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SPOTLIGHT ON
SOUTHEAST ASIA

FEATURING
The Evolving Nature of Survey

Field Notes | Research and Development

SPECIAL REPORT
TECHNOLOGY IN INSECURE ENVIRONMENTS: UKRAINE

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COMING IN ISSUE 21.3 | NOVEMBER 2017

EDITORIAL: IEDs and IMAS
FEATURE: Physical Security & Stockpile Management (PSSM)
SPOTLIGHT: Western Hemisphere

COMING IN ISSUE 22.1 | SPRING 2018

FEATURE: Battle Area Clearance in Urban Areas
SPOTLIGHT: Europe

The Journal of Conventional Weapons Destruction is a professional trade journal for the humanitarian mine action and CWD community. It is a forum for best practices and methodologies, strategic planning, risk education, and survivor assistance.

The Journal Editorial Board reviews all articles for content and readability, and it reserves the right to edit accepted articles for readability and space, and reject articles at will.

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Cover Photo
The HALO Trust in Laos.
Photo courtesy of The HALO Trust.

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FROM THE DIRECTOR

This June, the Center for International Stabilization and Recovery (CISR) partnered with Norwegian People's Aid (NPA) to facilitate the Southeast Asia Cluster Munition Remnants Survey (CMRS) Workshop in Washington, D.C. This two-day event, hosted by the Office of Weapons Removal and Abatement in the U.S. Department of State's Bureau of Political-Military Affairs (PM/WRA), brought together a number of organizations working in Cambodia, Laos, and Vietnam to discuss best practices in CMRS in the region.

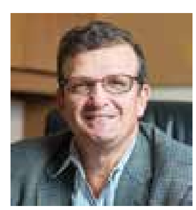
In this issue of *The Journal*, we also turn our focus to Southeast Asia and the evolving nature of survey. Greg Crowther discusses MAG's (Mines Advisory Group) work in Burma: building relationships, taking baseline assessments, delivering mine risk education, and conducting community safety mapping. LTC Shawn Kadlec and 1 LT Richard Calvin of the U.S. Army Pacific Command (USARPAC) illustrate the benefits of establishing an effective NGO-military partnership in humanitarian mine action through their work in providing military trainers to assist the Vietnam People's Army in training International Mine Action Standards (IMAS) certified instructors at the Vietnam National Mine Action Center (VNMAC). In addition, Julien Zwang and Simon Pascal from Danish Refugee Council/Danish Demining Group (DRC/DDG) reveal their findings from an epidemiological study of landmine and explosive remnants of war (ERW) accidents and survivors in Burma, while Tina Kalamar from the Gender Mine Action Programme (GMAP) explores the inclusion of diversity in mine action in Laos.

Turning to the evolving nature of survey, Roly Evans from the Geneva International Centre for Humanitarian Demining (GICHD) analyzes different fragmentation patterns in his article on cluster munition strikes. By analyzing different impact patterns on hard surfaces, Evans explains how this information can support survey operations looking to determine whether cluster munitions were used. Also from GICHD, Dionysia Kontotasiou and Olivier Cottray argue the importance of project documentation by reviewing the various elements of MediaWiki, a wiki that supports the Information Management System for Mine Action (IMSMA).

Looking toward the Middle East, Essam Ghareeb Barzangy examines iMMAP's range of information management and capacity-building services to address ERW and improvised explosive device (IED) contamination in Iraq. Additionally, Louise Skilling and Marysia Zapasnik from DanishChurchAid (DCA) note the threat of explosive hazards in northern Syria and how DCA is using risk education material to target adult returnees in Syria.

Our special report comes from The HALO Trust. Nicholas Torbet and Patrick Thompson examine HALO's work in eastern Ukraine and highlight how mobile technology including tablets, applications, and geographic information systems (GIS) can enhance the capacity of humanitarian organizations to identify hazardous areas in insecure environments. And finally, Andy Smith describes the various functionalities of the axiomatic Area Preparation Tractor in this issue's Research and Development section.

We have an exciting new set of upcoming topics for our 2018 *Journal* issues, including Spotlights on Europe, South and Central Asia, and Colombia and we will be soliciting for articles on battle area clearance (BAC) in urban areas, personal protection equipment and new detection technologies, as well as GIS, safe and secure managment of ammunition, and HMA's continual transition to IEDs. We encourage NGOs, government agencies, and independent researchers to submit. We look forward to hearing from you.



Ken Rutherford
CISR Director

FEATURE

MEDIAWIKI: SUPPORTING IMSMA DOCUMENTATION

by Dionysia Kontotasiou and Olivier Cottray [Geneva International Centre for Humanitarian Demining]

Over the last few years, wikis have arisen as powerful tools for collaborative documentation on the internet. The Encyclopedia Wikipedia has become a reference, and the power of community editing in a wiki allows people all over the world to contribute their knowledge. Use of a wiki for software documentation provides an effective collaboration tool as information can be easily fed into the system. Certain wiki implementations, such as MediaWiki, are project-oriented and include functionalities such as automatic page versioning, easy navigation, simple search mechanisms, as well as online, offline, and mobile usage.

Software projects tend to generate different types of documentation, ranging from initial user requirements and specifications to user guides and system documentation and the code itself. Code is typically managed within a software framework or code management system. At the Geneva International Centre for Humanitarian Demining (GICHD), the Atlassian Jira bug-tracker is used for issue tracking in the Information Managment System for Mine Action (IMSMA) project.[1,2] Formal (paper) documents such as specifications and user guides would typically be stored in a product lifecycle management (PLM) or document management system (DMS), but these are not suitable for administrator and user guides' documentation. To fill the gap, a centrally supported wiki for software project documentation was requested by the information management (IM) team in the IMSMA documentation project in 2013.

Methodology

This article addresses the use of MediaWiki to support IMSMA documentation at GICHD, reports on the current state of the IMSMA documentation, and describes what has been achieved since 2013. The requirements for the development of IMSMA Wiki are laid out in Section 1 to show why we chose an approach based on MediaWiki.[3] Section 2 introduces the basic features of the IMSMA Wiki and how a user can navigate them while reading IMSMA information. In Section 3, analytics (internal and external) are presented to showcase IMSMA Wiki's impact, and in Section 4 we address the different challenges of using MediaWiki as the documentation tool for IMSMA.

Requirements Elicitation and Identification (Section 1)

During the requirements elicitation stage, the first step is to identify the stakeholders, i.e., the persons or groups of persons who have interest in the produced software documentation. The stakeholders have specific needs that they expect the documentation to meet. Understanding the stakeholders and the ways they intend to use the documentation is essential as this helps to determine the forms of future documentation.

After identifying the stakeholders, the next step in the process is to identify the requirements. First, the requirements coming from stakeholders were gathered. The identified requirements had to be carefully addressed in order to ensure that the produced documentation can be properly used for the intended purpose as well as maintained and, if necessary, extended in the future. The second step in identifying requirements for IMSMA documentation was the analysis of existing documentation.

Evaluation Against Identified Requirements

In this section, we review every requirement in order to understand whether the produced documentation has fulfilled the identified requirements and, if not, the reason for that discrepancy.

- **R1 - Support for documents that contain text and diagrams.** MediaWiki pages can contain text and multimedia; this capability should be sufficient for displaying software documentation. MediaWiki, though, does not offer drawing functionality such as creating Unified Modeling Language or other diagrams.
- **R2 - Support for version control.** MediaWiki has version control for every page and provides the capability

Figure 1. Portals.
All graphics courtesy of GICHD.

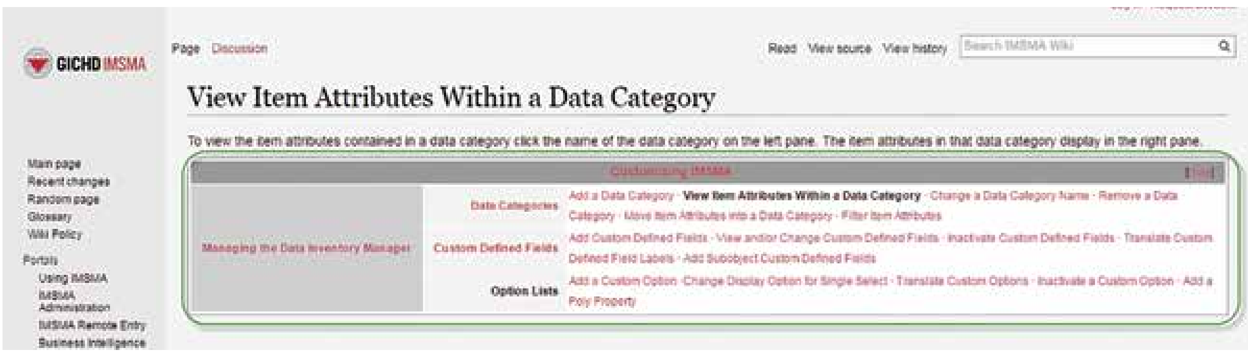


Figure 2. Navigation boxes.

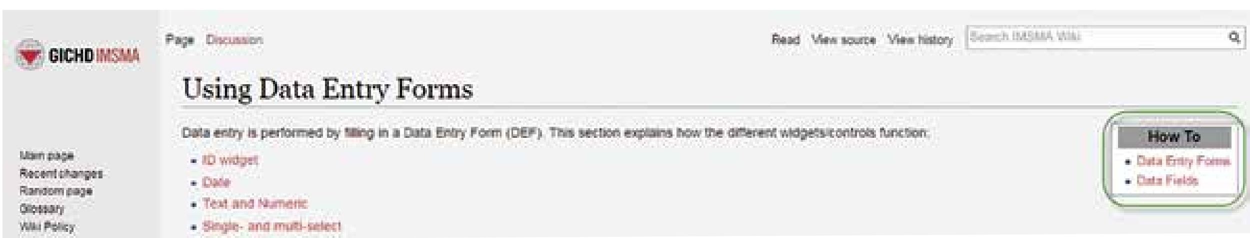


Figure 3. HowTos.

to show the differences between versions. Furthermore, a page can be structured into sections, and any section can be edited. This capability to segment pages should minimize possible concurrent changes made by different team members accessing the same page.

- **R3 - Support for easy access.** The web-based pages created with MediaWiki are easy for most stakeholders to read.
- **R4 - Low cost.** MediaWiki requires a server connected to the internet. In addition to network connectivity and the MediaWiki software itself, these elements are required: a web server (e.g., Apache HTTP Server), a relational database server (e.g., MySQL), and PHP.[4] On the server side, the cost of installing and maintaining MediaWiki is related to the administration of the server. Administration involves executing backups, installing version upgrades, setting user rights, customizing functionality, and configuring localization. In practice, little maintenance is required after installation. On the client side, there is no additional cost for the users of MediaWiki, since the only tool they need is a web browser.
- **R5 - Support for change requests.** MediaWiki allows every editor to change the content. When editors discover a problem in the page, they can correct it immediately. Anyone interested in changes to a particular part of the documentation can display what was changed, when, and by whom.

