, there is a need to optimise the relationship between sampling vacuum rate, sampling efficacy (which may vary with filter design) and the advantages of collecting dust.

Work with free-running dogs shows that a dog can miss mines if its nose is too far away from the mine during the search. It appears that under at least some conditions, the detectable plume of scent over a mine is small and localised. Mine detection using REST may therefore require that all ground be covered by the vacuum operator in much the same way as in the nose of a field search dogs covers all the ground. Apart from the obvious safety implications of such a requirement for the sampling process, using artificial scent and different filters can be used in different conditions or in different ways to optimise the sampling process. These issues need further research.

Sampling Conditions

It is known that variability in environmental conditions affects detectability of mines for animal sensing systems working in the field.5 It is sensible to assume that the known environmental effects on direct animal detection will similarly affect filter detection. Research undertaken for the GICHD by NOKSH in Bosnia (using dogs) supports this contention, with lower humidity at the time of sampling producing higher probabilities of detection. APOPO has similarly found that lower humidity gives better detection (using rats). One hypothesis is that sampling during dry conditions facilitates a higher rate of collection of dust particles, which has a greater impact on the quality of the sample than collection of air. Surprisingly, preliminary analysis of the Bosnian data set did not show any effect of temperature on detection probability, apart from decreasing detection probabilities at ambient temperatures below about 15°C at the time of sampling. The analysis is not yet completed and more research is planned.

Vegetation

The possibility that vegetation in the sampling area affects the quality of the filter sample has been much debated, but remains unexplored. Mechem's field experience suggests that vegetation has a positive effect. Vegetation potentially acts as a reservoir for explosive molecules, which are attached to leaves (particularly on the underside where they are protected from the sun). The vegetation may filter wind-blown molecules out of the air, or molecules could be taken up through the roots and deposited on the leaves during transpiration. Wind-blown pollen may also carry explosive traces. More research is needed to fully understand the importance of vegetation as a reservoir of target molecules. The results could significantly alter the way sampling is undertaken in the future.

The Analysis Process

The analysis process involves two central components—a training program for the detector and a testing concept. Both of these components vary among the four organisations currently training REST detectors. NPA originally developed REST detectors, but has recently modified its approach to the system developed by NOKSH. Unfortunately, to date, the only one of these training and operational concepts that has been formally documented in a way that is accessible to the demining community is the NOKSH program. At the time of writing, REST dogs were about to be accredited in the United Kingdom (although not for mine detection), but again no documentation of the training program or use concept for those dogs is available. Thus, understanding of the use of animals for REST detection is improving, but this knowledge is not generally being formally documented in an accessible way. Only limited comments on training issues can be made here.

Training Issues

Animals are good detectors, but they require careful tuning and calibration. Having produced the detector, maintenance of its skills is important. Clues are difficult to optimise detection, even if de-recognition mistakes are made. The animal needs full attention to the details of its operational use, including internal QC to monitor its reliability. Mistakes during training or testing could introduce ‘clues’ that tune the animal onto different scent. The word clue deserves further explanation. In this context, a clue means an aid that the animal uses to identify target filters. A clue can be a scent, the lack of scent, an unconscious signal from the handler or simply a non-random placement of filters in an analysis array. An animal will use any clue to aid filter detection, even if detection mistakes are introduced by doing so. Similar training or some research conditions (where the odour on the filter is known), such mistakes are likely to be treated as false positives. In some conditions of treatment and operational testing, it will probably be necessary to treat such mistakes as true indications. Clearly, the testing procedure must be rigorously designed to eliminate any possibility of clues. Independent laboratory analysis (using artificial detection procedures) can also support clue identification.

An alternative mistake is that positive filters are neglected (missed) by the animal. Such mistakes may be because of inadequate availability on the filter, or the sensory threshold of the animal, because of factors affecting the sampling process (see above), or because the detector is not working to peak performance (a training problem).

REST for Area Reduction

Two tests areas (in Angola and Tanzania) have been undertaken under a GICHD sponsorship to facilitate investigation of area reduction applications. A similar test field has been prepared for similar purposes in Croatia by Nomadics (with Mechem support). The two African test fields have the same general layout. To prevent cross-contamination between boxes with landmines, the minimum distance between mines is 35 metres. Testing is currently being undertaken in both locations to determine the potential of REST for area reduction.

Size and shape of the plume put up by a mine are the central issues being addressed using these test fields. Large plumes (or plumes that increase in size over time) mean that REST sampling may have to be rather coarse-grained (each filter
Environmental factors during sampling
- Continue sampling in test fields under different environmental conditions to determine the full environmental effects on detection.
- Investigate whether some filter options may work better under certain conditions than others.
- Investigate the effect of vegetation.
- Investigate the leakage (flow) rate from landmines and use this information to determine the potential for vapour detection.

Training
- Document and compare training test results to determine optimised training solutions.

Analysis—environment
- Determine the effect artificial modification of temperature and humidity in the analysis environment has on detection.
- Examine all aspects of the environment to identify potential clues that may jeopardise the analysis process.

Analysis—testing
- Identify procedures to provide effective internal controls on the detection process.
- Further develop and test filter handling procedures to ensure optimal testing.

Table 1: Areas needing further research before REST can be considered proven.

<table>
<thead>
<tr>
<th>Filter</th>
<th>Sampling machine</th>
<th>Sampling technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimise the filter to allow highest desorption during sampling.</td>
<td>For some applications, develop a low-weight battery-driven sampling machine with long operational time and easy charging.</td>
<td>Undertake tests to determine the most reliable sampling technique(s). Develop a new sampling concept for area reduction that will ensure quality sampling and high safety for the operators.</td>
</tr>
</tbody>
</table>

Table 2: Alternative routes to establishing a REST analysis capacity supporting demining operations.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>No need for demining organisations to develop costly and difficult analysis capabilities</td>
<td>Logistical burden in transporting filter cartridges (internationally)</td>
</tr>
<tr>
<td>Quick response time (need only to establish sampling teams initially)</td>
<td>Demining organisation has little/no control of the analysis process</td>
</tr>
<tr>
<td>Higher cost effectiveness</td>
<td>No global analysis concept in place</td>
</tr>
</tbody>
</table>

Table 3: Issues for future consideration if REST is to be established on a broad or global scale

<table>
<thead>
<tr>
<th>How big is the market and how many analysis capacities are required?</th>
<th>Who should undertake the analysis?</th>
</tr>
</thead>
<tbody>
<tr>
<td>The market will depend on the adoption of REST. If REST can be used for accurate area reduction, there is potential for a relatively large market.</td>
<td>There are currently four organisations involved in analysis of REST filters for humanitarian demining: NPA-Angola, NORD-Norway, APOPO, and Mechem and Meshem South Africa. Preliminary arrangements could be made with these four organisations. There may be more organisations with an interest in becoming centralised REST analysis providers.</td>
</tr>
</tbody>
</table>

REST Research Challenges
The REST workshop aimed first to identify areas requiring further research, and second to establish a forum for exchanging ideas and information between people involved in REST at all levels. Delegates included researchers, dog trainers, operational and management demining personnel, and equipment manufacturers. Discussions centred on three themes, each addressed during one day: equipment issues, training issues and operational applications. Table 1 presents summaries research objectives from different areas needing further attention before REST can become a proven area reduction alternative.

The Future of REST
The future of REST relies on proving the technology and facilitating its use.

How can the analysis centres be ensured to avoid potential routes to failure if REST is to gain ground in demining? There are pros and cons (Table 2).

Setting up sampling teams is relatively easy and could be done efficiently by most demining organisations. It is, however, unlikely that the industry itself will develop centralised facilities for analysis of filters. A range of questions will first need to be addressed, some of which are listed and discussed in the Table 3 below. These points go beyond the issues discussed at the workshop in Tanzania, and are prospecting, being raised as issues for future discussion.

<table>
<thead>
<tr>
<th>How can the analysis centres be ensured to be established on a broad or global scale?</th>
</tr>
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<tbody>
<tr>
<td>The market will depend on the adoption of REST. If REST can be used for accurate area reduction, there is potential for a relatively large market.</td>
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Who should undertake the analysis? There are currently four organisations involved in analysis of REST filters for humanitarian demining: NPA-Angola, NORD-Norway, APOPO, and Meshem South Africa. Preliminary arrangements could be made with these four organisations. There may be more organisations with an interest in becoming centralised REST analysis providers.

Who will test and accredit these organisations? There is a need to ensure that the same standards are followed by all organisations involved in REST. Each analysis centre must be accredited on a regular basis. Criteria for the accreditation process will be required. An impartial accrediting body must be identified.

How can the demining community be ensured of a high-quality analysis process? A QA system of the analysis process will be required. This could be a responsibility of an objective independent institution. Alternative QA measures could be developed to ensure a system of cross-check filters between centres and the operators.

How can the analysis centres be ensured to avoid potential routes to failure if REST is to gain ground in demining? There are pros and cons (Table 2).

How to train demining organisations to carry out quality sampling, storage, transportation and filter shipment?

There will be a need to train demining organisations in correct sampling techniques and to take environmental conditions into account. It is further important to develop a recording and logistics system. This will also require some training.
The K9 Demining Corps in Lebanon

by Amy Eichenberg, Program Manager, K9 DC Campaign

Lebanon’s Landmine Problem

Lebanon suffered 15 years of civil war from 1975-1990. Warring parties used landmines extensively to consolidate defensive positions along lines of demarcation. Unfortunately, many of the mined areas were neither marked nor recorded. Following the war, engineering units of the Lebanese Armed Forces (LAF) began to execute reconnaissance operations to gather information about minefields and to conduct a program of mine clearance. Eliminating the landmine threat was a slow and laborious process, as the LAF had limited resources and training for the task. While known and suspected minefields did not appear to severely impact socio-economic development within Lebanon, the fields of “hidden killers” have continued to threaten the population, inflict death and injury, retard development, restrict movement and discourage the return of internally displaced and refugee populations. Over the decade following the civil war, the LAF reportedly cleared 315 known minefields, but so far remained.

