Detection and Clearance
Why is it so difficult to identify a minefield?

Before a deminer can identify a minefield, he or she often has to face the danger of war debris. Shrapnel, barbed wire, corrugated iron and empty shell casings are a few in a long list of debris left by combatants. Over time, these contaminants are no longer visible on the surface of the ground and can complicate detection methods. UXO, including bullets, grenades, rockets and large aircraft bombs can also litter former battlefields. Deminers must work through this debris, discerning the location of landmines and UXO among the clutter—no easy task. Technical surveys are conducted to define the perimeters of suspected mined areas and to emplace boundary markers. Drawing this line between "mined" and "not mined" areas is a difficult and hazardous task. Mistaking the precise location of the perimeter can result in wasted resources and further suffering for the local population, and can culminate in a loss of confidence in the entire operation. However, if successful, the information gained through the various levels of surveying becomes the basis for prioritizing which areas and people are most affected, in order to deploy appropriate mine clearance assets to remove the hazards.

How do deminers find landmines?

There are two main methods used to locate mines: Distance (or Stand-off) Detection and Close Proximity Detection.

**Distance Detection** involves using devices that pinpoint landmines and UXO from a safe distance, either overhead or at ground level. Once the threat is located, a close detection device that analyzes the threat and provides multi-dimensional information provides the ideal risk-reduction capability. Distance Detection is performed by trained surveyors who gather information from many sources, including aerial photos, battle maps and terrain analysis techniques. New sensor systems under development seek to reveal the location of landmines using infrared, thermal, ground penetrating radar and other technologies. These technologies detect changes or anomalies in the terrain, for example a change in temperature or density between the soil and a mine casing.

**Close Proximity Detection.** To perform close proximity detection, a deminer must systematically probe the ground with a sharp stake or metal prodder and excavation tool, slowly edging forward until the mine is located. The deminer also uses a metal detector, which unfortunately does not indicate three-dimensional information about the target. Further investigation is therefore required to determine if the signal from the detector is caused by a piece of scrap metal or a mine. Another technique involves using mine detecting dogs. Because of dogs’ natural abilities in tracking and sniffing, they are ideal for locating mines, and also for identifying areas where no mines or other explosive threats are present. Dogs can cover large areas quicker than standard manual searching methods. Mine detecting dogs (MDDs, see p. 11) are considered to be a reliable method of detection in many circumstances.
Steel wheels capable of absorbing the effects of anti-tank mines enable this machine to cut vegetation safely.

Why not use machines to make demining faster and safer?

Numerous mechanical systems, ranging from flail systems to soil grinders, are operational worldwide. However, no mechanical system has reached 100-percent clearance reliability due to the complex nature of the mine/UXO threat and variable terrain conditions. The term "mechanical assistance" explains that these systems, while complementary to manual deminers and mine detection dog teams (MDDTs), cannot yet replace them in their hazardous tasks. By using mechanical means to clear vegetation and process the ground, the perimeter of the mined area can be ascertained quickly, thereby making it possible for the MDDTs and manual deminers to focus on locating and destroying individual mines and UXO in a safer, quicker and more economical manner.

In a country littered with landmines, how do you know where to start?

A series of analyses and decisions is necessary before mine clearance assets are deployed. Answers to questions such as "Who will benefit?" and "Who will be at risk?" are prime considerations when deciding to continue with mine clearance operations. Prioritizing needs, ranging from emergency relief to infrastructure development, is necessary to reduce risk and exposure to the threat while returning communities to a state of normality. The commitment of valuable demining resources demands careful analysis of the need to clear an area. (See chapter on Landmine Surveys, p.7.)
**How does the environment affect landmine clearance?**

The nature of vegetation and soil has a profound effect on clearance operations. Thick vegetation hinders the deployment of dog and man. Whether the detecting sensor is a dog’s nose or a metal detector, getting the sensor to ground level is all-important to ensure maximum efficiency of the detection system. Soil variables also influence the detection of mines; for example, hard, compacted soil or highly ferrous (iron) soil can hinder detection of mines.

**How do you prepare the ground for demining?**

Removal of vegetation is the first step in preparing terrain since vegetation prevents close inspection of the ground to locate landmines. Manual deminers can spend up to 80 percent of their time gingerly removing vegetation while exposed to landmines. This hazardous task can be accomplished with greater efficiency and safety using mechanical brush-cutters to remove vegetation. The use of armored brush cutters achieves two aims: the removal of vegetation and the activation of tripwires, detonating mines. Both of these activities contribute to identifying the actual location of mines or the minefield perimeter and preparing the terrain for deployment of manual deminers and MDDTs.