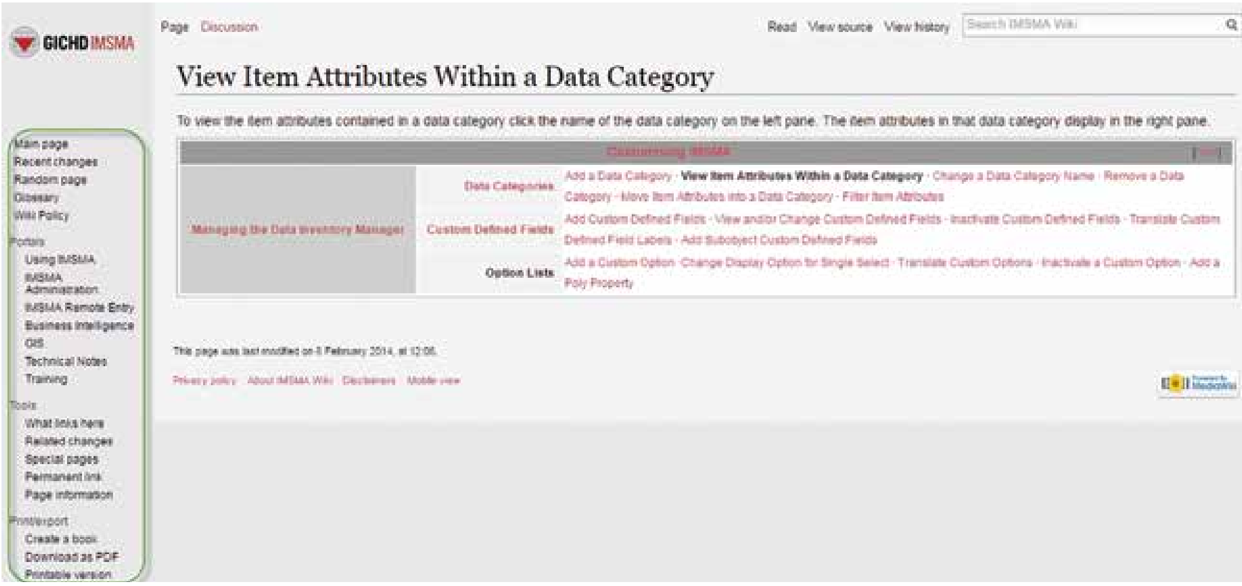


Figure 4. Sidebar.

Figure 5. Page tabs.

Using IMSMA Wiki (Section 2)

Anyone can access the IMSMA Wiki at http://mwiki.gichd.org. Its basic features are as follows:

Navigation. Every page on the IMSMA Wiki has information to show and allows users to move to other pages. This is called **navigation**. To help users navigate, there are several navigation elements:

- **Portals** help users and/or editors navigate their way through IMSMA topic areas. In essence, portals are useful entry-points to IMSMA content. Currently we support seven portals: 1) Using IMSMA, 2) IMSMA Administration, 3) IMSMA Remote Entry, 4) Business Intelligence, 5) Geographic Information Systems (GIS), 6) Technical Notes, and 7) Training.[5–11]
- **Navigation Boxes (or navbox)** are designed to sit at the bottom of pages and are a grouping of links used in multiple related pages to facilitate navigation between pages.
- **HowTos** are useful templates, used in several pages that support subpages. In that way, users can navigate from a page to its child pages easily.
- The **Sidebar** is displayed on the left edge of the page below the site logo. This sidebar gives the user access to important pages in the IMSMA Wiki such as the Main Page, Portals, Tools, Recent Changes, or Glossary.
- **Page tabs** are displayed at the top of the page to the right of the site logo. These tabs allow the user to perform actions or view pages that are related to the current page. The available default actions include: reading, viewing source code of the page, and viewing the history of the current page.

Searching. For searching, we use the core MediaWiki installation. The quickest way to find information in IMSMA Wiki is to look it up directly.

On every page there is a search box. The user should enter key words and phrases and press Enter or click the magnifying glass icon or the Search button. If a page has the same title as what the user entered, the user jumps straight to that page. Otherwise, it searches all pages on the wiki, and presents a list of articles that matched the user's search terms, or a message appears informing the user that no page has all the key words and phrases. If the user clicks the **Search** button without filling in anything, he/she will be taken to **Special:Search**, which gives extra searching options (also available from any search results list).[12]

Tracking Changes. MediaWiki offers a collection of special pages and tools to keep track of what is going on in the IMSMA Wiki. For example, IMSMA Wiki users can track

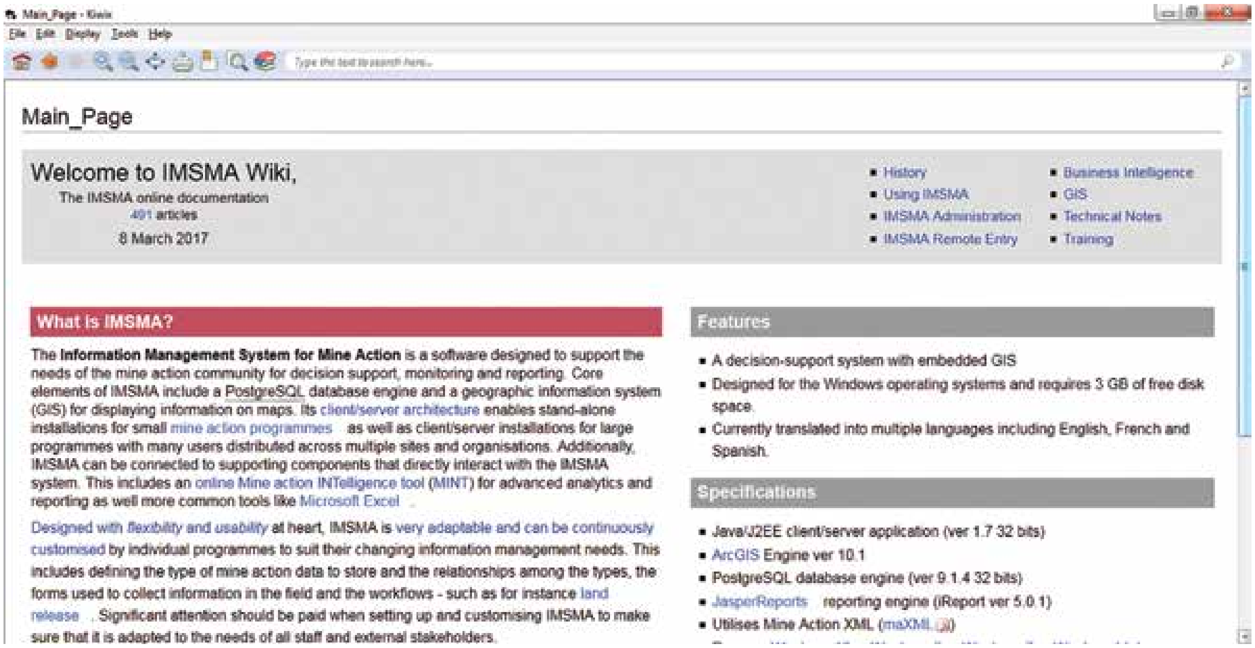


Figure 6. IMSMA Wiki in ZIM format opened in *Kiwix* reader. The latest version of IMSMA Wiki's *ZIM* file can be downloaded at http://mwiki.gichd.org/IM/Downloads.

recent changes to all pages (http://mwiki.gichd.org/IM/Special:RecentChanges).

- the revision history, which comprises all changes made to one page (accessible through the **View History** tab in all pages).
- the contributions of one specific user (http://mwiki.gichd.org/IM/Special:Contributions).
- newly created pages (http://mwiki.gichd.org/IM/Special:NewPages).

The most interesting page is **Special:RecentChanges**.[13] This page displays all edits, file uploads, page moves, deletions, and other actions done in the IMSMA Wiki. The menu at the top offers a collection of links to customize users' displays, i.e., limit the number of changes or the number of days shown, or restrict the display to show edits to a certain namespace only.

Glossary. This is a glossary of terms commonly used in IMSMA Wiki and is accessible at http://mwiki.gichd.org/IM/Glossary.

Offline Usage. *Kiwix* is an offline reader for web content.[14] GICHD uses it to make IMSMA Wiki available offline. This is done by reading the content of the documentation stored in a file format *ZIM*, a high compressed open format with additional metadata.[15]

Mobile Usage. By default, MediaWiki does not offer mobile device-specific support, making MediaWiki sites difficult to use on mobile devices. This has been mitigated in many ways by the MobileFrontend extension, which provides a mobile-friendly view of IMSMA Wiki.[16]

IMSMA Wiki Statistics (Section 3)

Internal Statistics. MediaWiki offers an internal analysis of various metrics like page creation and edits. However, these metrics do not reveal much about the traffic.

Google Analytics

Google Analytics Integration Extension has been installed to track IMSMA Wiki traffic.[17]

Several filters were created in Google Analytics to block and remove the irrelevant traffic (i.e., crawlers, bots, and spams), and include the following:

1. Creating a Valid Hostname filter for **Ghost Spam**. This filter **includes** only the valid hostnames (in our case, mwiki.gichd.org). This kills the ghost-referral spammers (traffic that comes from other hostnames).
2. Creating a filter for **Crawler Spam**. This second filter **excludes** known spammer domains from this list.[18]
3. Creating a filter for **Fake Languages** and other Spam Types. This is the latest form of spam in Analytics. This well-known spammer uses the language HTTP header to send messages as languages and uses legitimate sites like Reddit, Twitter, motherboard.vice.com or TNW (The Next Web). The hostname filter will prevent most

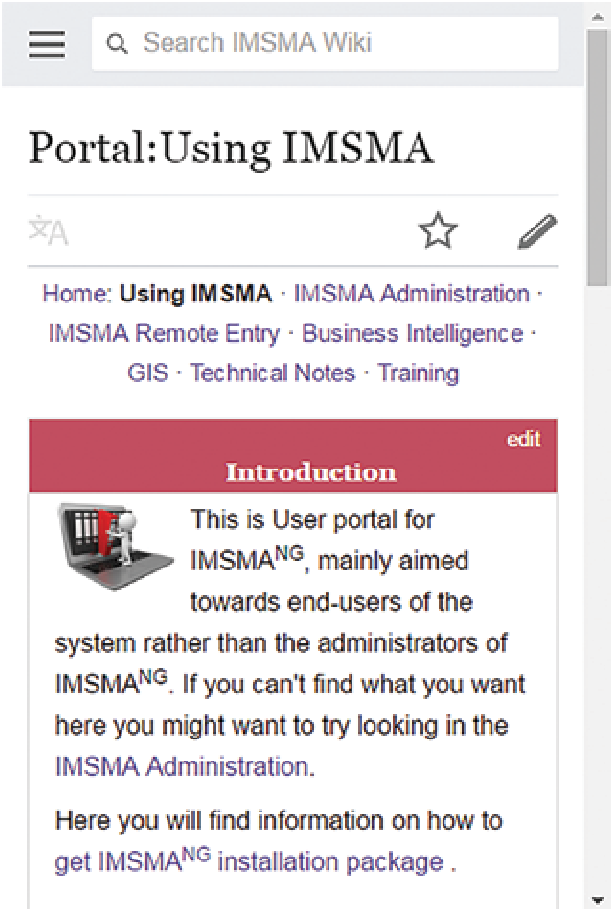


Figure 7. IMSMA Wiki page opened in mobile view.

Page statistics	
Content pages	574
Pages (All pages in the wiki, including talk pages, redirects, etc.)	2,204
Uploaded files	1,423
Edit statistics	
Page edits since IMSMA Wiki was set up	24,336
Average edits per page	11.04

Figure 8. Page and edit statistics covering the period December 2013 to March 2017.

of it; however, there are a few hits that may sneak in, a kind of mix of crawler and ghost spam. A third filter was added to exclude language spams.

4. Creating a filter for **Page Title Spam**. This is a combination of ghost and crawler spam.
5. Creating a filter for **Screen Resolution** exclusion. Automated bots have no screen, so the screen resolution almost always equals "not set."
6. Enabling "Exclude all hits from known **bots and spiders.**" This is a bit easier because Google Analytics has a built-in feature to exclude this traffic. It is using the IAB's "International Spiders & Bots List" for this, which is updated monthly.[19]

Challenges (Section 4)

User Involvement. Because of the collaborative nature of wikis, and the desire to use them as tools of information transfer, all group members need to be actively engaged in the use of the IMSMA Wiki as an information resource and in the editing of the IMSMA Wiki content. One necessary component of any wiki development is that its use be pushed by one of the primary maintainers, someone who will encourage use and development of articles and content, and will actively patrol and motivate new users. The wiki thrives through use, but a single person or group of individuals who support the growth and encourage new users to learn how to use the wiki and its many functions must drive use initially.