The Process

Perry Berlinly, the Executive Director of MLI and Paul Brown, Canine Specialist from Global Training Academy, which main working dogs and handlers, conducted a study on behalf of the Office of Humanitarian Demining Programs at the U.S. Department of State to determine the suitability of mine detection dogs (MDDs) in Lebanon. The study found the climate, culture, terrain and threat suitable for the work of dog teams. The high metallic content of much of the soil in affected areas made it very difficult for manual deminers equipped with metal detectors to work effectively and efficiently. The borders of minefields were ill defined, placing a premium on technologies that could assist in area reduction. Local populations were fearful of using previously cleared areas without a system of quality assurance (QA). The LAF had experience in the use of working dogs. K9s and veterinary care were immediately available, making Lebanon an excellent candidate for an indigenous MDD program.

Following a visit to Global Training Academy in Texas by the President of Lebanon’s National Demining Office, the Lebanese government requested dogs for its demining program. MLI immediately added Lebanon to its list of target countries for the K9 Demining Corps (K9DC) Campaign. This campaign seeks to develop an indigenous MDD capacity in severely affected countries by combining resources of the U.S. government, host nations and private donors. This process results in the deployment of certified dogs bonded with local handlers and local equipment to the minefields and mine action programs.

MLI received private funds to purchase, train and deliver six MDDs to Lebanon through a donation from the Humpty Dumpty Institute (HDI) in New York, HDI a non-profit organization, was founded in 1998 to create dynamic public-private partnerships to confront global challenges, specifically the international fight against landmines. After three months of training in Texas, Lebanon, MLDs, and handlers traveled from worksite to worksite with an assigned group of manual deminers permanently affiliated with the dog teams.

Accomplishments

The MDD teams have participated in demining projects throughout Lebanon. At first, the dogs began work in the Bekaa Valley and southern Lebanon, which suffer the most severe contamination. The teams worked an area in the western Bekaa known as Lucy’s Farm. This area had been previously demined and was optimal for animal grazing or farming, but the local population was afraid to use the land.

Thanks to the Marshall Legacy Institute (MLI), dogs are playing a large role in the demining of Lebanon.

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Mine Detection Dogs

Once the MDD teams conducted their searches and verified the areas as mine free, the land was quickly returned to productive use. Another project in the area was a Muslim cemetery that had also been mined. The dog teams searched and cleared this land, which was of immense value to the community. Delisting the land mine-free allowed the local population to begin the process of returning to normal life.

The dog teams conducted QA operations and verified that a schoolyard was mine-free. This has alleviated the fears of many parents and allowed the children to play soccer at school for the very first time.

The dog teams have also been very useful in assuring safe roads around Lebanon. The dog teams cleared areas around from Madgara to Jezzine. The landmine contamination of the road forced local populations to take long detours; hence, travel from the south of the western Bekaa Valley to the Lebanese coast was severely limited. Now the people and goods can easily and safely travel from the Valley to the coast.

Working with a full and manual deminers, the dog teams cleared a narrow road used by many shepherds to bring their flocks to the grazing. The road had been mined since the civil war, and there had been three AT mine incidents. Since starting work in September of 2002, the teams have cleared parts of 11.22-km AT mines but nothing intact.

The dog teams have been given increased responsibility. The primarily agrarian town of El Khiam is heavily dependent on their local reservoir. This reservoir is to be linked to a larger water project that will supply water to many people throughout southern Lebanon. When landmines were identified in the project area, dog teams and mechanical equipment were dispatched to eliminate the threat. Because of environmental considerations, the full could not be used. The dogs were not only tasked with the QA measures but with landmine detection as well. The dogs successfully completed the project in September 2002, and work has resumed on the Khiam water project.

The MDD teams have also provided great assistance in a U.S. Agency for International Development (USAID) project to upgrade a reservoir in the small village of Announ. Three AT mines were found in the reservoir and work was stopped. The dogs cleared a path instead of the reservoir and over the reservoir floor. Working with a full, over 2,500 sq. m were cleared without finding another landmine. The USAID project has started again.

These are only a few of the numerous projects the MDD teams have participated in from July 2001 through October 2002.

Challenges

The MDDs in Lebanon have met and overcome a number of challenges. Many of these challenges also apply to manual deminers. One is the extreme daytime heat in the summer. The dogs must begin work at first light, usually 5:00 to 6:00, and finish by 10:00 or 10:30 when it is too hot for them to continue. The hotter weather in autumn allows the dogs to work extended hours.

Much of the area in which the dogs must work is covered with thick brush, heavy vegetation and prickly thorns that impede the ability of the dogs to sniff the ground methodically. The U.S. government and RONCO Consultancy Corporation have introduced a mechanical tool to remove the vegetation and facilitate the work of the dog teams.

The MDD teams have also faced behavioral and health issues. Scooby had to undergo extensive remedial training, and sadly, had to pass away from cancer in December 2001. Ben and Rex replaced Scooby and Ben. In early 2002, Lebanon suffered a period of long and intense rain that severely limited the dogs’ ability to do their work. Extensive precipitation and moisture wash the explosive scent deeper into the soil, making it difficult for the dogs to detect the odor. However, once the storms subsided and the land dried out, the dogs returned to business as usual.

There has been an evolution in the methodology of the dog teams working with manual deminers. Initially, the dog teams worked from a Lockheed Martin (L3) worker, while the manual deminers trained to work with the dogs remained in place. A more efficient method was to assign the same group of manual deminers to the dog teams permanently. This greatly reduces the amount of training that manual deminers have to go through to work with the teams. The deminers are more comfortable and familiar with one another, allowing the mine detection process to perform at its optimal level.

While there was a reasonable comfort level in the LAF in working with dogs, it was necessary to build confidence among the LAF leadership and establish that the MDD teams perform tasks beyond QA. Many leaders were initially uncomfortable in relying on the dogs for landmine detection but, with their demonstrated performance, the dog teams have earned the trust of the LAF and are now allowed to perform a variety of roles, as indicated in the Khiam water project.

Conclusion

The MDD teams in Lebanon have proven to be an essential component of the national demining process. Through May and June 2002, the teams searched and cleared nearly 75,000 sq. m of land, allowing the local population to lead normal lives. The dogs are an integral part of the project, much like the livestock in agrarian societies. The dogs have greatly increased the safety of the local farmers and work crews and the MDDs have been able to work more efficiently. The teams have been very well received by the farmers and the security sector.

As a result, we decided to start from scratch. We also concluded that we would open our minds, cease old patterns and traditions from our minds and looking separately at our goal: ‘Find the mines!’

With experience from training EDDs within the Danish Police Force, we were capable of setting up a dog training program. We had several middle goals:

• Produce a Mine Rescue Team (MRT) for the Danish army to use in international operations
• Produce MDDs for work with NGOs
• Build up a Danish MDD capacity to support all NGOs and armies
• Build a Dog Section in the company with:
  • MRTs
  • MDDs
  • EDDs (for sale and use in our own operational teams in the security business)
• Drug detection dogs (DDDs); for sale and for use in our own operational teams in the environmental business
• Other special dogs on request

We wanted to be able to assist our customers with MDD teams consisting of one dog handler and at least two different types of MDDs; one search dog, which is capable of searching boxes on a long leash, and one special MDD, which searches straight ahead of the dog handler on a short leash. Beside these two types of MDDs, we train free search dogs, which are capable of searching boxes without a leash or with a flexible leash. These free search dogs are capable of searching at a relatively high speed.

Danish Mine- and Explosive Ordnance Disposal (EOD) Technicians (DANMINAR A/S), a company based in Denmark, provides various types of training for dogs in locating such things as bombs, drugs, mines and more. This article outlines their history and progress in the field of detection dogs.
Have We Achieved Our Goals With the MDDs?

Yes, but we had to change our course in the middle of our schedule. The requests for box-type MDDs were increasing, and we have now established the necessary level to make us ready for international operations. On the way, with our open minds, we also had to admit that doing things only one way is not the way to tackle problems. One dog was capable of receiving one set of training programmes, but another dog would not receive the same programmes. This meant that we had to have several training programmes for different types of dogs, different senses, different breeds and so on. The senior dog training adviser had to be able to direct the right way for each individual dog at an early stage but also able to adjust to another programme if the first chosen seemed to be wrong.

We must say that we have had great success with this concept, and it seems that it will bring good results in the future. Which training is the best is always open to debate, and we welcome anyone to come and participate in our training programmes, if just to benefit the quality of MDD work worldwide.

Within the special detection dog community (MDDs, EDDs, DDRs, etc.), there is also debate on contamination of explosives from other explosives, vapor bone penetration of different materials, the need for live mines in training and much more. Anyone is more than welcome to come to our facility and have a look at how we train our dogs, keep our explosives, consider contamination problems, etc. We train our EDDs on all commercial and homemade explosives known to man except for CL-14 and special military sheet explosives.

Another part of the MDD concept is that DANMINAR brings in the dog handlers from the Scandinavian Armed Forces and Police Force. All of our MDD handlers are fully educated in mine clearance, and they all have several years of experience working in foreign countries with MDDs. This assures the customers that the teams actually operate on a highly professional level, making things much easier because the MDD handlers are acquainted with the special way of life, working for a long period away from home, often under very poor conditions. It takes a special breed to be able to work out of a tent camp in the bush somewhere on the African continent for three to four months without any possibility of having frequent contact with your loved ones.

Have We Achieved All the Goals We Started Out With?

Not all of them, but we have come a long way, and we have established our dog facility to an acceptable level. This facility continues on page 89.

Mine Detection Dog Program: The Cambodian Experience

by H.E. Khem Sophoan, Director General, CMAC

Background

The MDD Program was first introduced at the Cambodian Mine Action Center (CMAC) in late 1996, three years after the establishment of the CMAC institution. The aim of using MDDs has been to fill a technical gap within CMAC in order to accelerate mine clearance progress. Integrated training for both dogs and Cambodian handlers started in January 1998. Technical experts from the Swedish Armed Forces conducted the training, and the MDD program at CMAC became operational in June 2000, starting with two teams.

Why MDDs?

Experts would agree that MDDs are extremely sensitive in detecting tiny pieces of explosive material—TNT in particular—and ignoring non-explosive metal. The primary purpose of using MDDs at CMAC was to locate and define the boundaries of minefields. This is known as area reduction. Our experience over the last five years or so has proved that MDDs are more effective than manual clearance in areas with heavy laterite or hard ground, areas where metal fragments are scattered abundantly, or places where deeply buried mines are suspected. The dog team has a big advantage over the manual demining teams who are using metal detectors to locate mines. The dog uses his sensitive nose to locate explosives, while a metal detector will find any piece of metal, which then has to be treated as a potential mine. The consequence of this is that time is wasted in investigating pieces of metal that can turn out to be anything from nails to spent bullets. When MDDs mark a spot on the ground, there will always be explosives nearby.

