THE HALO TRUST

CLEARING THE PATH:

HOW TECHNOLOGY IS CHANGING MINE ACTION IN UKRAINE

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THE KEY FINDINGS OF THE PAPER ARE:

- There is no technological “silver bullet” to delivering a mine free Ukraine but instead vast potential in using innovation across the spectrum of humanitarian mine action to improve efficacy, efficiency, and safety. Tech can also inspire political will to what is possible, an essential ingredient as we look to the future.

- The pace of technological change is outstripping the ability to develop effective standards and consistent approaches to regulation by international authorities.

- Barriers remain in developing certain technologies from a laboratory concept to a field-ready prototype.

RECOMMENDATIONS

- Operators need to better coordinate to understand needs and capabilities as well as collaborate to share information from the results of trials of new technology or approaches. Smaller operators in the sector may be wary of cost when considering adoption of new technology. Sharing state-of-the-art technology, data and analytics or renting equipment where resources are limited could be an efficient solution. National authorities should look to fast-track technologies that have been proven in other countries.

- Donor investment in research and development (R&D) should be viewed as an essential component of modern humanitarian mine action, not a nice to have. However, few donors invest in mine action R&D. With decades of clearance ahead in many countries, investment is needed to bring forward the end point as quickly as possible. Donors should also look to leverage military innovation through enhanced military to civilian dialogue, as well as consider how barriers to prototyping and commercialisation of certain cutting-edge technologies can be overcome. Currently less than $20m is committed to R&D by donors each year - this is primarily the US Defense Department funding plus a few other small contributions.

- The sector at large needs to improve support to innovation through the “Mine Action Technology Workshops”, the GICHD-led “Technological Hub”, strengthened links to the Mine Action Support Group and potential new partners including entrepreneurs, manufacturers, start-ups and groups such as the accelerator programme hosted by the Kyiv School of Economics.

UNCHARTED GROUND:
TRANSFORMING LANDMINE CLEARANCE WITH NON-TECHNICAL SURVEY APPROACHES

The scale of the challenge in Ukraine is driving innovative approaches, leveraging drones and AI analysis to better inform risk-management decisions about reduction and cancellation, in turn reducing costs of unnecessary clearance. The increasing commoditisation of drones, and the greater availability of high-resolution satellite imagery will continue to improve the accuracy of non-technical survey in the future and should be considered integral to the process.

The use of open-source data is increasingly central to non-technical survey (NTS) work and should not be seen as particularly new or groundbreaking. However, there is a need for greater rigour in managing and analysing the diverse conflict-related datasets available. Social media and connected populations can often provide solid evidence about conflict events—such as the location of specific units and the types of weapons used—but this data is inconsistent in quality and quantity across different regions. Furthermore, misinformation presents a significant challenge in obtaining reliable evidence.

The scale of interest and expertise in demining in Ukraine can provide benefits for the global demining sector. As a recent report on demining from the Tony Blair Institute suggested "Ukrainian entrepreneurs and start-ups will need to play a critical role in developing and manufacturing the technological innovations that will enable demining operations to scale efficiently and effectively".

Amazon Web Services (AWS) is investing $4 million to support the work of The HALO Trust to use artificial intelligence (AI) with drone imagery to locate minefields and other explosive remnants of war in Ukraine. Innovating with AWS will enable HALO to make wider use of the high-resolution drone footage it collects, including testing machine learning (ML) models for identifying mines. AWS and HALO will explore new ways to map minefields and prioritise mine clearance—while saving lives and restoring communities.

A HALO deminer in Ukraine checks for trip wires during clearance operations.

The MRead detector uses magnetic resonance technology and has been on trial in Angola

BEYOND THE SURFACE:
INNOVATIONS IN DETECTION TECHNOLOGY FOR SAFER LANDMINE CLEARANCE

The average deminer in HALO will spend approximately two thirds of their time manually digging through ground to investigate signals made by a detector. Current detection technology has a high 'false positive' rate, meaning the majority of these signals turn out not to be an explosive hazard.