To better promote user involvement and engagement, we use the Contribution Scores extension, which polls the wiki database to locate contributors with the highest contribution volume.[20] The extension is intended to add a fun metric for contributors to see how much they are helping out.

Protection. Wikis are designed to be open documents and to make entry and editing of information easy. Making it difficult to edit pages is counter to the spirit of the collaborative effort, and detrimental to success of the project. However, there are many cases to be made for page protection in the event of information that should not change, complex page structure that could easily be damaged, and user control of certain information. These cases are limited, and typically handled by granting the user, in control of that particular page, advanced privileges.

To overcome this protection challenge, we use the restrict access by category and group extension.[21] Even though Mediawiki is a free/public access collaborative document tool, sometimes it can be helpful to have a restricted view of wiki documents.

Multilingual Support. There are two main use cases for language support across IMSMA Wiki: the language of the content and the language of the interface.

- **Interface language selection.** On each MediaWiki website, users who create an account can select the language of the software interface. That means, for example, that you can read IMSMA Wiki pages in

	Acquisition			Behaviour		
	Sessions	% New Sessions	New Users	Bounce Rate	Pages/Session	Avg. Session Duration
All Users	50,911 % of Total: 100.00% (50,911)	69.69% Avg for View: 69.69% (0.00%)	35,479 % of Total: 100.00% (35,479)	65.03% Avg for View: 65.03% (0.00%)	3.75 Avg for View: 3.75 (0.00%)	00:03:57 Avg for View: 00:03:57 (0.00%)
All Users - Clean	43,823 % of Total: 86.08% (50,911)	66.06% Avg for View: 69.69% (-5.20%)	28,951 % of Total: 81.60% (35,479)	61.31% Avg for View: 65.03% (-5.72%)	4.18 Avg for View: 3.75 (11.31%)	00:04:31 Avg for View: 00:03:57 (14.53%)

Figure 9. Google Analytics with (all users) and without (all users – clean) irrelevant traffic covering the period December 2013 to March 2017.

English with the interface in, for example, French. This feature is particularly useful for users who are familiar with the interface in their mother tongue. MediaWiki offers a choice of languages for the interface.[22]

- **Content language selection.** We are in the process of translating the most useful IMSMA Wiki pages (e.g., Installation page) into other languages such as French, Spanish, Russian, and Arabic.

Conclusions

For larger projects that generate lots of documentation, it is essential to enforce some structure to keep information in the right place. As with any website or information system, there should be someone in charge of maintaining project documentation and ensuring that the contributed information is valid.

Use of wikis for project documentation greatly facilitates communication and learning from project contributors. A true wiki implementation allows authenticated users to edit and add information and corrections to every page. Thanks to the open approach and simplicity of use, wiki usage grows organically without the need for training sessions or system coaching like for PLM systems. In particular, for projects spanning multiple organizations in several countries, an easy-to-update shared documentation and communication medium on the internet can be of great value.

See endnotes page 65

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Dionysia Kontotasiou joined GICHD in March 2013 as a MediaWiki specialist. She is the technical manager of the Information Management System for Mine Action (IMSMA) and administrator of the in-house MediaWiki website that serves as IMSMA's documentation and support site. Prior to joining GICHD, she was a research assistant in the Informatics and Telematics Institute in Thessaloniki, Greece. Kontotasiou earned a diploma in Electrical and Computer Engineering and an MSc in Medical Informatics from Aristotle University of Thessaloniki.

Olivier Cottray
Information Management Division
Geneva International Centre for Humanitarian Demining

Olivier Cottray joined GICHD in January 2012, initially as the information-services coordinator. As head of the Information Management Division, he is in charge of managing the team that provides information-management capacity development and technical support to the mine action community. Prior to joining GICHD, Cottray ran geographic information systems (GIS) support cells in the U.N. and nongovernmental field operations and helped found the NGO, Map Action, and has run emergency GIS cells in a number of countries. Cottray earned a Bachelor of Science in geography and economics at the London School of Economics (U.K.), and a master's degree in GIS and remote sensing at the University of Cambridge (U.K.).

FEATURE

INTERPRETING SUBMUNITION FRAGMENTATION MARKS ON HARD SURFACES FOR THE SURVEY OF CLUSTER MUNITION STRIKES

by Roly Evans [Geneva International Centre for Humanitarian Demining]

Submunition fragmentation can produce distinct patterns on hard surfaces that can assist in establishing if a cluster munition has been used. This article will review some of the submunition fragmentation impact patterns seen in current and former conflict zones around the world. It will also underline the risks of misidentifying such patterns and the need to corroborate them with associated evidence such as the submunition fragmentation itself. Trying to accurately identify evidence of cluster munition strikes is an important skill, not just for those surveying contamination for subsequent clearance, but also for journalists and human rights advocates seeking to document instances of cluster munition use.

When a submunition impacts the ground, normally from a high angle, those that function typically spread fragmentation of one form or another. If a submunition impacts a hard surface such as concrete or asphalt, fragmentation can cause distinctive scarring. Different submunitions make differing fragmentation scarring patterns. These patterns are sometimes referred to as craters. If taken in conjunction with corroborating evidence, these may be used as a basis for assessing whether a strike has taken place and if so, dependent on the submunition, possibly what direction it came from. It should be noted that some submunition fragmentation patterns can easily be mistaken for those caused by other munitions such as mortar rounds.

Article 2 of the 2008 *Convention on Cluster Munitions* (CCM) classifies an explosive submunition as "a conventional munition that in order to perform its task is dispersed or released by a cluster munition and is designed to function by detonating an explosive charge prior to, on or after impact." Most mechanically fuzed submunitions function on impact. Currently there is a range of what could be classified as submunitions in use by non-signatories to the CCM. For example, there are spin-stabilized fragmentation submunitions, anti-armor fin stabilized submunitions, anti-armor chute stabilized submunitions, and Dual Purpose Improved Conventional Munitions (DPICM) (with or without a self-destruct mechanism). There are even modern sensor fuzed submunitions that might be referred to as submunitions but are not necessarily classed as such by the CCM.

There are a number of factors that govern the fragmentation effects on a hard surface of a given submunition. Chief among these are the type of fragmentation employed in the submunition, the shape of the submunition, the amount of explosive fill, and the angle of impact.

Type of fragmentation is a key factor. Primary fragmentation comprises fragments that originate directly from the munition. Submunition primary fragmentation may differ from some other munitions. Older mortar rounds for example typically use homogeneous continuous cast or forged body steel that fragments in a much less even manner leaving a relatively less defined pattern or scarring. These fragments are sometimes referred to as natural fragmentation. Submunitons on the other hand often tend to make more defined scarring. Some submunitions might employ a matrix of ball bearings or small cylindrical steel pellets. Examples include the BLU-26 or the 9N210. These will usually form a more defined fragmentation pattern than a continuous cast mortar. However, they will form a less defined fragmentation pattern than submunitions employing pre-formed fragmentation. This involves flat sheet steel processed through a rolling press and scored in diamond-like shapes that fragment along the uniform lines of weakness. The fragmentation pattern produced is, in comparative terms, more uniform. Examples of such submunitions include the BLU-63 and AO-2.5RT and the fragmentation jackets of BLU-97 and DPICM such as the M-77. Pre-formed fragmentation leaves relatively neat scarring.

Shape is another way of characterizing the fragmentation effects of such submunitions. The shape of a submuni-

Image 1

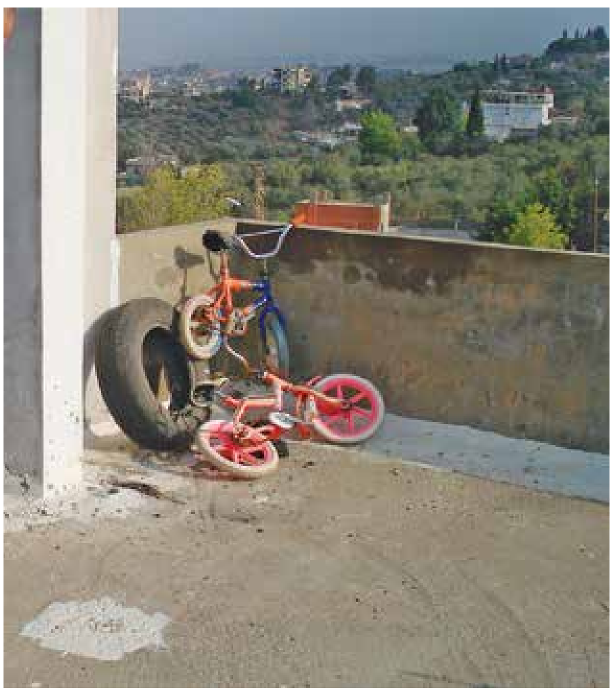

Image 1 (top) and 2 (bottom). Two BLU-63 submunition impact patterns on a roof in southern Lebanon from the 2006 conflict. Note the relatively even distribution of scarring from the fragmentation on the concrete.
Photos courtesy of the author.

tion has a significant effect on the type of fragmentation pattern it creates. A spherical submunition such as a BLU-26 or BLU-63 will likely disperse fragmentation in all directions relatively evenly. An elongated or broadly cylindrical shaped submunition such as a 9N210 will most likely concentrate fragmentation on the side of the point of impact from which the submunition came. The fragmentation will disperse radially, perpendicular to the axis of impact. Most submunitions incorporating a shaped charge such as a BLU-97 or DPICM will also produce fragmentation like this, in addition to a distinct indentation, scabbing or hole created by the shaped charge itself.

The **size** of a submunition will also have a bearing on the size of fragmentation pattern created. Larger submunitions with more explosive will typically create larger scarring patterns or craters. For example, a BLU-97 (explosive fill of 287 g cyclotol) will likely create a larger impact pattern than an M-42 DPICM (explosive fill of 31 g composition A5).

The **angle** that fin stabilized submunitions impact is also important—the steeper the angle, the greater the potential for a larger pattern. A cylindrical shaped submunition impacting at a steeper angle will project fragmentation in a less concentrated manner to one side—the radial projection of fragmentation likely to be greater than if a submunition impacted at a shallower angle.

Some of the more common submunitions encountered incorporate a number of the characteristics described previously. Spin-stabilized submunitions such as the BLU-26 or the ShOAB-0.5 tend to be high explosive (HE) fragmentation munitions. They also tend to be spherical or at least oval in shape. When a spin-stabilized submunition impacts a hard surface the distribution of fragmentation is relatively even. The scarring lines will normally radiate 360 degrees out from the point of impact. For this reason, it can be hard to discern which direction a strike came from with these submunitions, (see Images 1-2 and Figure 1). For spin-stabilized, HE fragmentation submunitions, the volume of explosive content can range from 85 g cyclotol (BLU-26) to 303 g RDX-TNT (AO-2.5RTM). On a hard surface, this will cause an impact pattern of roughly 30–60 cm in diameter with some scarring possibly radiating further.

Sometimes the same submunition might cause a tighter, yet still even pattern. In southern Lebanon this was observed with BLU-63 impacts onto asphalt, a slightly softer hard surface that absorbs more of the impact leading to less scarring, (see Image 3). At the time these impacts were sometimes referred to locally as pocket marks or pockmarks.

Image 3. BLU-63 impact patterns on asphalt, Yohmor, southern Lebanon, August 2006. Note how in asphalt the fragmentation may be tighter than seen on harder concrete surfaces.
Photo courtesy of Steve Priestley.