Organization of MDD Teams

An MDD team at CMAC consists of a supervisor and an assistant, six dog handlers, six close markers taking care of any brush cutting or any demining with metal detectors, and three drivers who also act as medics if needed. This gives one CMAC MDD team 17 personnel.

Method

The method for working with dogs is both easy and hard. The easy part is to teach the dogs to find the smell of TNT, a substance found in mines and IEDs. This is quite similar to the way we use narcotic dogs and other sniffing dogs. The hard part is to be able to read the smallest sign the dog sends out. When dogs sense the smell of TNT, they will sit or lay down to show their handler that there is an explosive device near by. This is called marking. It was developed for Cambodian conditions, and it gives the handlers control over their dogs at all times.

Core Activities of MDD Program at CMAC

Currently, three main activities are carried out within the MDD project: training, operations and veterinary services.

Training

MDD training is conducted at the CMAC Training Centre, located in Kampong Chhnang province, 50 km northwest of the capital, Phnom Penh. CMAC is committed to a sustainable training program to support MDD operations for both expansion and replacement purposes. The program’s MDDs mainly come from Germany and Sweden.

MDD Operations

At present, CMAC deploys five MDD teams—two teams each in Battambang and Rattanay Meanchey and one team in Pursat. Another 35 or so dogs are currently being trained with plans to increase the capacity of CMAC’s MDD program to the strength of seven teams by the year 2005.

In operations, MDDs have been deployed to support manual demining in...
Assuming the National Ownership

After nearly six years of administration by Sweden, the MDD program was finally handed over to the CMAC on Saturday, 14 December 2002. This was another positive step toward a greater national ownership of the management process for CMAC. The national staffs are now taking full ownership of the program, from managing the dog training program to conducting operations in the minefields. Unique to the MDD program is also the fact that it is a program that allows Khmer women to work in field operations as dog handlers. Thanks to the Swedish government’s invaluable contributions, this project has been successful.

Challenges in Managing the MDD Program

We have to acknowledge that we are also facing difficulties while we are running the MDD program. For example, the limited facilities and skills within the veterinary services. The following are urgently needed:

- Lab (Diagnosis)
- Surgery expertise
- Autopsy
- X-ray and MRA
- Pharmacology

Though MDD teams have been remarkably successful, they could not do so without the support of the mechanical brush cutter. The nature of vegetation in Cambodia makes it difficult for MDDs to even access the minefields. The condition of the tropical weather also makes MDD teams quite costly to operate. As mentioned earlier, all MDDs are bought from European countries, where dogs are used to a colder environment. In Cambodia, we need to have the proper equipment, such as a cooling fan for the doghouse during the night and umbrella to shade the dogs while they are resting during operations, as the weather is quite hot in this country.

All in all, MDDs are obviously being seen as an important tool in demining by working in cooperation with the mechanical brush cutter and integrating

Mine Detonation Dogs

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Mine Detection Dogs in Denmark

Mine detection dogs are called DANMINAR Dog Training Centre and is located in Denmark, approximately 50 km west of Copenhagen. At the training centre, six people are working to train MDDs, explosive and weapon detection dogs and DDDs. We train approximately 15 MDDs, five to eight EDDs and four DDDs per year. The EDDs and DDDs are mostly used by DANMINAR’s own search teams, which operate all over the world at security jobs, etc. But EDDs and DDDs are also sold as fully trained dogs with the training of dog handlers to governmental organisations all over the world. In total, we now have more than 20 fully trained dogs of different types, all ready to go to work or to be sold.

As DANMINAR, we still consider ourselves beginners in this business, and we do welcome any information or help that we can get. We do believe that this business is too important and dangerous to let commercial issues get in the way of developing better and safer ways to free the world of the landmine problem. Even if we (the dog training companies and organisations) do share all the jobs in the world, we still cannot manage to solve the problem within the next 100 years.

So folks, lets cooperate!
Mine Detection Dogs

With its Mine Dog Centre in Pretoria, MineTech International has begun a two-year program to assess the potential of the Dreser for development as an alternative breed for mine detection work. The programme has been initiated by the Geneva International Centre for Humanitarian Demining (GICHD), which has provided six dogs for the project. The study involves keeping detailed records of all areas of the Dresers' development process to identify both the positive and negative aspects in training these dogs as mine detection dogs (MDD). The project began in October 2002, and although it is still in early stages, some interesting observations are emerging. Hugh Morris, Operations Director at MineTech, looks at some of the processes and progress of the study to date.

Mine Drill for Drovers

by Hugh Morris, Operations Director, MineTech International

Introduction

The Dreser is a relatively new breed of dog, dating back to the early 20th century. With its relatively short physique, short legs, big body and strong build, it is perhaps at first glance not the most likely candidate for the role of mine detection. Not so; there are real benefits to sourcing a smaller, trainable, portable, logistically efficient dog. The Dreser's size and shape is what the GICHD called "the answer to Dyck's [Project Manager for MineTech] prayers." Bred from German Dachshunds and Danish Steddhusfræ, they are also known as the "cooler-Swedish Dachshunds." However, its cousins are Basset, Beagles and Dasch, and not only do they make excellent family pets, but they are also reliable hunting partners with a finely honed sense of smell. Dreser or "to hunt" in Swedish, is what the Dreser does best, tracking hare, fox and occasionally deer, with the courage to pit himself against wild animals, including the wild boar.

Our dogs arrived directly from Sweden, and as part of a system whereby each new litter is named in alphabetical order, this group landed the letter “e”—appropriately enough for their designation, "experimental." They had originated from three different litters.

The oldest, Edward and Einstein, were born March 29, 2002. Elvis and Eddy on July 7, and the babies, Eric and Ernie, arrived on July 19. The dogs are all males, and with other breeds we have achieved excellent results with both males and females, so there is no reason to believe that Dreser females will not perform to a similar standard.

Acclimatisation

For dogs that had to travel from Sweden and then face exposure to a totally new environment and climate, they were not abnormally stressed or nervous. They settled down quickly getting used to a new home, environment and handler. Einstein was the only dog with early problems, initially losing weight after not eating for the first few days. The dogs are weighed on a daily basis with their weight progress analyzed at the end of every week. This weight management programme monitors whether or not the dogs are growing at a satisfactory rate, are medically sound and are adapting to their new environment. After the first few days, all dogs had gained weight and continued to grow steadily on a high-protein diet similar to Ekabarka. Initially fed twice a day until they reached six months, they now get one main feed on average for a 16 kg dog.

The Dresers also receive medical check-ups on a daily basis to ensure they are medically fit at all times, but also to ensure we understand when they are ill and know whether this is a factor in limiting progress with their tasks. These medical check-ups are of vital importance to us and, at the Mine Dog Centre, are carried out from birth right through the socialising, training and operational life of the dog. All the daily checks are recorded in the "dogs' log book", alongside all other aspects of the dog's daily performance.

The crux of MineTech's mine dog training involves three key processes—socialisation, retrieval and agility. The programme has developed through years of dog handling and training the young dogs to react at a specific task. Since 1998, 62 German Shepherds, two Labradors and 16 Malinois have qualified through this regimen, using different conditioning techniques to suit the temperaments of each dog. There are five key characteristics that will make a dog perform well in a minefield: a high motivation to please the dog handler, high ball drive, excellent focus on work, stable temperament and good adaptability. Our programme is designed to both assess and develop these fine key proiciencies.

Socialisation

Once the dogs had settled in, they were exposed to a variety of positive influences as part of a socialisation period to better equip them to deal with the outside environment. Socialisation minimises the chances of a dog getting disturbed by unfamiliar sights and sounds, and means which they will adapt more easily and be more focused on their duties which are coming into the minefield. Our aim at the Mine Dog Centre is to rear and socialise the Dresers into well-balanced adult dogs who are confident, responsive and able to concentrate on their work.

The Dresers have been progressing through a series of socialisation trips, similar to the activities given to other dogs. They are exposed to a range of experiences—people, traffic, different environments and locations, gamihs, obstacles, shopping malls, etc., and each of the dogs has progressed well and continues to improve.

Retrieving or Ball Drive

Retrieving is an essential part of the whole programme since it is the retrieval or ball drive of the dogs and the motivation for retrieving that generally determine whether they will be suitable for use as future demining dogs. Our dogs are assessed initially on their enthusiasm in playing with a ball or a retrieval object. This is called a long, it is made of rubber and very chewable. Once we notice that a dog has a high drive to play with the ball, the ball is tossed further and further away for him to collect and return to the handler. Gradually, the game starts to include small tasks for which the puppy is rewarded with the ball on successful completion. As the programme progresses, the dogs are assessed and played with on different terrains, but the long or retrieval object remains the same.

It is essential throughout that the dog workers to please his handler as well as to gain a reward. At the Mine Dog Centre, we believe that the praise and attention the dog receives after each successful exercise must be on the same level as the reward. Praise and attention introduce additional motivations, and these are used to direct the dog into other activities. For example, in agility training, dogs that clear an obstacle successfully become more and more motivated if they are praised and rewarded at the end of the exercise. Reward through play is a major motivator for every dog and produces a high level of trust and a strong bond between each dog and his handler.

Dogs that have no “ball drive” in the early stages of socialising very quickly fall by the wayside as the training programme progresses. Although it is possible to teach some dogs how to retrieve, our findings show that dogs that have to be taught the retrieval skill do not have the same output or drive as dogs that do it naturally. As a result, we do not commit resources to teaching a dog ball drive, since experience shows they will fail when it comes to performance in the field.

Agility

The agility tests are important in that they allow us to focus closely on the differences in character among the dogs. Over time, they have all shown more confidence and are more aware of their own physical abilities. Our studies have proved that agility can be seen as a stepping stone to a more mature and confident adult dog, and a dog with this confidence will find it easier to adapt to new environments and different circumstances. To date, the Dresers have responded well to agility training, and there are no apparent differences here among the Dresers themselves or between the Dresers and other breeds.

Findings

It is still early in the study, but already we are gathering some positive results. The Dresers are no longer as dependent on each other as they were upon their arrival in South Africa. We are now giving them more time to themselves and have already seen, through this process, that the dogs have learned individuality and confidence. We continue to monitor their progress.