**What’s all this I hear about dogs?**

“Man’s best friend” has found a noble role in humanitarian mine clearance. Natural hunting characteristics and an extraordinary tracking and sniffing capability make the dog an excellent sensor or mine detector. Dogs can detect vapors emitted by mines and UXO under difficult conditions and cover large areas faster than standard manual searching methods. Dogs can also locate mines where metal detecting technologies fall short, such as on railway lines. MDDTs are used in survey, mine clearance and quality assurance operations. After machines have removed vegetation, MDDTs can cover suspected areas quickly.

Creating a man-dog team is a complicated process. While the dog must be screened and tested for above-average working characteristics, careful selection of a dog handler with suitable patience and temperament to work with animals is also critical. The training and bonding process takes six months. Perfect unison of the team is vital to its safety and to locating landmines.
The most common breeds of dog used in mine detection are Dutch and German Shepherds and Belgian Malinois. These dogs are prized for their keen sense of smell, robustness, temperment and ability to “stay on task.” MDDs are now considered to be a reliable component in the deminer’s toolbox.

**What is it like to be a deminer?**

Mine clearance usually boils down to an individual effort. In a minefield, the deminer is alone; his sole audience is his partner or supervisor located at least 25 meters away. The deminer cannot see the mine that he must find before it finds him; mental concentration is focused on survival.

**The Clearance Operating Sequence:** Systematic procedures establishing the start lines for clearance are laid out in detail. Areas where no mines are reported or suspected are marked with colored tape denoting safe areas and the perimeters of mined areas. Deminers are closely supervised, working either alone or in pairs, deployed on or near the edge of the suspected area. Following is a description of a type of "One-Man" manual demining drill.

1) The deminer approaches the baseline wearing personal protective equipment (PPE) consisting of a face shield and body armor. The deminer is equipped with vegetation-cutting tools, probe and excavation tools, tripwire feeler, metal detector, mine tape and mine markers.

2) The deminer visually scans an area approximately one meter wide by half a meter deep, looking for evidence of landmines: exposed fuses, mines, UXO, tripwires or surface scrap metal.

3) Satisfied that no mines are present on the surface or in the vegetation, the deminer sweeps the area with his/her tripwire feeler, looking for wires barely visible to the naked eye.

**What is the difference between a minefield and a mined area?**

**Minefields** are designed and laid by professionals using conventional methods. The location of each mine is carefully recorded and the perimeter of the minefield is marked with warning signs. If a minefield record is made available and the markings are still in place, locating and neutralizing landmine hazards becomes very simple. However, few of these types of minefields exist today.

**Mined areas** are undefined in size, shape or content. Determining the actual boundaries of suspected mined areas is difficult and requires both interviewing knowledgeable persons living nearby and developing maps.
4) The deminer carefully removes all vegetation to ground level, using a variety of cutters to ensure no piece of brush falls onto the ground, and gently places the cuttings behind him in the safe lane.

5) The deminer calibrates his/her metal detector for sensitivity and ground compensation. Moving the detector head in overlapping patterned sweeps, he/she covers the search area, listening for the signal indicating the presence of landmines. If a signal is heard, the sweeps will be oriented to identifying the center and edge of the target and a marker is placed at the target location.

6) The deminer then backs off from the marker approximately 20 cm and begins probing for the suspected mine at a 30° angle. He continues in this manner until his probe hits something solid, at which time he will carefully excavate a small trench, removing soil to expose enough of the object to determine whether or not it is a mine. If a mine is found, he then excavates sufficient space to place a demolition charge.

7) Deminers prefer to destroy the mine in place, using an explosive charge at the end of daily operations. Neutralizing or defusing mines is avoided to reduce risk exposure. However, under extreme conditions, mines can be neutralized by specially trained personnel and moved elsewhere for destruction.

This painstaking process is repeated meter by meter, clearing ground to "metal-free" status. If a mine is overlooked or missed, it is normally the deminer who will pay the price, since his work requires him to walk repeatedly up and down his lane. Missing a mine exacts a heavy—usually lethal—penalty.

**Documentation, Data and Information:** The task is not complete until the paperwork is done. Careful recording of the mine action process is necessary to document the effort, record the standard of clearance and exact boundaries of the cleared area and residual hazards to the community.

*This deminer is working to help turn the minefields into agricultural fields so that civilians can use them again.*