While such patterns can indicate a possible cluster strike employing spin-stabilized submunitions, they are not conclusive proof on their own. As a basic principle of survey, corroborating evidence, including distinct fragmentation from submunitions and possibly parts of a parent dispenser should be sought. The above fragmentation patterns are very similar to those that could be created by a grenade with a close or equivalent amount of high explosive. It can be easy to misidentify the cause of a fragmentation pattern on a hard surface.

Cylindrical blast-fragmentation submunitions will normally cause a distinctly different pattern on a flat hard surface. As with any broadly cylindrical or elongated high explosive fragmentation munition, be it a submunition such as the 9N210 or AO-1SCh or a standard high explosive mortar, much of the fragmentation will be concentrated on one side of the impact. The side of the fragmentation pattern from which the munition came is typically grooved by splinters. This is because the fragmentation is projected radially from the body of the munition, meaning broadly half is dispersed upwards, to the sides, and into the air and half into a semi-circular pattern on the hard surface, (see Figures 2 and 3 and Image 4). The resulting pattern has been likened to a "rising sun."

Much land service ammunition will make a similar pattern, with the size determined by the amount of explosive within the munition and the angle of impact. Rockets and larger caliber HE mortar rounds have been known to create large semi-circular splinter patterns with a radius of up to 1 m. This type of pattern from a submunition is evident from a confirmed 9N210 strike in Donetsk in October 2014. Images were gathered by a journalist at two separate sites after

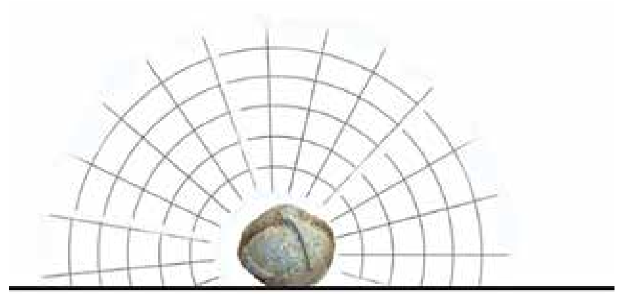

Figure 1. Likely fragmentation dispersion from a spherically shaped spin-stabilized submunition—in this example, a BLU-26. Note the fragmentation spreads in a broadly even manner on a flat surface, especially when compared with fin-stabilized submunitions.
Figures courtesy of the author.

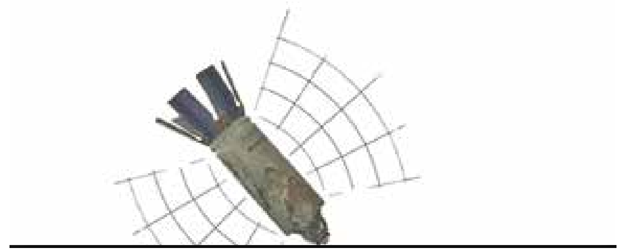

Figure 2. Probable fragmentation dispersion from a 9N210 submunition on a flat hard surface. Fragmentation from such a submunition is dispersed radially with that projected downward scarring on the side from which the submunition came.

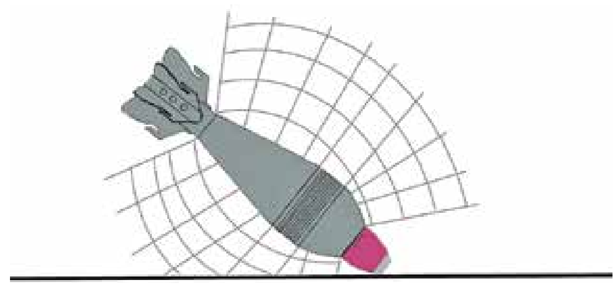

Figure 3. Probable fragmentation dispersion from an 82 mm HE mortar on a flat hard surface. Many mortar rounds, especially older Soviet designs employ pre-cast casing that often results in less defined fragmentation patterns. Broadly the pattern will be similar to submunitions such as 9N210, although possibly with rougher scarring.

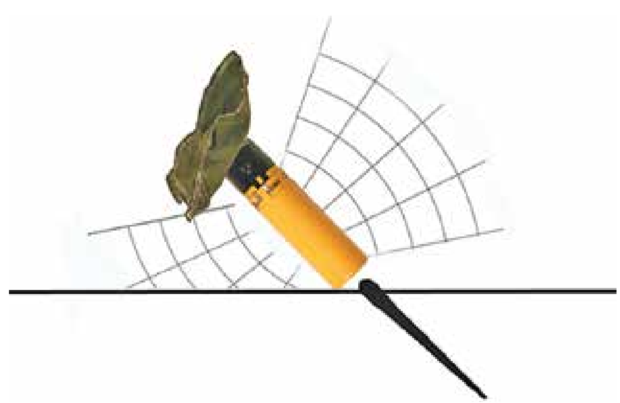

Figure 4. Probable fragmentation dispersion for a BLU-97 submunition on a flat hard surface. Note the fragmentation pattern is broadly similar to a fin-stabilized submunition, but the shaped charge will likely produce a larger hole or scabbing at the base of the pattern.

Image 4. Fragmentation pattern on a hard surface caused by a 9N210 submunition impact outside ICRC office on Universitetskaya Street, Donetsk, October 2014.
Photo courtesy of of Harriet Salem.

the strikes. Patterns within each site were broadly consistent, showing a preponderance of scarring on one side of the impact (see Images 4 and 5).[1]

While these patterns can be caused by munitions such as a HE mortar rounds, the individuals on the ground went to extensive lengths to find all relevant evidence and, in so far as is reasonable, corroborate details of the strike (see Image 6). Finding distinct parts of the submunition including fins, fuze remnants, preformed fragments, and the aluminum skin was enough to confirm a 9M27K cluster munition rocket strike.

Submuntions containing a shaped charge will often produce a fragmentation pattern that can look quite similar to cylindrical fragmentation submunitions such as the 9N210. Fragmentation will typically spread to one side of the impact in a semi-radial pattern, (see Figure 4, page 13). However, there is an important difference. Often the shaped charge will itself make a more prominent indentation or hole into the hard surface. Also, depending on the submunition, more preformed fragmentation can mean less pronounced or neater scarring than a similar pattern from a purely high explosive fragmentation submunition (see Images 8–10).

Submunition impact patterns or craters on a hard surface can reveal important clues about the whole strike that

Image 5. A fragmentation pattern on a hard surface caused by 9N210 submunition impact near an ICRC office, Donetsk, October 2014.
Photo courtesy of the Harriet Salem.

can assist both survey/clearance personnel and journalists or observers. For cylindrical munitions, whether it is a submunition or a simple HE mortar, a line bisecting the radial fragmentation pattern on one side of the impact can give an indication of the direction from which the munition came (see Image 11, page 16). This is a simplification of a technique sometimes referred to in old U.S. Military Field Manuals as the “Main Axis Method.”[2] These techniques date back to

Image 6. Fragmentation from a 9N210 submunition collected at the scene of a cluster munition strike in Donetsk, October 2014. It is important to try to corroborate submunition impact patterns with associated fragmentation when possible.
Photo courtesy of Harriet Salem.

World War II when soldiers tried to identify enemy mortar and artillery positions.

Today, field operators looking to survey a cluster strike may try to find out the general orientation of the strike (or strikes) to assist in further survey and clearance. Should all the bisecting lines point in the same direction this might indicate one strike, or more strikes but all delivered from the same direction. This is the case regardless of whether the delivery mechanism was a cluster munition from an aircraft or a rocket, projectile or mortar carrier munition. In the October 2014 Donetsk example the craters revealed two possible strike directions for the two strike locations, coming from different locations to the south of the city. In areas where significant amounts of fighting have taken place over a prolonged period it is more likely that both cluster strikes and indirect fire will have come from multiple directions and the orientation of any resulting fragmentation patterns on hard surfaces could reflect this. In an area of multiple strikes it becomes harder to differentiate the evidence.

There are parts of mine action that can still improve the recording and documentation of all relevant evidence found in the field. Cluster strike fragmentation patterns on hard surfaces are important evidence. Such evidence is stronger when corroborated by associated fragmentation. Locations of fragmentation patterns or craters on soft surfaces and the larger remnants such as the carrier munition should be also recorded—even today this does not happen as much as it should. All recorded evidence should then be reviewed as a whole, ideally using Geographic Information System software. In this way operators have a better chance of estimating the extent of a given cluster strike earlier in the land release process.

Effective survey of any explosive contamination requires good knowledge of the evidence a surveyor is looking for. This is especially true when surveying cluster strikes. Survey

Image 7. Mortar impact patterns, Douma, Syria. Note how the scaring is similar to cylindrical submunition fragmentation patterns. The two are easy to mistake for one another. Also note the same orientation of the three patterns indicating they all came from the same direction and probably from the same mortar barrel. The mortar round tail units are embedded at the base of each pattern.
Photo courtesy of KiloBuzz.

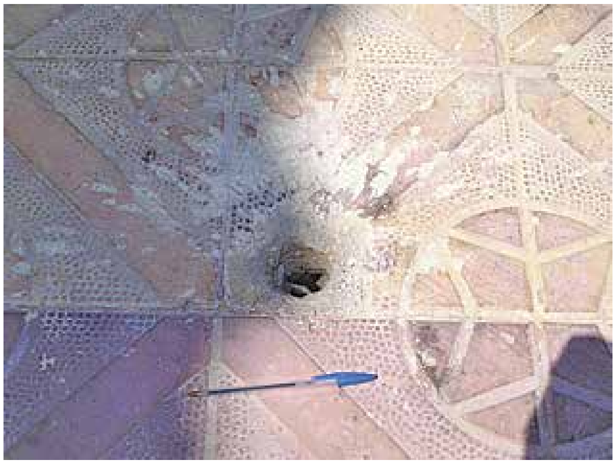

Image 8. M Series DPICM impact pattern on a tiled hard surface, showing the central hole made by the shaped charge, southern Lebanon, August 2006. Note that the fragmentation pattern is broadly similar to a fin-stabilized submunition, but the shaped charge will likely produce a larger hole at the base of the pattern.
Photo courtesy of Steve Priestley.

Image 11. 9N210 fragmentation pattern, Donetsk, Ukraine, October 2014. The superimposed line indicates the direction from which the submunition impacted.
Photo courtesy of Harriet Salem.

Image 9

Image 9 (top) and 10 (bottom). M Series DPICM impact patterns on a roof in southern Lebanon from the 2006 conflict, showing the central hole (since filled with cement) made by the shaped charge. Note the relatively neat scarring from the pre-scoured fragmentation jacket of the DPICM.
Photos courtesy of the author.

training should therefore look to prioritize knowledge of relevant evidence in a given operating environment. It should also look to improve how this evidence is recorded. Operators should also be able to accurately and consistently record not only actual explosive hazards, but where practicable and appropriate, the relevant associated evidence. At present, some databases, be it at operator or national level, do not facilitate the recording of associated evidence. The need to improve this situation shows that there remains more work to be done in order to implement land release principles in mine action.

See endnotes page 66

The author wishes to thank Harriet Salem for her kind assistance in developing this article.

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FEATURE

USING MOBILE GEOGRAPHIC INFORMATION SYSTEMS TO IMPROVE OPERATIONAL EFFICIENCY, DATA RELIABILITY, AND ACCESS IN MINE ACTION

by Paul Rittenhouse and Lindsay Aldrich [James Madison University Department of Integrated Science and Technology and Center for International Stabilization and Recovery]

The inherently complex field of mine action, with its many political, financial, and physical considerations, is also a spatial, data-driven field; and as a result, geographic information systems (GIS) stand to play a major role. Spatial data can help address questions such as: Where are the hazardous areas and what has been cleared or cancelled? Where have teams already surveyed? Where should they go next? How many square meters have been cleared? Due to the complexities surrounding assigning tasks and prioritization, standard operating procedures (SOP), quality assurance/quality control (QA/QC) and database design, GIS often gets limited to high-level planning, database cataloging, and end-of-task analysis and reporting. With the improvement of mobile technologies and location-based services, GIS is poised to play a bigger role in the day-to-day operations of landmine and unexploded ordnance (UXO) clearance.