The dogs are responding well to both the socialisation and agility programmes, which play a very important role in the development of a dog's character. Most importantly, retrieval or ball drive in the younger dogs is proving to be as high for the Dresers as it is with the German Shepherds and Malinois. Edward and Einstein, however, are not achieving the same standard as their younger cousins. The two older dogs showed no retrieval progress at all, and at this point, we can only conclude that this was because they had not been exposed to the programme from a sufficiently early age. The pair only receives now and then and for very short sessions. What is interesting

Continued on page 95
Mine Detection Dogs: An Integral Tool in RONCO Mine Clearance Operations

Mine detection dogs (MDDs) have become an important tool to maximize operational efficiency in many programs across the globe. For about 15 years, RONCO has been one such organization. This article describes the role of MDDs in RONCO’s operations.

by RONCO

Introduction

Brenda sits, alerting her handler that she has located the training mine. Her handler retrieves a red rubber ball from his pocket, throws it, and praises Brenda after she has chased it down and obediently returned to her position. Brenda is easily satisfied with the positive reward she receives; her handler, Janice Josopick, is pleased with her performance over the past week of refresher training. He trusts her keen ability to detect mines; she trusts him to lead her to the lane and care for her after a long day in the field. Together, RONCO’s bonded MDD team of Brenda—a Belgian Tervuren (a cross between a Belgian and German Shepherd)—and her handler, a Level 2 trained dog handler—work all over the world, preventing injuries and fatalities from landmines and UXO.

In the past, the team has deployed to the Balkans, Cabo, Namibia and Afghanistan to tackle mine clearance tasks. However, their most challenging is their most recent deployment in mine-laden Afghanistan, where the RONCO MDD teams searched more than two million square meters of land in Khost and Uruzgan in the past year. During their deployment, Brenda and Jano—along with RONCO’s other 15 MDD teams—were overwhelmingly successful in a country often considered to be one of the most dangerous and severely mine-infested in the world. For example, while verifying the clearance of an area near Kandahar Air Base allegedly free of mines, Brenda detected the presence of an explosive device that had previously been overlooked. With her highly sensitive and well-trained nose alert to the mine, thus precluding any chance of tragedy and safeguarding U.S. soldiers stationed at the air base.

An Integrative Approach

Brenda and Jano’s success over the past six years, working at challenging tasks such as their present one in Afghanistan, results from both the precision of MDD training techniques and the integration of MDD teams into demining operations. Beginning in the late 1980s, RONCO and its partner, Global Training Academy (Global), developed an innovative and highly effective method of detection, clearance and verification of minefields that is still used today. By integrating MDDs into clearance operations, RONCO quickly developed the capacity to vastly increase productivity in the field, and more importantly, to prevent the risk of casualties to deminers. The integration of MDDs into mine clearance and quality assurance (QA) tasks has evolved into an industry-standard method of demining, making RONCO a leader in the innovation and design of MDD programs. RONCO began incorporating dogs into demining operations in Afghanistan in 1989, following the departure of Soviet forces. In a country highly burdened with landmines, a trained dog’s sharp ability to pinpoint and alert handlers to the locations of mines, as well as the speed with which it can cover large areas of ground, became a valuable asset to manual demining teams.

Utilizing the dogs’ fine-tuned skill set of shortening mines and integrating the dogs into manual demining operations proved to be a highly accurate, safe and cost effective development in humanitarian demining. Today, some 15 years later, trained and experienced dogs like Brenda are still the most precise method of mine detection.

A Tested and Proven Technology

In 1995, the U.S. Army conducted a field test to assess the value and accuracy of 30 detect demining technologies, including RONCO’s Global MDDs. In the assessment, dogs were deployed to test and quantify the performance of 10 different types of mine detectors, including ground-penetrating radar. In March 1997, RONCO participated in a joint demining project in Mozambique and conducted its first demining operation in Afghanistan in early 1999. After the fall of the Taliban, the demand for precise and reliable technology increased, and RONCO’s team continued to expand its expertise in mine clearance.

Ronco’s MDD Programs

MDDs alone, however, are an insufficient approach to humanitarian demining. Rather, it is their integration with manual and, when possible, mechanical mine clearance operations that is the most effective employment of MDDs and a fundamental feature of RONCO’s programs. With more than 14 years of training and field experience, RONCO has used dogs in countries including Croatia, Kosovo, Albania, Mozambique, Namibia, Rwanda, Eritrea, Azerbaijan, Lebanon and Afghanistan. As a result, RONCO has developed the rehabilitation centering technique, an integral component of RONCO’s mine clearance “tool kit.” Currently, RONCO is employing MDDs for clearance projects in seven countries. The impact of MDDs on demining can be seen in the following examples.

Demining of the Sena Railway Line in Mozambique

In 2000, RONCO began providing on-site technical support and assistance to the Mozambican National Institute of Demining (IND) under the U.S. Department of State (DOS) Office of Humanitarian Demining Programs. RONCO’s Mine Action Support (IMAS) contract. In total, RONCO has employed 12 MDDs in support of the IND. In efforts to locate and demine demining areas in Mozambique, the IND quickly charged RONCO with its highest-priority task: the clearance of UXO and mine clearance around the Sena Railway Line. Despite severe flooding and extreme working conditions, RONCO continued mine clearance operations in this major task throughout 2001 and 2002.

In comparison with 2001, in 2002 RONCO experienced ideal weather conditions for demining on the Sena Railway Line. With successful coordination of the demining teams, optimal productivity from the MDD teams in the field and minimal mechanical downtime for the two machines being employed in this task, considerable progress was made towards completing the railway clearance. The integration of manual, MDD and mechanical methods of clearance proved to be extremely effective during these operations.

RONCO teams in Mozambique cleared over 450 kilometers of railway line in support of the Sena Railway Line Rehabilitation Project, as well as over seven million square meters of ground in other areas of Mozambique. Clearance of the railway line was completed in September 2002, some six months ahead of schedule. Clearance and QA operations on the rail, in addition to cleaning construction access routes to the railway, enabled contractors working to restore the railway line to rebuild five railway bridges and multiple water drainage channels. As a result, the railway line will be extended an estimated 15 kilometers and extended from Beira to Mocuba, will be completed sometime in the spring of 2003, some 20 years after the railway was closed. Demining and reconstruction of the Sena Railway Line, which runs through Mozambique’s economic heartland, will have a significant impact on economic development and job creation; it has already produced jobs for some 150 Mozambicans employed by the rehabilitation project.

Integrating MDDs Into Demining Operations in Afghanistan

In 1989, RONCO created the African Mine Detection Center (AMDC), an Afghan non-governmental organization (NGO) with 92 MDDs and about 270 Afghan employees. Although RONCO completed its fieldwork on the AMDC in early 1994, the Center continues to operate effectively today; currently it comprises 144 dogs teams, including an experienced and highly skilled breeding program and support staff. The entire UN demining effort in Afghanistan.

In 1993, RONCO-trained teams found 22,000 mines and UXO in Afghanistan, more than one-fourth of the 80,000 pieces of ordnance destroyed under UN auspices worldwide that year. More recently, RONCO deployed 11 staff members and eight MDD teams to Afghanistan in support of the U.S. Army’s effort to clear landmines and UXO at Bagram and Kandahar Air Bases, key footholds for Operations Enduring Freedom and Iraqi Freedom in the aftermath of the September 11th terrorist attacks on the United States. By the end of the 2002 Afghanistan deployment, the total number of personnel peaked at 35 staff members providing on-the-ground technical oversight and 16 MDD handler teams conducting clearance and QA tasks. The MDD teams deployed by RONCO consisted of highly experienced dogs (including Brenda) and their Bowman handlers (including Jano); most had been working together between four and five years and had previously worked in widely varying areas, including Bosnia, Azerbaijan, Kosovo, Namibia and Guanararamo Bay, Cuba. Due to their success, the U.S. Army has brought the RONCO teams back to Afghanistan for a second following a two-month break over the worst part of the Afghan winter.

As noted earlier, over two million square meters of land were cleared from Bagram and Kandahar Air Bases, from the Afghan National Academy in Kabul and from other, smaller areas around the country in 2002. Over 100,000 mines and UXO were located and destroyed during these operations, most of them being detected behind flail operations.
significant number of AT mines; however, were detected ahead of the trials, since small operators, when processing land suspected of containing AT mines, requested that the MDD teams proceed to them to minimize possible damage to their equipment.

**Partnering With MLIs in Eritrea**

In 2001, RONCOO began providing assistance to the Eritrean Demining Program (EDP) by establishing an MDD capability to support mine decontamination objectives. In addition, RONCOO participates in the Marshall Legacy Institute’s (MLI’s) Mine Detecting Dog Partnership Program (MDDPP) in Eritrea. This program combines the resources of the U.S. and Eritrean army headquarters independently in the field with periodic resupply, maintenance and supervisory visits from Eritrean army headquarters. The MDD section supports the demining platoons in their survey, clearance, and QA operations.

In June 2002, the EDP assigned the RONCOO team to the MDDPP section to clear a site vital to the local agricultural economy and to the resettlement of internally displaced persons (IDPs) in the area of Temestep, the Survivable Demining Tractor and Tools (SDTT) and the BDM-48 conducting demining operations in both the wet and dry seasons. The development of a fully integrated humanitarian demining capability is a significant and noteworthy accomplishment for TMAC, considering the extent and severity of Thailand’s landmine and UXO problem, particularly along its border with Cambodia.

TMAC is faced with the daunting task of both creating an effective humanitarian demining program (to date, two HMAs are in operation). It has begun manual demining and a fourth was recently established and conducting field integration and training, mechanical equipment training and trials, and local clearance operations in high priority areas. TMAC is also charged with quickly and effectively transforming mine- and UXO-contaminated farmlands to productive fields in order to resettle IDPs and ease population pressure along the border with Cambodia. This land, furthermore, is mostly highly fertile latosol soils that are both heavily contaminated with metal (particularly in areas previously used as refugee areas for the Khmer Rouge and other Cambodian resistance groups) and landmines, such as French and/or British types.

In all of the above examples, the success of RONCOO and the host country is due to the integration of MDD programs into manual mine clearance operations. These programs are even more effective when combined with both manual and mechanical operations, bringing the full range of clearance technologies to the task of clearing landmines and UXO from economically important, but denied, lands.