On average a deminer may excavate seven signals in a day, but one in every 85 will result in the successful identification of an item of explosive ordnance. This is a problem, but how can it be addressed?

In a perfect world, every signal excavated would lead to the discovery of an item of explosive ordnance. However, detectors currently used across the sector search predominantly for metal or for disturbances in the ground, using ground penetrating radar. In doing so, it is inevitable that non-explosive 'clutter' in the ground, such as scrap metal, will result in a false positive.

The solution is to explore the range of detection methods that search directly for explosive compounds. One example is the partnership between HALO and MRead an Australian-based company, may have the answer. Using magnetic resonance technology, MRead are developing a detector, which they hope will enable the detection of explosives in the soil (rather than the metal elements within the mine as has traditionally been the case). If successful, this would enable deminers to only excavate when there is detection of explosives in the ground, removing the likelihood of false positives resulting from clutter in the ground.

For deminers, this will mean far fewer excavations per day, and a far higher percentage of excavations that result in the removal of an item of explosive ordnance. In turn, the efficiency of operations could be expected to improve significantly, allowing HALO to get more items out of the ground in a shorter time, and consequently return more safe land to the communities in which we work.

There are also other advanced detection techniques which have been known in the lab for many years but have yet to be put into practical application – rapid advances in edge computing, signal processing, machine learning and mobile power sources may provide the opportunity to deploy these techniques in the field.

While magnetic resonance and other advanced techniques may, in time, revolutionise the future of mine clearance operations, continued investment in innovation has allowed the sector to take great leaps forward in recent years.

In Afghanistan, the widespread emplacement of Improved Explosive Devices from 2005 to 2021 led to a largely new threat for the sector. IEDs with zero or close to zero metal components created a challenge for operating procedures previously largely reliant on the detection of metallic elements in ordnance.

This led to the trialing and adoption of ground-penetrating radar detectors capable of identifying both disturbances in the soil indicative of explosive canisters as well as elements commonly found in IEDs such as wires or carbon rods. The adoption of this method has saved the sector millions in donor funding, resulting in productivity increases of over 600 percent. HALO Afghanistan has now cleared over 5,000 IEDs. Each item cleared represents a life and a livelihood protected.

Similarly in Angola, the South African Number 8 Anti-Vehicle mine contained such low levels of metal it was impossible to reliably detect through existing technology in HALO.

In areas of Angola that HALO work, this mine has been used to create some of the largest and most dense minefields in the world. One such minefield is 18 kilometres long, containing an estimated 60,000 landmines. With no detector able to identify the mine safely, HALO's only option would have been excavating entire minefields in full, an incredibly laborious, inefficient and environmentally damaging endeavour.

The trial of the GPZ7000 (originally designed to detect gold), led to the identification of this detector as a viable clearance method capable of identifying the small metal components within the Number 8 mine.

Thousands of Number 8 mines have now been destroyed thanks to the research and testing invested.

The Robocut at work in the minefields of Ukraine

BREAKING NEW GROUND:
CUTTING EDGE SOLUTIONS FOR MINE CLEARANCE

The clearance of explosive contamination in rural areas in many of the countries HALO works is not a straightforward process. Dense vegetation, trip wires, and booby traps pose challenges to manual deminers, resulting in slow and inefficient clearance efforts.

In places such as Ukraine, tripwires are a common threat. Using deminers to manually search for tripwires is ineffective and time consuming, requiring painstakingly slow and delicate search methods.

In areas with heavy vegetation such as Sri Lanka, preparing the ground (i.e. cutting back dense vegetation) to allow detectors to operate is time consuming and dangerous.

In such contexts, manual clearance is not effective and investment in mechanical assets to either clear explosives or prepare land for quicker manual clearance has been essential.

In Ukraine, the scale of new contamination, widespread use of tripwires, and often difficult vegetation has led to the introduction of remote-controlled vegetation cutters.

One such machine is the Robocut, which both removes vegetation in advance of detector search, but also cuts through tripwires, improving both the safety and the speed of clearance operations. This is an example of how commercial off-the-shelf technology from another industry, with minor modifications (such as remote camera systems), can be applied to demining.

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