Standard GIS Applications

Mine action centers and implementing partners have varying systems for investigating, reporting, and remediating suspected hazardous areas. Non-technical and technical surveys have different SOPs and accuracy requirements. If one were to describe field survey in simplistic terms: teams survey areas and document the geographic location and relevant information about their survey on paper notes and/or forms in the field, and then ultimately enter the data into electronic forms or databases from the office. The timeframe in which the data is migrated from paper to electronic forms or databases depends on, but is not limited to, the results of the field surveys and program-specific QA/QC protocols. Later, information management personnel use the electronic database to harvest data back out into GIS desktop platforms for mapping, analysis, planning, or reporting. This system works and is successful, as evidenced by the many mine action programs effectively using these methods around the world. Despite this success, there are some common drawbacks with this method, leaving room for improved efficiency, reliability, and opportunities for analysis.

Survey and IM personnel with JMU/CISR comparing traditional vs. mobile data entry during the CAST pilot phase in Vietnam.
All images courtesy of CISR.

Potential for data collection errors. When survey teams manually record coordinates and supporting data in the field and staff later transcribe these into paper or electronic forms, there is a significant risk for data errors. Coordinates can be logged incorrectly and attributes can be incorrectly assigned.

Loss of efficiency. Redundant data entry costs time. Discovering, tracking down, and fixing transcription errors also takes time. Time lapses in data entry of days, weeks and even months can cause backlogs in information processing and affect operational decision making and reporting

Loss of access. When data remains in paper form, it is more difficult for managers, directors, and stakeholders to access, evaluate, and use the data to coordinate efforts.

Early integration of GIS into the survey process can help mitigate these issues by reducing the access points at which human error may occur, and reducing the time to input data, thereby allowing for internal data analysis sooner without circumventing the set QA/QC process flow.

Operators are commonly using some form of GIS technology for reporting after tasks and QA/QC are complete, but in

Figure 1. Example of a hand-shaded survey task map.

order to maximize the potential of this technology, programs can integrate GIS on the front-end for planning as well. Then, promptly synchronized GIS data can inform:

- quick, informal analysis;
- coordination of activities between field team leaders;
- timely, end-of-day or early morning field operation planning discussions; and
- prompt identification of new survey boxes.

Therefore, by entering data into a tablet or other mobile GPS-capable device, decision-makers have access to more data in close to real time for planning and greater flexibility of daily operations.

Case Study: CAST Mobile GIS Solutions

The Center for International Stabilization and Recovery (CISR), with funding from the Office of Weapons Removal and Abatement in the U.S. Department of State's Bureau of Political-Military Affairs (PM/WRA) utilized Esri's ArcGIS Online platform and Collector App to develop CAST (**C**ISR **A**GO **S**urvey **T**ool). This is an integrated GIS data collection tool that allows humanitarian mine/UXO clearance operators to record spatial and qualitative information directly into geodatabases using mobile technology.

How does it work? During a non-technical or technical survey, an operator uses a mobile phone or tablet with Esri's Collector App to securely access CAST in the field and fill out their unique digital, GIS-based form.

CAST uses the GPS capabilities on a mobile device to capture spatial data to record new or update previously collected information. If online, this data is immediately updated to the cloud. If offline, it is stored locally and synchronized when the device is back online. This cloud-based data is immediately available to other online (or synchronized) mobile devices and desktop computers running ArcGIS Online (AGO) or ArcGIS Desktop. As a result, field operators, team leaders, information managers, and other stakeholders have early access to field data across a variety of platforms.

Benefits of CAST. Using mobile devices to collect field data directly into geodatabases has immediate impacts on survey efficiency. As seen in Figure 1, traditional means of collecting data in the field often include updating task maps by shading survey grids and filling out paper forms to note findings.

Using mobile GIS tools such as CAST in the field (Figure 2) not only allows personnel to fill out data forms with both open responses and preordained choices, but potential errors from manual (or multiple) data entry are reduced. Field sketches of task maps that were previously manually edited are now digitally updated program-wide. These updates appear immediately if there is a cellular connection in the field, or teams may utilize the offline synchronization features in remote areas where cellular connectivity in the field may be unreliable or non-existent.

Because CAST operates over ArcGIS Online, and is therefore integrated and accessible across multiple platforms, fellow team members can see recently synchronized survey progress in the field, while information managers can access findings online and start processing and evaluating information sooner. Additionally, managers with assigned levels of access may view digital dashboards that provide GIS-driven, up-to-date progress reports rather than relying on tabulated reports that may be impacted by the time delays associated with traditional data entry.

CAST is one example of how utilizing mobile GIS technology early in the demining process can improve mine action survey operations by providing detailed data collection and mapping of landmines and UXO in post-conflict areas where civilians are at risk. CAST is efficient by improving the reliability and accuracy of current field data collection methods.

Figure 2. Sample CAST data-entry form.

It is accessible in that personnel in various organizational capacities can quickly access survey data through the many integrated platforms. It is a tool that is both flexible and customizable to meet the data collection methods and international standards of the conventional weapons destruction (CWD) community. Data can also be easily exported from CAST into common data file formats such as an Excel table or .csv for upload into operators' broader information management and reporting systems.

Potential challenges. Although utilizing mobile GIS technology in the field increases efficiencies overall, programs will need to plan for several contingencies and start-up costs when applying this technology, whether using CAST or otherwise. Environmental factors such as extreme heat or humidity could cause changes in mobile device performance. For example, during the pilot phase of the CAST development, survey teams in Vietnam working in summer months found that a tablet would occasionally begin to overheat and temporarily shut down to protect its systems. The team navigated this issue by having multiple tablets or other mobile devices available and loaded with the survey application. Therefore, any program using mobile devices for survey will not only need to plan for the start-up cost of mobile devices for survey team members, but they should also budget for a few extra devices if operating in areas with extreme heat. The paper survey data collection method costs less, but a program should consider the efficiencies to be gained with this investment.

Besides the cost of mobile devices, programs will also need to invest time and potentially some funds in training staff to use a specific mobile survey tool. Each user needs to be trained in the application interface, such as accessing the application, logging in, recording data and synchronizing collected data with the cloud. However, an advantage is that with limited hands-on training, team members of varying levels of experience with computer technology quickly learn to use simple mobile applications such as Esri's Collector app (on which CAST is based). The key is for the training to be hands-on and to have a follow-on component for users to ask more questions after engaging with the technology for a time.

Conclusion

While countries clear mines/UXO, operators and support organizations from around the world continue to examine current methodologies and develop new strategies to improve the success of clearance efforts. One such strategy is the continued integration of mobile GIS technology into CWD programs. These technologies allow spatial analysis to have greater impact in both day-to-day operations and reporting tasks. Data collected in the field is reliable and is more readily accessible. Managers can evaluate and report on field surveys, allowing timely and effective planning for new tasks, and team leaders can better coordinate with each other in the field. Taking GIS tools and analysis to the next level in this way improves planning, reporting, and stewardship, which furthers national program goals and ultimately contributes to safer communities.

Authors' note: During the pilot development of CAST, survey teams in Vietnam successfully used a beta version of the mobile survey tool to survey millions of square meters of land and map the geolocation of hundreds of explosive hazards for safe demolition. We would like to acknowledge and thank our colleagues with NPA Vietnam and Project RENEW who collaborated with JMU CISR on the pilot project and provided extremely valuable ideas and feedback, which led to the development of CAST.

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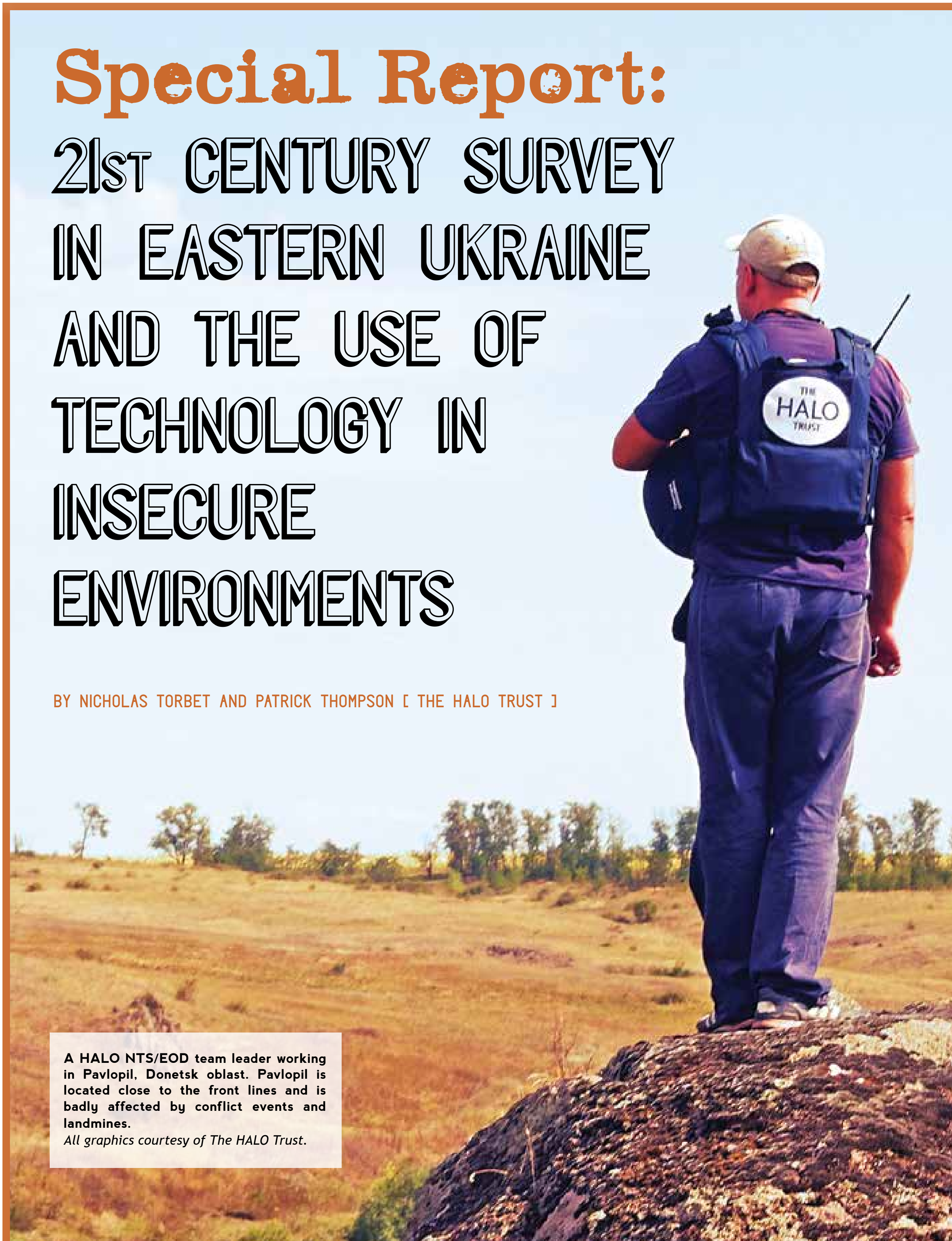
Special Report: 21st Century Survey in Eastern Ukraine and the Use of Technology in Insecure Environments

BY NICHOLAS TORBET AND PATRICK THOMPSON [THE HALO TRUST]



A HALO NTS/EOD team leader working in Pavlopil, Donetsk oblast. Pavlopil is located close to the front lines and is badly affected by conflict events and landmines.
All graphics courtesy of The HALO Trust.