**Conclusion**

Brenda sits again, alerting Jano that she has found another training mine. Just days after a week-long trip to the United States where they were honored as Mine Detection Dog Team of the Year at the Champions for Children Awards and Benefit Gala, Brenda and Jano are both re-acclimated to the terrain and environment of Afghanistan. The May 2002 event was co-hosted by MLI and the U.S. Fund for the United Nations Children’s Fund (UNICEF), and honored other mine action pioneers, including Queen Noor of Jordan, Senators Chuck Hagel and Patrick Leahy, and America Online (AOL) Chairman James Kimsey. Of the award recipients, Brenda and Jano are, by far, the closest to the action. Both have spent the majority of their time over the last six years in landmines, dedicated to the removal of landmines in mine-affected countries.

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**Mine Drone for Drovers continued from page 91**

in general about the successful dogs is that the motivation for the retrieval behaviour appears to be different from other breeds. From a young age, they appear to be motivated to complete the task for themselves—no attention-seeking behaviour is present. This may explain why there is more of a problem in getting the Drover to work for his handler without becoming distracted by things, which can be seen as total normal for his genetic makeup. If a bird flies close by while the Drover is working, the Drover will lose focus on its task immediately and switch attention to the bird. A dog such as a Kooiker or Malinois is much more focused on the issue of whether or not he is pleasing his handler. With the Drovers, a dog bred to hunt, the motivation is clearly very different.

Operationally, however, the Drover does have other key advantages. One is size and weight, which results in less ground pressure, minimizing the chances of detonating a landmine, although it remains to be seen whether the size of the dog will be a problem when working in difficult terrain such as long grain. Size is also a factor in mine hunting. The small size of the dog means that it can be flown round the globe as hand luggage or excess baggage, whereas other dogs would be limited to the cargo section.

Time will tell whether the Drover will be able to translate many of its inherent skills and characteristics to play an integral part in mine action. We do expect to see some of these dogs in the demining field, but it is still too early to say which dogs will be successful.

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*All photos courtesy of MineTech.*

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The GICHD has recently published a number of studies on a wide range of mine action topics. One of these publications was an evaluation of the Operational Demining Capabilities Detection (OMCD) project. The study found that implementing operational demining capabilities detection systems would have a significant impact on the rate of demining in the desert. The study also identified potential areas for improvement in terms of the efficiency and cost-effectiveness of the disposal process.

In addition, a study on the use of Unmanned Aerial Vehicles (UAVs) for mine detection was conducted. The study found that using UAVs could significantly reduce the time and cost required for mine detection in certain areas. These studies are important for improving the effectiveness and efficiency of the mine action process.

The GICHD is also developing a new operational demining capability detection system. This system will allow for the rapid assessment of minefield conditions and the identification of potential areas for further investigation. The system will be based on a combination of remote sensing technologies and ground-based surveys.

Overall, the GICHD is making significant progress in improving the efficiency and effectiveness of the mine action process. These studies and new technologies are essential for achieving the goals of the Convention on Cluster Munitions (CCM) and the Convention on the Prohibition of the Use, Stockpiling, Production, and Transfer of Chemical Weapons (CWC).
**NOTES FROM THE FIELD**

**Sudan**

Preliminary planning for mine assessment and clearance is in an advanced stage and funding is required to proceed. A team of technical and operational liaison experts has been established and $1,894,000 is now required to open a key logistic route. The explosive detection dog (EDD) evaluation/coordination area in Kadugli is complete. A small team of Kosovo Albanian deminers has been temporarily deployed to establish the EDD teams to Abyei. There, while local personnel are being selected and trained, Danish Church Aid (DCA) was successfully accredited as a mine/UXO clearing organization and licensed to conduct operations on January 9, 2003.

**UNDP Updates**

**Albania**

Demining activities in Albanian wound down in December 2002. A planning group met on November 28, 2002, to review the current strategy and make plans for 2003. The following are the development objectives for 2003:

- Complete the impact surveys in and around Paleshe, where the Albanian border meets the Montenegrin border, by June 2003. This will complete the impact surveys started in 2002.
- Complete the technical surveys by November 2003, which will release an estimated six million square meters of land.
- Clear an additional 500,000 square meters of land.

Demining activities will resume in March 2003, beginning with a refresher training course. Clearance activities for 2003 will require $5.42 million.

**Ethiopia**

In December 2002, the Ethiopian Mine Action Office (EMAO) deployed two newly trained civilian demining companies to conduct survey, marking, clearance and mine risk education (MRE) activities. The companies were in support of the Emergency Recovery Project (ERP), which is funded by the World Bank. EMAO is currently finalizing its contract with the World Bank for 2003. The funding will support the four demining companies that currently work in the country and enable EMAO to field rapid response teams and establish a national QA capability.

Also in December, the United Nations and the government of Ethiopia launched an appeal for assistance in dealing with a major humanitarian crisis facing Ethiopia: the ongoing widespread drought. 20 percent of the population has been identified as being at risk of food and water shortages. The drought impacts mine action efforts because the displacement of the affected population is significantly slowing down manual clearance operations and exacerbating logistic/transport problems.

**Bosnia-Herzegovina**

UNICEF continues to support its three-year mine program (2002–2004), targeting 600,000 children between the ages of five and eight in pre-schools, primary schools and secondary schools. The program is working on three levels:

1. technical support provided to the Bosnia-Herzegovina Mine Action Center (BHMAC) to ensure the effective coordination of mine programs with national mine action plans;
2. the use of mine action experts for mine programs in collaboration with the Ministries of Education and the development of community capacities to maintain an adequate level of mine awareness.

Additionally, the Italian government has recently pledged €500,000 to UNICEF for its Mine Injury Prevention Program in Bosnia-Herzegovina.

**Grenadiers**

A survey on mine victims has just been completed. A team composed of the staff from the Ministries of the Interior and Defense has now been trained on victim data analysis and mine risk assessment. Furthermore, UNICEF has deployed a TA to build the technical capacity of five national bodies, enabling it to implement MRE at national levels.

**The DRC**

The UNICEF Country Office has started recruiting a TA for the period of February 8 to March 16, 2003. The role of the advisor will be to identify and prepare project proposals regarding the UNICEF Country Office's role in mine action programs. The United Nations Humanitarian Coordinators for Refugees (UNHCR) and the MCC are currently working on an MRE project for Angolan refugees living in the DRC who should be repatriated to Angola in 2003.

**Ethiopia**

UNICEF continues to support the development of EMAO, working closely with UNDP Engagement with a national NGO, the Rehabilitation and Development Organization (RAOD), is under review, as the focus is now on support to the government. Discussions on how best to move the RAOD Regional MRE network in the Tigrai region toward EMCA responsibility are ongoing. Funding is urgently required to support EMCA capacity building.

**Guatemala**

UNICEF has been updating IMSMA and indicator’s reports on a monthly basis. A study that aims to identify inequalities in terms of gender, socio-economic status and health status among landmine survivors’ families is being developed. Also, UNICEF recently opened three counseling centers to provide support to landmine survivors.

**Iran**

UNICEF has recruited a consultant to develop in MRE programs. Contingency planning is ongoing. In 2003, UNICEF will work through the government and the Islamic Red Crescent Society to ensure that the situation of a crisis in the region, refugees would receive effective MRE at the border and in the camps.

**Sudan**

The United Nations Mine Action Office (MAMO) is working with host countries to enhance its mine action programs and to improve specific activities, and the community liaisons will be the Victims of Mines and Landmines Association (VMA) and the Anti-Mine Committees (AMC).
News from the OAS

This article highlights recent news from the Organization of American States (OAS) Mine Action Program.

by Whitney Tolliver, MAIC

Success in Costa Rica

Since 1996, the OAS Mine Action Program has assisted the government of Costa Rica in its efforts of mine clearance, mine risk education (MRE) and victim rehabilitation. On December 10, 2002, the country became the first in the Americas to officially declare itself free of AP mines. Mine contamination within the country had been concentrated primarily along the northern border as a result of the conflict in Nicaragua. Costa Rica itself has never produced, imported, stockpiled or used AP mines.

Initiating the demining program proved to be difficult due to an absence of maps illustrating the mined zones in the country. Costa Rican local authorities and OAS officials estimated that a total of 5,000 AP mines possibly littered the ground. This figure was later reduced with the help of the Inter-American Defense Board and local civilians in order to define three main contaminated areas: Alajuela, the Upala border and Guanacaste.

The clearance operations experienced a few temporary delays due to a lack of funds in December 2001 and an inconsistent availability of air medical evacuation support. Once operations resumed, Costa Rican democrats were able to extract 338 AP mines and pieces of UXO in the marked areas, declaring the country mine free.

Costa Rica ratified the Ottawa Convention in 1999, and with mine clearance complete, has accomplished its goal well in advance of the treaty deadline.

Donor Contributions Make Mine Action Possible

With the increased demand for assistance in humanitarian demining in the Americas and other parts of the world, the OAS Secretary General Celso Gavia hosted a donor conference on October 17, 2002. The event detailed the work of the OAS Mine Action Program and thanked donors for their support.

The conference resulted in a positive outflow of continued contributions by donor governments. Norway donated $475,893 (U.S.) to assist programs in Honduras and Guatemala; Italy contributed $52,000 for demining operations in Guatemala, Honduras and Nicaragua; and France committed $75,000 toward a program to rehabilitate landmine victims. The most recent approximation of donated sums totals $1,508,000 from the governments of France, Canada, Brazil, the United States and Norway. This follows contributions of more than $24.5 million by 17 different countries since 1998.

The OAS uses donor funds to finance modules of operations in recipient countries. The modules are divided into six-month time frames and cost approximately $350,000-$450,000 each. Currently, the OAS Mine Action Program is running modules in Honduras, Guatemala, Peru and Ecuador; and three operational fronts in Nicaragua. With only two more six-month modules, the OAS believes the government of Honduras will be able to declare the country a "landmine-free zone" this year.

The OAS also hopes to implement a new demining program in Colombia this year. The modules, however, are expensive and the OAS Mine Action Program

Continued on page 103

The Survey Action Center

The Survey Action Center (SAC) serves as the executing agency for Landmine Impact Surveys (LISs), which will allow for greater prioritization of demining efforts and further integration of the various mine action sectors.

by David Hartley, MAIC

Background

The Survey Working Group (SWG), which consists of leading international NGOs and UN agencies in mine action and the Geneva International Centre for Humanitarian Demining (GICHD), created the Survey Action Center in 1998. The SWG asked one of its members, the Vietnam Veterans of America Foundation (VVAF), to serve as fiduciary and management body for the SAC. At the end of 2001, the SWG authorised the creation of an independent Board of Directors. The SWG retains the advisory body for SAC.

The SWG is responsible for the protocols that have been established through the SAC that define and maintain the high international standards of the LIS. The goal of an LIS is to provide information in order to improve priority setting by donors and mine action agencies.

Operations Update

In Africa, SAC's surveys are progressing as planned. After completing an advanced survey mission in Angola, Mike Kendell and Bob Eaton—the Director for Survey and the Executive Director, respectively—met with various mine action leaders and representatives to discuss plans for the survey.

As a follow-up, Mr. Kendell returned to Angola in December to draft survey implementation plans with UN and NGO partners for the LIS. In addition, the director of the National Inter-Sectoral Commission for Demining and Humanitarian Assistance (CINDAH) signed a letter voicing support for SAC's operations. The German government is funding this preliminary phase of the LIS.

The data collection itself will take approximately 10 months to complete. SAC is working with the Danish Demining Group (DING) and Norwegian Peoples Aid (NPA) and Ethiopian Mine Action Office (EMAO) to organize and conduct a survey in Ethiopia. Three field offices have been established for the implementation of the LIS. (1) Mekelle in the Tigray region, (2) Dire Dawa in the Somali region, and (3) Arwas in the southern region. Also, interlocutor recruitment and training commenced recently, and the first batch of results from the Expert Opinion Collection have been delivered. Final arrangements (permissions and logistics) are being made with the communities selected for the pilot test.

At the end of February, SAC's survey of Somalia was completed. Of December, 238 communities had been surveyed, including the Sahel region and all accessible districts of the Togdheer region. Security concerns in the eastern Soel region that borders Dandalk had temporarily halted data collection, but a complete assessment of the security situation and its impact on the survey was completed in early January. To date, LIS have also been completed in Chad, Mozambique, Thailand, Yemen and Cambodia.

In Ethiopia, SAC is providing technical and training support to the UN-sponsored LIS, which is being implemented through the Ethiopian Solidarity and Cooperation Association. Senior staff training by the SAC team was conducted in December, and Expert Opinion Collection is in progress. The start of data collection is scheduled to begin in April and continue throughout the end of June 2003. A team consisting of Ted Paterson, Sito Sekkines and Greg Wicaksono was in Sarawao for the Task Assessment and Planning pilot project. These individuals brought valuable and varied experience to bear on the issue of task selection within high- and medium-impact communities. Alaisir McAlster from Cranfield Mine Action (CAM) was also involved during this time to begin work on the strategic-planning module of the survey.

Acknowledgements

Much of the content and data in this article was provided by the Survey Action Center. To learn more, visit their website at www.sac-na.org.

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https://commons.lib.jmu.edu/cisr-journal/vol7/iss1/1/1
Canadian Centre for Mine Action Technologies

Funded by the Canadian Landmine Fund, the Canadian Centre for Mine Action Technologies (CCMAT) works with Canadian and international organizations to enhance the mine action community. To date, they have tested and evaluated a number of new widely used pieces of mine action equipment as well as researched new technologies to further develop demining technologies.

by Susanna Sprinkel, MAIC

Introduction
CCMAT was established in 1998 at the Canadian Forces Base in Suffield, Alberta (Canada). Their mission is "to contribute to the development and deployment of low-cost, sustainable technologies for mine detection, mine neutralization, personal protection and victim assistance." In its first five years, CCMAT has become a valuable resource for testing and evaluating the development community's newest technologies. So far, they have collaborated with Canadian industry on a number of different projects.

Product Testing
One of the most important functions of CCMAT is to guide Canadian companies through the process of developing mine action technologies. This element includes setting up and carrying out a means for effectively evaluating equipment throughout its development. As a result, a company is able to weed out inefficient equipment or to improve their designs at an early stage, saving both time and money. Initial testing and evaluation by CCMAT is conducted at three main sites: the Mine Effects Site, the Mechanical Equipment Site and the Mine Detection Test Site. Previous activities include the development of the Promac Brush Cutter and Deminer (BDM48), the Mechanical Reproduction Mine (MRM), the Binary Explosive Fixor (FIXOR), and the Niagara Foot.

Orthotics Limited (NFO), the Niagara Foot is an injection-molded prosthetic foot that is less vulnerable to failure from fatigue than other prosthetic feet. This product has been tested by mine victims in Thailand, where results gathered by survey have reported that the Niagara Foot is not only easy to use but also requires little muscular exertion, thus enhancing mobility in the opposition leg. For more information on the Niagara Foot, visit http://www.promac.bc.ca/.

Mechanical Reproduction Mines
Produced by Amtech Aeronautical Limited, the MRM has become a valuable tool at CCMAT and other demining organizations for testing mechanical equipment and training deminers. For more information about the MRM, visit http://www.amtech-group.com/.

Binary Explosive Fixor
Since its development, FIXOR has been used in major demining operations throughout the world. This binary explosive consists of two non-explosive elements that can be mixed together to form an explosive immediately before being placed next to landmines/U/OXO. Because FIXOR includes two separate non-explosive elements, it can be carried on commercial aircraft, making it more readily available than alternative solutions. For more information on FIXOR—produced by MIREL Specialty Explosive Products Limited—visit http://www-lived.com/.

Niagara Foot
Developed by Niagara Prosthetics and Promac Brush Cutter and Deminer
The BDM48 uses a revolving drum to clear heavy vegetation, tripwires and most mines, preparing an area for manual demining. Through extensive testing, the BDM48 has demonstrated more power than previous brush cutters and has become a valuable tool in clearance efforts in Thailand. For more information on the BDM48—developed by Promac Manufacturing Limited of Duncan, British Columbia—visit http://www.promac.bc.ca/.

Research & Development
Aside from testing and evaluating mine action technologies, CCMAT also has an extensive research and development (R&D) program carried out, in part, through contracts. Ongoing R&D projects include the use of hyperspectral imaging for aerial mapping of minefields and for detecting tripwires, the use of ground penetrating radar (GPR) and thermal neutron activation in mine detection, the development of a sonar device for underwater detection, and the development of an instrumented prodder that can differentiate between rock and metallic/plastic objects, thus reducing false alarms. Additionally, CCMAT has been researching the influence of soil conditions on metal detectors in order to enhance mine detection. Protocols for many of these research projects have already been developed and are currently being tested at CCMAT facilities. Full reports of these projects can be found under the Technical Reports section of the CCMAT website (http://www.ccmat.gc.ca/).

Hyperpectral Imaging
Hyperpectral Imaging can help identify potential mine-affected areas during the area reduction survey process. The Compact Airborne Spectrographic Imager (casli), developed by Irres Research of Calgary and Defense Research and Development Canada (DRDC-Suffield), was able to detect surface-laid mines obscured by vegetation but has been less effective in identifying buried landmines. Consequently, CCMAT is researching the use of short-wave and thermal infrared wavebands for detecting buried targets.

Ground Penetrating Radar
In the past, GPR has only been effective in detecting large AT mines. As a result, CCMAT has been researching the necessary factors for identifying AP mines through GPR. These factors, including sensor height, polarization, soil type, surface roughness and variation in soil water content, are being investigated by Sensom and Software, Inc. of Toronto in an attempt to enhance current GPR technology. While technology is proven effective, CCMAT will use the results of these studies to develop a handheld or small robotic vehicle-mounted GPR sensor.

Sonar Detection
Currently, a parametric sonar detection device is being developed by Gauges International Limited in order to detect landmines/UOX in flooded minefields and economically important canals and waterways. Initial trials indicated that this technology could detect munitions buried in up to 30 cm of sediment and 75 cm of water.

Protective Footwear
In order to better protect deminers from mine blasts, CCMAT and collaborating organizations have been researching enhanced protective footwear. To test this footwear, they are developing a surrogate leg and a numerical model that mimic the response of a human leg to a mine blast. The aim is to develop protective footwear that prevents catastrophic injury from the most common AP mines.

References
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continues to search for more funds to fulfill the needs of the affected countries. To sum, an estimated $8 million is needed to sustain the program this year.

Nicaragua Completes Mine Awareness Campaign
On October 31, 2002, the Nicaraguan government, in collaboration with the OAS Mine Action Program and the United Nations International Children's Emergency Fund (UNICEF), completed a major mine awareness and MRE campaign in the department of Nuevo Segundo. Much of the effort was led by two Nicaraguan landmine survivors who actively promoted the program.

The campaign emphasized the solicitation of information from local inhabitants about the location of mines near their homes. As a result, more than 400 mines and pieces of UXO were able to be located and destroyed.

References

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Use of Mechanical Equipment in Mine Clearance

In recent years, mechanical equipment has become more and more prominent in demining programs around the world. This article provides an overview of mechanical demining equipment and highlights the involvement of the Geneva International Centre for Humanitarian Demining (GICHID) in promoting such equipment.

by Johannes Dirscherl, GICHID

The Mechanical Demining Equipment Catalogue

In 2002, the GICHID published the first issue of the Mechanical Demining Equipment Catalogue. The purpose of this document was to provide the international demining community with an overview of commercially available equipment. The list of available equipment was based on documentation provided by manufacturers, test reports provided by independent sources and subject lessons learned in the field. A section on each machine attempted to broadly state an opinion on the capabilities and restrictions of each piece of equipment.

In February 2003, the second issue of the catalogue was published. Several new pieces of equipment were added, and almost every manufacturer reported the latest version of their machines. The catalogue is available in hard copy, on CD or on the GICHID website (see contact information below).

The Necessity of Mechanical Equipment

Mine clearance programmes are based mainly on manual demining—a slow, dangerous and work-intensive method. The use of mechanical clearance equipment is increasingly becoming acceptable to the demining community. The main roles for mechanical devices include area reduction and ground preparation. The cost-effectiveness model developed by the GICHID allows programme managers to utilise mechanical assets to their fullest operational and, therefore, cost-effective potential.

In July 2002, the GICHID published the study "Mine Action Equipment Study of Global Operational Needs." The purpose of this study was to examine the effects of technical equipment improvements on the productivity of demining programmes. One of the major conclusions is that the effective determination of the outer edge of mined areas is of predominant importance for increasing productivity. It is generally acknowledged that sustained acceleration of this process is possible only if dogs or mechanical clearance equipment is used.