The conflation of humanitarian and military spheres has long been a feature of modern conflict, restricting access to areas in which the need for humanitarian assistance is greatest. However, the advent of mobile technology has provided novel opportunities to circumvent old problems. In Ukraine, The HALO Trust's (HALO) ability to conduct non-technical survey is restricted in certain areas, and the security environment means this is unlikely to change in the foreseeable future. Nevertheless, HALO pioneered a number of techniques that allowed for systematic assessments of the region, painting a general picture of contamination that will facilitate pro-active non-technical survey once the situation improves. This article examines HALO's work in eastern Ukraine and illustrates how tablets, applications, and geographic information systems (GIS) can enhance the capacity of humanitarian organizations to identify hazardous areas in insecure environments. In addition, the article summarizes the initial survey findings conducted in Ukraine to date by international humanitarian operators.

While the roots of the current conflict lie in the longstanding political, cultural, and linguistic divisions between the western and eastern regions, the immediate cause was a series of protests and counter-protests that evolved into full scale civil conflict in early 2014. In April 2014, two self-proclaimed "People's Republics" in Donetsk and Luhansk regions declared independence from Ukraine. Almost immediately, the Ukrainian government launched the Anti-Terrorist Operation (ATO), in an attempt to return this territory to state control.

A TM62M anti-vehicle mine identified by HALO NTS/EOD teams in Shyroki, Luhansk oblast.

The struggle that ensued has cost an estimated 10,000 lives.[1] Two years after the signing of the Minsk Protocol, ceasefire violations are a daily reality, weapons systems remain largely in place, and intense fighting occasionally occurs along the line of contact, although the front line of the conflict has remained relatively static.[2] The economic and human cost of the conflict continues to exact a heavy toll from communities living in Donbas, and the use of landmines and cluster munitions has been widely documented.[3] Indeed, according to the *Landmine and Cluster Munition Monitor* 2016, Ukraine had the fifth highest rates of landmine and explosive remnants of war (ERW) casualties in the world.[4]

Prior to 2014, Ukraine's capacity to respond to the hazards posed by ERW consisted of the Armed Forces and State Emergency Service (SES) of Ukraine. The principal hazard was from unexploded ordnance (UXO) dating

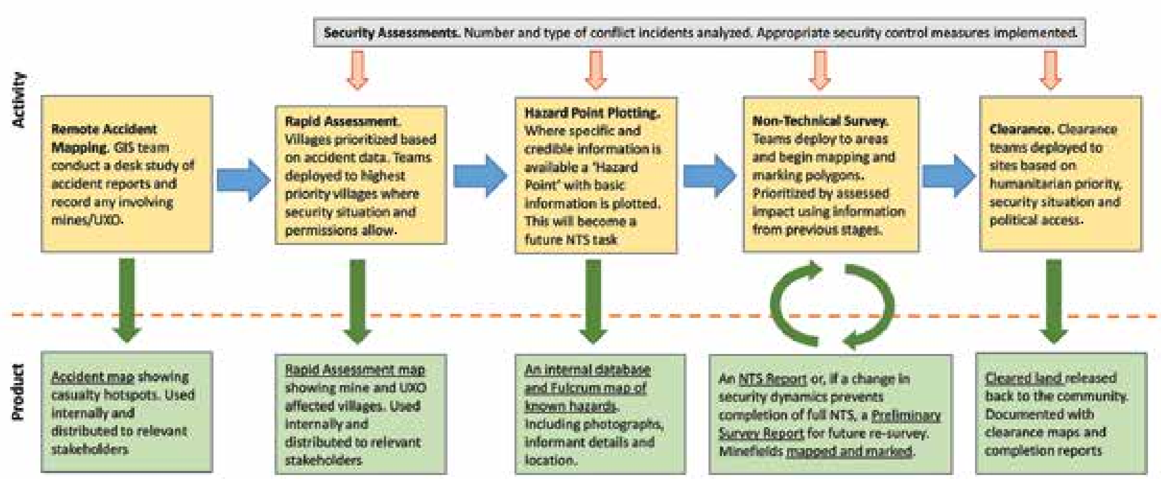


Figure 1. Visual aid to HALO's multi-layered survey process.

from World War I and World War II. As casualty rates from mines and UXO skyrocketed from the current conflict, international funding and international humanitarian operators arrived to supplement the preexisting capacity. At the time of writing there is no national mine action center, but the lead body in mine action coordination is the Department of Environmental Security and Mine Action, a branch of the Ministry of Defense.[5]

HALO's program in Ukraine opened in November 2015. The program now has over 200 Ukrainian staff conducting clearance, survey, explosive ordnance disposal (EOD) call outs, and mine risk education (MRE) across the region. Eastern Ukraine is a complex environment in which to work. Humanitarian clearance requirements must constantly be balanced against the need to ensure the safety of personnel, neutrality, and ensure that mine action activity is not conducted in areas still considered militarily relevant by any party to the conflict.

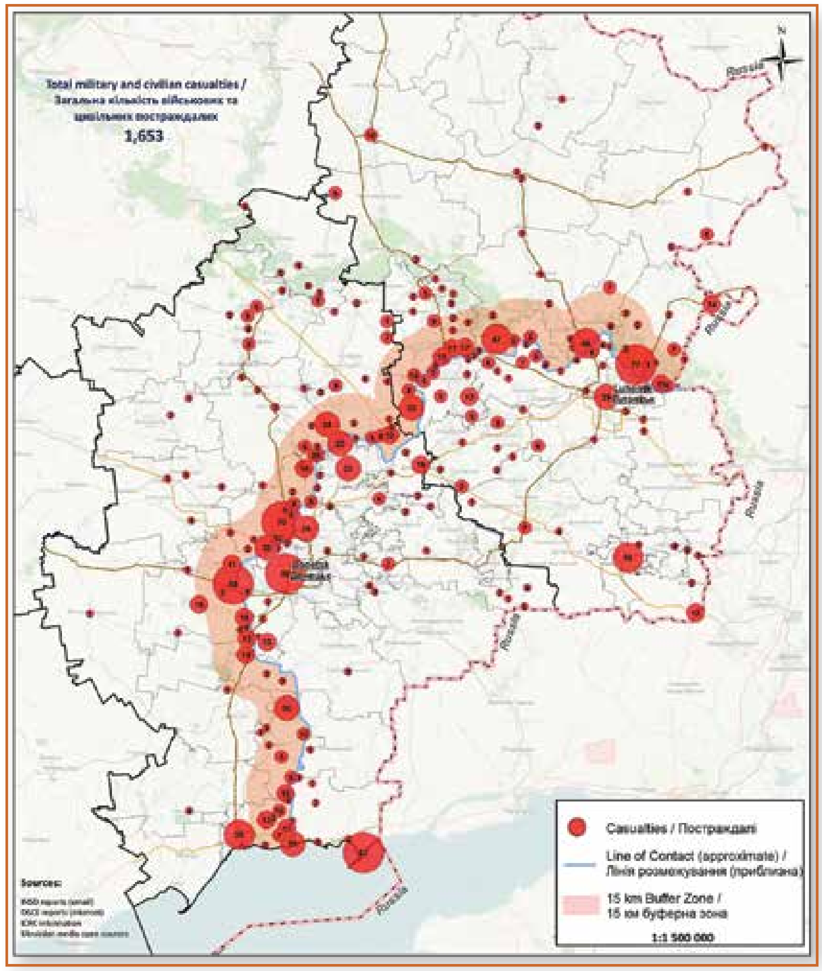


Figure 2. Results of HALO's remote accident mapping: mine and ERW casualties in eastern Ukraine, May 2014 through June 2017.

Challenges and Solutions

The main challenges to systematic non-technical survey across the region are the rapidly changing security environment in areas close to the line of contact, and restricted access to both non-government controlled areas (NGCA), and areas controlled and used by the Ukrainian military. Fighting can escalate very quickly in specific areas. This can include high-intensity indirect fire from mortars and artillery, small arms fire, and sometimes Multiple Launch Rocket Systems (MLRS). However, this is rarely, if ever, followed up by attempts to seize territory. To mitigate these challenges, HALO adopted a survey methodology to identify areas where non-technical surveys can be conducted and, if not, to capture as much relevant information as possible to inform future decision making.

Where full non-technical surveys cannot be conducted, four layers of alternative information gathering mechanisms that gather as much relevant data as possible were created and are used to inform future non-technical survey activity. These layers **(Remote Mapping, Rapid Assessment, Hazard Points,** and **Preliminary Survey Reports)** can be conducted as standalone activities, or combined to capture increasingly more complex and detailed information. The principal advantages of this system are that all activities are recorded through a single information management system (allowing for easy presentation and analysis of data). Even in areas of extremely limited access, useful data can be extracted and recorded, ensuring crucial information is neither lost nor forgotten.

Remote Mapping. The restricted access to NGCA is the most intractable issue facing humanitarian organizations in eastern Ukraine and is not limited to those

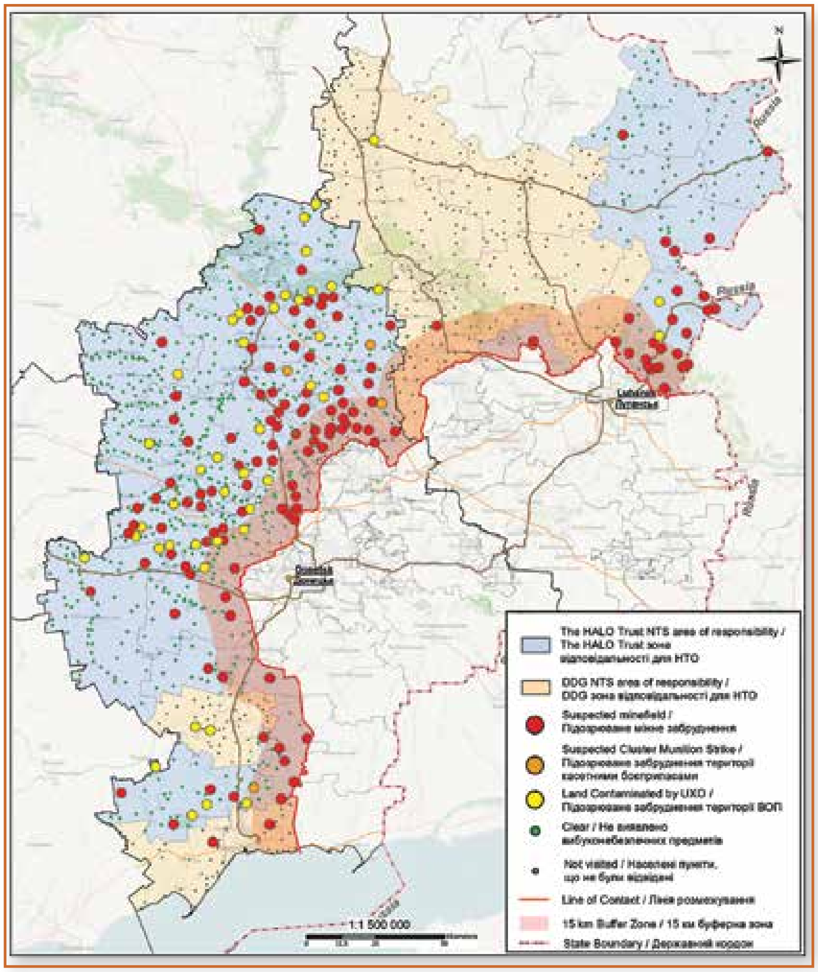


Figure 3. Results of HALO's rapid assessment in eastern Ukraine.

both government and NGCAs. This allows for the prioritization of survey activity and provides focal points for discussions with relevant authorities concerning areas in which HALO seeks permission to work. While it remains difficult to verify the information received from NGCA, the information recorded through this system is a valuable interim measure that is used by a number of international and state bodies such as the Organization for Security and Co-Operation in Europe (OSCE), International Committee of the Red Cross (ICRC), Donetsk Regional State Administration, and Civilian-Military Cooperation Unit of the Ministry of Defense.