Limits of the Currently Available Mechanical Equipment

The productivity of a piece of equipment is directly related to its size. The larger a piece of equipment, the greater its potential productivity. Yet the size of a piece of equipment goes together with critical logistical and, therefore, financial implications, which may negatively impact cost-effectiveness.

Flail Systems

Flail systems are commercially available in various sizes. They are the most common demining vehicles in the world. Their usefulness for ground preparation and vegetation clearance is beyond doubt. Yet their capability of clearing mines reliably is of good reason—the subject of intensive dispute within the demining community.

Agreement as to standardized and internationally accepted test procedures has not been reached. This struggle of philosophies may continue for some time. Regardless of disputed clearance performance, some systems can throw mines or parts of mines out into previously cleared areas, increasing the time required for the post-clearance confirmation process. The dust arising from the flailing process may considerably impair the maneuverability of the vehicle and may even cause serious technical problems (e.g., overheating) under specific operational conditions.

Tiller Systems

Tiller systems have evolved from forestry equipment. Depending on their configuration, they may even be used for soil with a high rock ratio. The clearance performance tends to be similar to flail systems. In order to withstand the detonation pressure from mines, the tiller drum needs to be relatively heavy. For that reason, the platform vehicle tends to be a...

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Group consisting of the government of Sudan, the Sudanese Red Crescent Society and two national NGOs. The term of reference for a needs assessment and analysis have been developed. The assessment will analyze at-risk groups and their locations. It will help focus MRE activities and will also strengthen the capacity of local national research institutions and will commence in the Nuba Mountains, Juba and Kasala state.

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Notes from the Field

The Demining Technology Information Forum (DTIF) organizes conferences and publishes proceedings and relevant papers in an effort to increase communication between users and developers of demining technology.

by DTIF

The primary aim of the DTIF is to create an opportunity for the research and development (R&D) community to exchange ideas and information on technology for humanitarian demining. However, the DTIF also gives the users community a chance to have their voices heard by the developers of demining technology and vice versa. The aim is accomplished through workshops with the proceedings published on the DTIF website (www.maic.jmu.edu/dtif)

The three DTIF workshops held to date have been:

October 6-8, 1999 - Workshop on the Uses and Development of Mine Action Technology, Vancouver, Canada, June 4-5, 2001 - Ground Penetrating Radar in Support of Humanitarian Demining, Italy, September 23-24, 2002 - 5th Symposium on Technology and the Mine Problem and from the 2nd Joint Australian/American Conference on Technologies of Mine Countermeasures, held in Sydney, Australia, 2001. These papers were re-published with the permission of the organizing committees, the objective being to expand the audience for the work among the demining R&D community.

DTIF has had considerable success with its workshops—one completed and more in the planning stages (one on detection of explosives and another, jointly with James Madison University, on mapping of mine affected areas). When the DTIF online journal (DTIF) was introduced, the editors intended it as a vehicle for the publication of solicited and unsolicited papers on the development of technology for mine action and experience with the use of technology in the field (lessons learned). To attract more high-quality papers on these and other related subjects, the editors are considering a hard copy version, possibly as a part of the Journal of Mine Action.

The website will be retained as the most appropriate vehicle for the publication of the proceedings of DTIF workshops and other mine action conferences.

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HUMAID’s Demining Efforts in Guinea-Bissau

Guinea-Bissau may not have one of the largest landmine problems in the world, but the lives of native Guineans continue to be threatened on a daily basis by landmines/UXO that remain from previous conflicts. This article highlights the efforts of the non-governmental organization (NGO) HUMAID, whose main objective is to keep working until Guinea-Bissau is landmine-free.

Bissau. An estimated additional 4,000 mines were planted in four areas in the south of the country. (These estimates do not include landmines and UXO left over from the War for Independence that ended in 1974.) Once the civil war was resolved in 1999, a group of seven military veterans trained in demining methods decided to form HUMAID, under the incentive and direction ofCanisius Elaine Grimmond. When Grimmond passed away later that year, former American Ambassador to Guinea-Bissau John Blacken was encouraged to take over her role as Administrator in HUMAID.

Getting Started

Upon taking on the administrative position at HUMAID, Blacken determined that the best way to receive donor sponsorship was to prove they could go into the field and get the job done. Working with Blacken's pickup truck and personal funds, the group set out to identify and mark mine-affected areas and to begin removing UXO in Bissau. By the time they received their first donation from the British government in May of 2000, HUMAID had removed 165 UXO and marked all minefields in Bissau, including four additional minefields south of the city.

With this grant from the British government, the NGO was able to recruit and train more deminers as well as purchase additional personal protective equipment (PPE). These funds lasted only a month and a half, but the group of HUMAID personnel was not discouraged and continued removing UXO from the city. They used radio broadcasts to advise civilians in Bissau to notify HUMAID of any known

minations in the area and were able to remove 508 UXO by November. Over the following year, HUMAID began securing a number of grants from the American, French, German and Swedish governments. Until December 2002, HUMAID was the only organization to conduct mine/UXO clearance operations in Guinea-Bissau. However, a National Demining Commission for the country was established in 2001. In the next year, they formed the NGO LUTCOM, funded by the United Nations Development Program (UNDP), LUTCOM and HUMAID have been collaborating on minefield clearance projects since December 2002.

Threat to Civilians

During the civil war, many natives of Bissau and surrounding areas fled their homes, returning to front-line backyards infested with landmines and UXO. Throughout their operations, HUMAID has found that a number of civilians have been storing these munitions in their homes, and many also have dangerous weapons in their backyards. Additionally, three teenage girls were killed when, in the mistaken belief that Howitzer warheads contain gunpowder, they tried to break open the warheads to obtain gunpowder for New Year's fireworks. As long as these landmines and UXO remain in the ground, the continuation to pose an imminent threat to civilians.

Design Priorities

Some mechanical systems are showing potential capacity as primary ground processors with minimal alteration to existing equipment, or as a support or a complement to the specified residual specific. Reaching a technological breakthrough is perhaps delayed by the lack of profitable markets for commercial manufacturers to explore. However, a system as near as possible to a "stand-alone system" is not far from being realized.

Supplementing an acceptable degree of clearance performance for various types of soil, the following characteristics are considered to be of primary importance in the design of clearance machines:

• Protection of the operator: Only if it is guaranteed that the operator is protected against detonation of an anti- vehicle or vehicle fragmentation mine will the use of the system in a minefield be considered acceptable. In this context, it needs to be added that remotely-controlled systems do guarantee the protection of the operator to a high extent. However, they also incorporate disadvantages. Due to the distance from the vehicle, the operator may not react adequately to undetected ground or other obstacles.

• Freedom: In most mine-affected countries, road infrastructure is limited. Weight and dimensions of the vehicle have to allow for transportation to remote areas of operation with limited logistical difficulties.

• Cost-effectiveness: Regardless of procurement and operating costs (spare parts, petrol, oil and lubricants (POL), required staff), the cost of clearing one sq m of land must be lower than the cost of employing other assets (manual deminers, mine detection dogs) with the same result in terms of quality. For mine owners, this inevitably requires continuous operation for as many hours as possible with as much area cleared as possible.

• Repair: The inherently high wear-and-tear effect on the equipment results in a high demand for maintenance. While the construction of the system needs to be solid and simple, it must be possible to repair and maintain it on site.

• Availability of spare parts: The availability of spare parts must be guaranteed. It is considered useful that the equipment is based on a commercial vehicle that is manufactured either in the country of operation or by a company that provides global parts service.

Use of Mechanical Equipment in Mine Clearance

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The Future

In the medium term, the GICHD believes that, given suitable topography, soil and mine type, machines capable of becoming "stand-alone" assets will become realized. While this may be so, for the foreseeable future there will be a need for at least some form of backup clearance system in support. The goal is that this backup system will be minimal, fast and highly cost-effective. It will be based on the known residual threat likely to be left by a particular machine. In most current installations, the combined applications of mine detection dogs, manual teams and machines in measures suitable to a specified environment will continue to provide the best results.

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The International Test & Evaluation Program

On 17 July 2000, Belgium, Canada, the Netherlands, Sweden, the United Kingdom, the United States and the European Commission (EC) signed a Memorandum of Understanding to form the International Test and Evaluation Program (IIEP) Germany became a participant on 14 June 2002. The following information was extracted from the IIEP website (www.itep.ws).

by IIEP

Organizational Structure

IIEP is managed by an Executive Committee consisting of one representative from each member, that reports to a Board of Directors. Administrative and technical support is provided by a Secretariat, currently hosted by the EC Joint Research Centre in Ispra, Italy. The Secretariat is the main communication channel and point of contact for those seeking information from or contact with IIEP. Points of contact for the participating countries are provided on the website and contact information for the Secretariat may be found at the end of this article.

Activities

A work plan, listing national and collaborative projects, has been prepared and published on the IIEP website. It is divided into six technical areas including survey, detection, mechanical assistance, personal protection, manual tools and decontamination. The lead nation and partners are identified for each project, and a timeline for completion is provided.

When IIEP was established in 2000, there were no universally accepted methods for testing and evaluating humanitarian demining equipment and systems. Individual IIEP participants were in the process of developing test methods that generate reliable, reproducible and statistically significant data. Under IIEP workshops are being conducted to review these national methodologies and identify universally acceptable test protocols for metal detectors and mechanical assistance equipment. A similar process is planned for personal protective equipment (PPE).

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Costa Rica: The First Country in Latin America Free of Anti-Personnel Landmines

On December 10, 2002, Costa Rica declared itself the first country free from anti-personnel landmines in the Western Hemisphere. Placed in hills and brooks, bridges and roads, mines and UXO were buried for more than 15 years during the conflict in Central America.

by Jaime Perales and Carl Case

Introduction

With the support of the Organization of American States (OAS), Costa Rican deminers detected and destroyed more than 338 mines on the border with Nicaragua, and cleared more than 130,000 square meters of land. As a result, formerly contaminated areas were rehabilitated as potential agricultural zones. There were no mine accidents, or 338 deaths, that we had the opportunity to prevent and this gives us satisfaction and pride," said Luis Alfonso Bornos, international supervisor of the OAS.