Rapid Assessment. As illustrated in Figure 3, Ukrainian ATO command established a buffer zone in the area adjoining the line of contact. The buffer zone comprises all territory 15 km (9.3 mi) from the line of contact, and mine action activity is restricted throughout. Mine clearance organizations must apply for permission to conduct non-technical survey and clearance on a site-by-site basis within the buffer zone. This can be a lengthy process, particularly as the military authorities responsible for managing the permission process rotate on a regular basis. However, the restriction only applies to formal non-technical surveys and clearance; as such, less formal data gathering solutions were developed. Rapid Assessment is the first and most basic level of information gathering in the field. Through the systematic visits to each village in the region, survey teams gather information from meetings with key informants (village authorities, clinics/hospitals, military representatives) and record whether or not there is believed to be contamination in the area.

This information is recorded on a digital form and plotted on a map. Each settlement visited is given a **status** (e.g., **mined** or **ERW present**) and a corresponding

involved in mine action.[6] The de facto authorities in the region have actively resisted the engagement of international non-governmental organizations (NGO), and due to the particular sensitivities surrounding mine clearance, it is unlikely that humanitarian operators will be able to secure access to these areas in the immediate future. HALO's solution to this is limited.

However, through the monitoring of open source media and reports of other international organizations, HALO has compiled a database of all recorded incidents that occurred in eastern Ukraine since May 2014. These incidents are recorded and analyzed by the GIS department on a weekly basis, which disaggregates information on the age, sex, and status (i.e., military or civilian) of the victims. Where the information is available, the location and type of ERW that caused the incident are also recorded. This information is then plotted on a map that forms the first layer of survey information. The map gives a clear indication of mine and ERW incident hotspots in

A HALO NTS/EOD team interviews a mushroom farmer in Avdiivka, Donetsk oblast. Avdiivka is located around 2 km (1.2 mi) from Donetsk city and has seen some of the worst of the recent fighting in eastern Ukraine.

color code. The result is a useful snapshot of general contamination, backed up by key information on the nature of the hazard in each place, allowing regions to be prioritized for future survey work. It is a relatively straightforward system that requires little training and, as such, can be easily implemented on a new program for immediate use. Conducting assessments of this sort are also less politically sensitive than minefield mapping, and local authorities may be more likely to allow organizations to start collecting data while formal mine action permissions and accreditations are negotiated.

Hazard Points. The information gathered during Rapid Assessment is supplemented by another Fulcrum application dubbed Hazard Points. This application is used where survey teams encounter physical evidence that will warrant follow up with non-technical survey but is currently inaccessible due to the security situation. In these situations, the teams create a geo-referenced **pin** that records key evidence of mine or ERW contamination. When a hazard is identified, the pin is placed on the map at its actual location (if seen by the team) or assessed location (if reported by a credible source).

A form linked to the pin allows key data to be recorded such as informant details, grid references, and photographs. To avoid the system being overpopulated with suspect data, a degree of quality control is required to ensure that the information is credible enough to warrant the creation of a pin.[7] While the Hazard Points application does not provide sufficient information to justify creation of a confirmed hazardous area (CHA) or suspected hazardous area (SHA), it identifies areas for follow-up when access improves and records valuable information in the interim. Furthermore, when combined with the Rapid Assessment, it provides operations management with a mechanism to submit specific, detailed, and well-informed requests for clearance and non-technical survey to the relevant authorities, greatly increasing the chances that these requests will be approved.

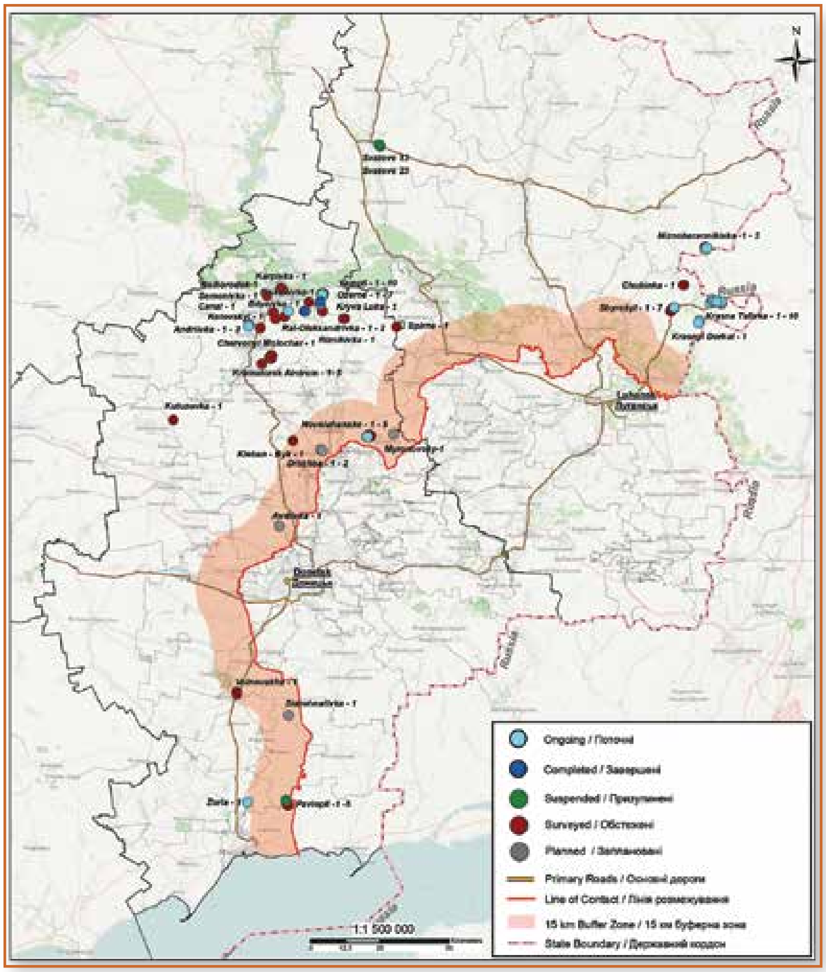


Figure 4. HALO's current task status in Donetsk and Luhansk regions, June 2017.

Preliminary Survey Reports. The Rapid Assessment and Hazard Point appli\\v\\\\cations were designed in response to external restrictions placed on non-technical survey activity by state authorities. However, an equally difficult situation may arise when permission for full non-technical survey is granted in restricted areas, but teams are prevented from completing full, Information Management System for Mine Action (IMSMA)-compliant reports by the local security dynamics.

HALO undertakes detailed security assessments and liaises closely with the local military to understand the situation ahead of deployment to these areas. Nevertheless, it is often impossible to understand the nuances of each area until teams arrive there and speak with local actors. On a number of occasions survey teams identified CHA, particularly accident sites, but were unable to gather sufficient information to create a complete non-technical survey report. This can occur either when the accident site is located in the **grey zone** between the positions of government forces and non-government forces, or when local military advise that it is unsafe to proceed to the site due to recent conflict activity. In areas where the security dynamics change rapidly, teams may need to evacuate from an area midway through the survey process.

HALO survey manager (and co-author of this article) using a tablet during survey operations in the buffer zone.

In these instances, submitting a full non-technical survey report is inappropriate, as the full extent of a minefield or the nature of the mine threat will not be fully established. The operations team instead decided to record this information in a separate and distinct form known as a **preliminary survey report**.[8] This report generates a Task ID that is recorded on HALO's database and linked to the Fulcrum tablet application ensuring that gathered information is not forgotten and that follow-on survey has access to the best information available.

An RGD-5 fragmentation grenade on a tripwire, found by a HALO manual clearance team on the task Ozerne-4 in Donetsk oblast.

A HALO NTS/EOD team leader gathers information from local communities using Fulcrum.

The HALO Trust	
Villages assessed	873
Villages affected by landmines	135
CHA/SHA mapped	82
CHA/SHA total sq m	8,368,515
Danish Demining Group	
CHA/SHA mapped	34
CHA/SHA total sq m	6,192,130

Table 1. Surveying conducted by HALO and DDG reveals the contamination in Ukraine.

Limitations. The procedures and technology discussed previously do have limitations that restrict their usefulness. First, in environments where conflict activity is ongoing, there is likely to be a significant delay between interim survey measures and subsequent non-technical surveys and clearance. In this time, the nature of the threat may change considerably. As such, the information gathered by these interim measures may be, at best, out of date, and, at worst, misleading. The need for the constant reassessment of survey information has long been a feature of mine action programs, but it is particularly relevant in the aforementioned situations.

Second, much of the value of recording information on one digital platform depends on reliable internet connections in the field. The synchronization of tablets does not require ultrafast data connections, but intermittent coverage often results in some delay between uploading information in the field and its register on the management terminal.

There is also a considerable managerial challenge: all data must be checked before being entered into the database and analyzed regularly if it is to be of value. This requires high-caliber GIS personnel who also have a good understanding of field and technical operations, and similarly technology-savvy field personnel who are comfortable using mobile technology to support their fieldwork. Many of the knowledge gaps can be resolved through training courses; however, this increases the demand on operations management.

Finally, and most significantly, it is clear that HALO's procedures do not provide complete solutions to the challenges in Ukraine. The simple fact is that the political and security environment in eastern Ukraine renders comprehensive non-technical survey activity impossible. HALO's solutions are interim measures designed to ensure that areas of high humanitarian priority are surveyed wherever possible, and where this activity is restricted, sufficient information is gathered to ensure that future activity can take place in the most efficient manner.

Results. Non-technical survey is still very much a work in progress, and given the nature of the conflict in Ukraine, is likely to remain so for some time. Yet

HALO's clearance reveals a TM62M anti-vehicle mine beside a truck that struck a mine of the same type in 2014, Krasna Talivka, Luhansk oblast.

the surveying conducted so far, by both HALO and the Danish Demining Group (DDG), has already revealed extensive contamination as summarized in Table 1.

Conclusion. Current political and military realities in eastern Ukraine preclude the possibility of comprehensive, systematic non-technical survey in those regions where the humanitarian impact of mines and ERW is highest. While some challenges seem all but insurmountable, HALO has undertaken a range of proactive measures—underpinned by advances in mobile technology—that ensure all opportunities for the expansion of survey are recognized and seized. Moreover, the interim data collection methodologies provide a framework for operations planning and management that could be applied to any nascent mine action program, especially those operating in insecure environments.

It is accepted that the measures that have been taken so far are not a substitute for full non-technical survey. Yet when the current restrictions on the mine action sector are lifted, the information that has been collected will save valuable time and resources, ensuring that the threat of mines and ERW is dealt with quickly and efficiently in the communities that need it most.

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The HALO Trust

Nick Torbet is HALO Ukraine's operations manager. Nick arrived in Ukraine in July 2016, having previously been HALO's programme manager in Laos. He is the operational lead for over 200 staff and is responsible for the day-to-day oversight of the program's operations in eastern Ukraine. Before HALO, Nick served as a British Army officer for over ten years, specializing in explosive ordnance disposal.