OAS/Mine Action began its work in 1996 with the government of Costa Rica in the areas of mine clearance, mine risk education (MRE) and mine victim rehabilitation. With the conclusion of operations, the government fulfilled its commitment to the Ottawa Convention, which stipulates the destruction of anti-personal landmines in approximately a ten-year period. Costa Rica signed the Convention in 1997 and ratified it in 1999.

Multilateral Cooperation Effort

OAS/Mine Action is a program created by the OAS at the request of its member countries. Apart from Costa Rica, OAS/Mine Action has programs in Honduras, Guatemala, Nicaragua, Ecuador and Peru. In collaboration with the Inter-American Defense Board (IADB)—military counterpart of the Inter-American System—the program has the following components: 1) humanitarian demining, 2) MRE, 3) mine victim rehabilitation, 4) stockpile destruction and 5) database and information systems.

The financial support of 19 donor countries has permitted the OAS to clear more than 1,400,000 square feet of land in Central America and more than 22,000 anti-personnel landmines. The total effort of more than $40 million (U.S.), channelled through the OAS for all Central America, has been key to finalizing mine clearance operations in Costa Rica.

The IADB has assisted in the training for demining operations since the creation of the program. To the present, this military entity has trained approximately 260 international supervisors from 11 member countries. International supervision coordinates more than 900 deminers placed in five mine-affected countries.

Mine Clearance in Latin America

The programs supported by OAS/Mine Action have different challenges, depending on the country. In Honduras, more than 220,000 mines have been cleared from the border with Nicaragua. In addition, some 2,209 mines have been cleared from the border with Nicaragua. In 1998, Hurricane Mitch caused flooding and mudslides, which have delayed operations. In spite of this setback, it is expected that demining will finalize at the end of this year.

Civil war in Guatemala lasted more than 30 years, leaving different types of UXO throughout the country. The UXO found in the affected zones includes homemade mines, booby traps and various types of grenades. There are an estimated 8,000 pieces of UXO in the country that are being located and destroyed systematically by three entities: volunteer firefighters, former members of the Guatemalan National Revolutionary Unit and the National Army. It is expected that operations will be completed by the end of 2004.

In Nicaragua, mines are scattered throughout the country, especially in strategic areas such as bridges and electric towers. Nevertheless, Nicaragua has reliable equipment and personnel (as well as a reliable infrastructure) in those areas, which have permitted a constant clearance effort. According to official sources, more than 65 percent of mines have been cleared and all mine stockpiles have been destroyed. It is expected that Nicaragua will be a landmine-free country by the end of 2005.

As a result of the 1995 conflict between both countries, Ecuador and Peru have more than 130,000 mines on their border. With more landmines than the four Central American countries combined, Peru and Ecuador have emphasized the need for mine clearance. The OAS has collaborated in the areas of technical training, supervision and stockpile destruction. The large

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by Dennis Barlow, Director

How many times have we been cautioned to bound valuable information; to share it only at the risk of watering down our organizational—or personal—power? Our altruistic inclination to give and (hopefully) receive information has all too often been beaten back by vague suspicions of those who may want to use our information as a way to marginalize us. Often times, this imperative is reinforced, if not indirectly, by our own organization. At the Mine Action Information Center (MAIC), we have tried to drive this awaveness down and deal in facts (to paraphrase Woodrow Wilson), "open information, openly arrived at." We were gratified at the directors’ meeting when someone from outside the mine action community (Niels Brandt of the UN High Commission for Refugees) suggested that the paradigm has now shifted. To share information in today’s world, he asserts, it is increase—not diminish—one’s power. It is through that helpful and re-emboldened lens that we would like to review two critical issues facing the mine action community—strategic planning and coordination. Both were raised at the recent meetings in Geneva.

Strategic Planning

The recent efforts, notably of Cranfield University and the Geneva International Center for Humanitarian Demining (GICHD), to apply a more structured and goal-oriented approach to mine action planning has resulted in a methodology that requires discrete and logical actions based on goals, levels of analysis and decision-making strategies. Each of these decisions—whether to determine objectives or tasks, analyze various courses of action, implement the plan or evaluate it—requires a different set of informational inputs.

Even more daunting, the information needed for each set of requirements will probably be vastly different. Some required data can be very technical in nature, such as soils taxonomy and landmine specifications. Other types of data will deal with economic factors including land use, environment, trade, markets and distribution of goods. Some necessary information will deal with societal considerations such as education, gender roles, and customs, while other phases of strategic planning will require information relative to other supporting agencies and organisations involved in work in the region. In other words, the need for accessing and properly using information becomes more critical as the necessity of strategic planning becomes more evident.

Reflecting on the information needs of a mine action strategic plan, it can be concluded that the requirements are much more complex than planning an event to be conducted by a very controlled organization (e.g., military operations) concerned with a short-duration event that ceased the evasion of mines with a specific task (e.g., capping an oil well). Even worse from the planner’s perspective is that mine action operations, which are diverse, often calling for capabilities residing in organizations that do not usually "play well together." A mine action campaign, therefore, should have a database to support phases over a considerable period of time, involve a number of unrelated functional specialists, support the well-being of all segments of a threatened region and facilitate the integration, or at least cooperation, of diverse—or perhaps even antagonistic—organizations. This last requirement quite naturally leads us to the second major topic of the directors’ meeting.

Coordination

The words communication, cooperation, coordination and collaboration cause entirely too much confusion in mine action. They should be used carefully and correctly. Anyone who employs these terms should be aware of the meanings and the contexts in which they are to be used. In this paper, the words cooperation, coordination, collaboration and communication will be used to denote different degrees of relationships.

Nevertheless, the concept of coordinating plans, and finding and utilizing congruencies both within mine action campaigns (internal coordination) and outside the realm of mine action (external coordination), has become a major discussion point within the humanitarian mine action community. Discussions about how to integrate the various functions of mine action as well as the advisability of "mainstreaming" mine action activities into socio-economic development plans are healthy—and critical—trends.

Mine action coordination requirements, just as with planning requirements, need more information and communications support than other more traditional coordination endeavors. Anyone with experience in the mine action realm is aware of the great diversity of functions found under the mine action umbrella. Bringing order out of that system of chaos is hard, especially given that in most mine action programs there is no single line of authority. When the activities of UN support, technical advice, training assistance, donor wishes, medical aid, bilateral agreements and a host country typically beset with...
many developmental problems, the goal of a unified approach may be more of a hope than a reality.

Furthermore, it becomes increasingly difficult when trying to effect linkage with external authorities. Communications with “outside” agencies usually involve talking with officials who do not understand the landmine issue, who do not comprehend what it could possibly do with them, and who would probably like to avoid at all costs dealing with an issue as volatile—politically as well as technically—as landmines. Officials who are responsible for humanitarian assistance actions, peacekeeping missions and development programs could potentially have a great need for integration with mine action activities, but they are not typically included in demining planning or informational distribution, nor do they, as a matter of course, initiate such coordination.

The Keys to Effective Information Sharing

Bringing about the kind of effective strategic planning and coordination that should be at the heart of many mine action initiatives is the problem touched on by Mr. Harlind at the Mine Directors’ meeting. Mine action practitioners must do a better job of identifying, processing and above all, sharing information. The following are common-sense guidelines that could take some of the sting out of information sharing and bring in a little daylight.

Be Proactive

I once had a boss who said, “When in charge, take charge! When not in charge, take charge!” While overstated, the idea of mine action planners taking the initiative in offering information-sharing techniques is right on the button. Whether a mine action organization is in the lead, in support or situated laterally in the organizational “wire diagram,” the important thing is to cast widely about you to find out who is involved. Even if the Ministry of Health, for instance, should be in charge of landmine casualty data, that fact should not preclude mine action victim assistance staff from visiting that ministry to discuss and decide on the preferred method of sharing information and helping reach an agreement on such a methodology.

Refine Information Needs

When “brokering” information, you should be willing to do two things. One is to have clearly in mind what information you need and would find valuable. Do not go on a fishing expedition and make potential information sharers suspicious by rooting around in their information treasure chest hoping to turn up a serendipitous gem. Asking for specific information needs will be the quickest and most professional way to get what you need. Conversely, if you do your homework and find out what information other organizations need, you may be able to create a “win-win” scenario by trading information that you need for information that someone else needs.

Use Common Platforms

One of the great success stories in mine action is the advent of the Information Management System for Mine Action (IAMS), an information software system that has allowed most of the mine action centers to interface in a practical and reliable way. For this, the mine action community (and the GICHD, in particular) should be lauded. However, this does not mean that the goal has been reached. The greater challenge remains of making mine action-related information interface with information systems utilized by peacekeepers, humanitarian organizations, host governments and commercially accepted electronic vehicles. The more related platforms mine action operators and managers can “talk to,” the more information they will be able to capture, share and process.

Keep It Simple

The world may be getting smaller, but it is not getting any simpler. Data measurement, data input, analysis, programming, etc., are skills that are still in great demand and are not accessible or sustainable in many parts of the world, including developed countries. Not only operators but also managers and, yes, even policy makers, are not necessarily capable of processing all the information that they see or are presented. Therefore, every form, every input mechanism and every display needs to meet the “Napoleon’s Corporal” acid test. There is an apocryphal story that Napoleon, before sending a message to his subordinate generals or field marshals would first have it read by a lowly corporal. If he understood the message, it was sent; if he did not, it was re-drafted. So it should be with all information systems. If they are not logical and as simple as they can be, they may be counterproductive.

Sandboxes are for Sand; Ricebowls are for Rice

Every organization seems to want to prevent others from encroaching into its area of interest, to maintain (ideally to enlarge!) its sandbox or protect its ricebowl. This zero-sum approach to mine action can be its death knell. Mine action depends on a multitude of varying organizations, functions, players, philosophies, resources and motivations to somehow be applied in a complementary way. We do not suggest a world in which all simply reduce their organizational boundaries to rubble, nor do we believe that an autonomous entity should direct mine action actions. But we do believe that many different capabilities can be applied in a most ingenious and cooperative way in which those skills are maximized when used in the proper mix, at the proper time and with proper support. To this end, we believe that endless discussions concerning precise definitions of subjective terms (e.g., “development”), the precise moment for “mainstreaming” to occur and the precise term to be applied to describe an ideal relationship are inhibitors to real and desperately needed action.

Share your information. Tout your successes. Let others learn from your trials and errors. Maybe it will not work, but it would be such a noble way to fail—certainly better than watching landmine accidents mount because we could not learn to play nicely with others.

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