Patrick Thompson
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Patrick Thompson has worked as HALO Ukraine's survey manager since August 2016. He is responsible for the coordination and deployment of HALO's three NTS/EOD teams. He has previously worked on HALO's programs in Cambodia and Mozambique. Thompson graduated from the University of Bristol, U.K., in 2013, and briefly worked in security sector reform in Lebanon and Jordan before joining HALO in 2014.

in the SPOTLIGHT SOUTHEAST ASIA

Catholic Relief Services: Information and Communication Technology in Monitoring & Evaluation

by Nguyen Tuan Phong and Ta Thi Hai Yen [Catholic Relief Services]

In February 2015, Catholic Relief Services (CRS) Vietnam initiated a new project to support the reintegration and rehabilitation of survivors of accidents involving landmines and explosive remnants of war (ERW). With funding from the Office of Weapons Removal and Abatement in the U.S. Department of State's Bureau of Political-Military Affairs (PM/WRA), CRS' Access and Reintegration (A&R) project takes a comprehensive approach to serving the needs of 3,219 survivors of landmines and unexploded ordnance (UXO) in Quang Binh and Quang Tri provinces. Through collaboration with the Government of Vietnam's provincial Department of Labor, Invalids and Social Affairs (DOLISA), CRS provides survivors with access to medical care, rehabilitation, and social and livelihood support services. The key to success has been establishing an effective and functional coordination system at the local level for referrals, strengthening a network of community-based workers, and supporting families to provide appropriate, home-based care and support. CRS' A&R project creates a network of support that ensures increased access to comprehensive services for survivors and advances their reintegration into society. The A&R Project has established a model for scaling to six affected districts in the targeted provinces and beyond.

Information and Communication Technology, Application Development, and Deployment

To ensure increased efficiency and effectiveness of project monitoring and evaluation activities, CRS has applied Information and Communication Technology (ICT) for Monitoring, Evaluation, Accountability, and Learning

A community-based worker uses digital forms to collect monitoring data in Ham Ninh commune, Quang Ninh district, Quang Binh province.
Photo courtesy of Nguyen Huu Thong/Catholic Relief Services (CRS).

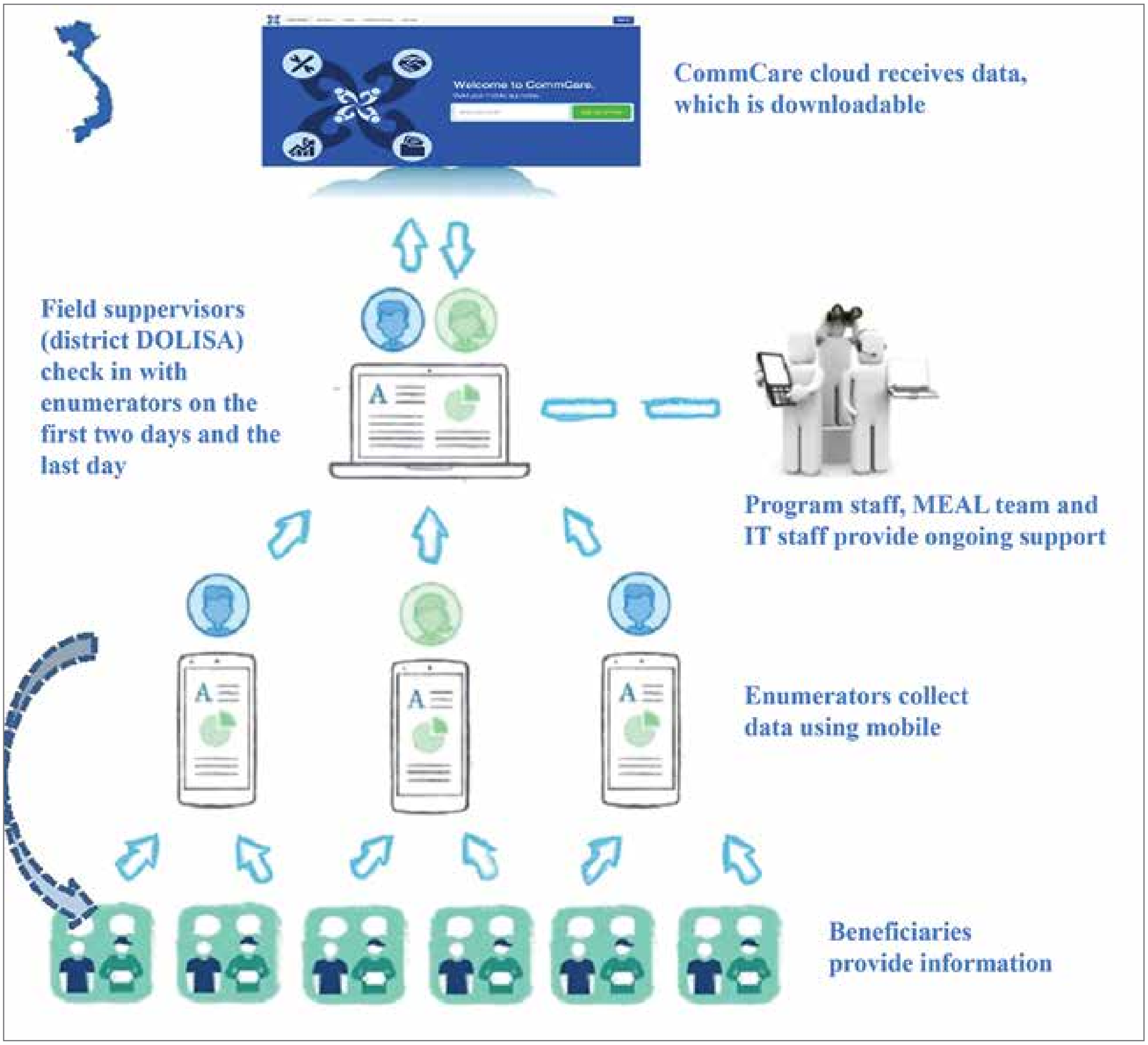

Figure 1. Data management structure.
Figure courtesy of Catholic Relief Services (CRS).

(ICT4MEAL) solutions to collect data for baseline survey as well as for monitoring project implementation. The package of six digital forms, used for data collection in both baseline survey and monitoring activities, was developed by CRS with Dimagi CommCare software running on an Android operating system, then installed in Samsung Galaxy Tablets 3 for data collection.

In order to successfully apply the ICT4MEAL solution, CRS, in close coordination with DOLISA, developed a detailed design and feasible deployment plan. After four months of designing and testing, the digital forms were ready for use in August 2015. CRS trained 110 data collectors and partner staff on how to use mobile devices and digital forms. As a result, personnel collected data from 3,219 landmine survivors in 98 communes of six target districts in Quang Binh and Quang Tri provinces. Following the baseline survey, 107 community-based workers in Quang Binh province were trained on how to use digital forms to collect monthly monitoring data. They have continued their monthly data collection since March 2016.

Efficiency and Effectiveness

Use of this technology has enhanced the quality, timeliness, and accessibility of collected data. Quality checks are built into the digital forms with an automated skip pattern and data validation check between connected questions, which contributes to the overall data quality. In addition, required answers must be filled out before moving on to the next question, thus ensuring data completeness.

Data can be collected on the digital forms offline and synchronized to the cloud once an internet connection is available. It can also be accessed by several authorized users at any time. The accessible real-time data assists staff in checking data and fixing errors in a timely manner during data collection and quickly making quality data readily available for analysis and use for decision making.

The ICT4MEAL solution saves a significant amount of time, work, and money compared to a paper-based data collection system. Despite the initial cost of the tablets, CRS saved approximately US$9,886 by not having to print paper questionnaires and in staff time that would have been needed for data entry and data cleaning. In addition, it also helped shorten the surveys' timespan by about 50 days on data entry, data cleaning, and transport of questionnaires from the field to the CRS office.

Using the Real-time Data for Adjusting Project Activities

Thanks to the real-time data collected on a monthly basis, project decision makers were able to make timely adjustments for project activities as needed. According to the design of the project, landmine survivors only receive financial support for transportation from their home to national standard hospitals. However, from the monitoring data that is disaggregated by each type of service, the project team realized that landmine survivors needed medical support that was not being covered by existing service providers. Using this data, CRS and partners adapted the program activities to provide the necessary medical support for landmine survivors.

In addition, real-time data also helps in monitoring the project's quality. The community-based workers, who are also data collectors, are required to visit landmine survivors on a monthly basis to update their needs into the digital forms and provide appropriate referrals. Since the data is automatically uploaded into the cloud, the project management team can easily track the community-based workers' performance with real-time data. In this way, community-based workers are assessed, and reminders are sent to their supervisors if they have not fulfilled their responsibilities.

Lessons Learned

Since using this ICT4MEAL solution application, CRS has identified a number of lessons learned. Firstly, from the initial planning and designing stages and throughout the life of the project, close collaboration among relevant staff (program, monitoring, evaluation, and IT) is essential. Each staff has specific expertise that is critical to the application's success. Secondly, planning and preparing before the activity begins is important to ensure all aspects (and potential problems) can be addressed. Finally, close supervision during implementation is necessary to ensure on-the-spot error fixes and the adjustment of plans in a timely manner. The quality of the system has contributed to improving the support that landmine survivors receive in Quang Binh and Quang Tri.

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Ta Thi Hai Yen has been with CRS Vietnam since 2007 and is an experienced program manager and specialist in UXO/mine risk education and survivor assistance. She is experienced in participatory assessment, project design, preparation, and management of budgets, results-based reporting, and leading teams. She has successfully managed projects funded by PM/WRA for the past seven years. She is also a graduate of the Center for International Stabilization and Recovery's 2012 Senior Managers' Course in ERW and Mine Action.

Mine Detecting Rats Make an Impact in Cambodia

by Cynthia D. Fast, Ph.D., Håvard Bach, Paul McCarthy, and Christophe Cox [APOPO]

Despite decades of national and international mine action efforts, Cambodia remains littered with landmines. The casualty rates are among the world's highest, and there is considerable socioeconomic damage from landmines and other explosive remnants of war (ERW).[1] Cambodia has established the goal to clear all known minefields by 2025.[2] To achieve this, funding must be secured, and land release rates must be increased. This can only be achieved by taking advantage of available resources and improving land release methodology.

The mine clearance capacity in Cambodia is largely composed of manual demining teams and much smaller animal detection units. Historical reasons fueled preference for manual mine clearance; however, considerable improvements in animal detection methodology have enabled more reliable and effective land release. Moreover, with many of the large, well-defined minefields cleared, technical survey will be essential for effective land release of the vast number of poorly defined mine suspected areas remaining. Despite broad consent that more animals will expedite the land release process in Cambodia, manual teams still disproportionately outnumber animals.

As a nongovernmental organization (NGO), APOPO is best known for its African giant pouched mine detection rats (MDR), previously deployed in Mozambique and currently active in Angola. Internal and external evaluations repeatedly show that APOPO's MDR are exceedingly reliable and efficient.[3–9] Yet, degrees of skepticism lurk within the mine

The APOPO MDR team in Siem Reap, Cambodia.
All graphics courtesy of APOPO.

action industry. Initially, the Cambodian Mine Action Centre (CMAC) was hesitant when APOPO proposed bringing rats into Cambodia. Nevertheless, after APOPO agreed to neuter all rats, and assuaged concerns that the rats could transmit the Ebola virus, shipping arrangements were secured. APOPO accepted rigid initial testing and prolonged quality monitoring of the rats by CMAC.

With joint APOPO/CMAC operations planned for districts in Siem Reap, where suspect land had not been used for almost 30 years, the first group of APOPO mine detection rats arrived in Cambodia in September 2015. Before deploying APOPO's MDRs to the minefield, CMAC conducted two phases of evaluative testing on the rats' performance.

Accreditation of the MDR in Cambodia involved tests that examined the MDRs' abilities to locate buried explosives at the DU4 CMAC Facility in Prasat Bakong. During this test, each rat had to detect a total of six mines hidden within an area of 400 sq m (478 sq yd). To avoid potential influence between rats, unique areas of land containing the same number of mines were used to test each rat. All 14 of APOPO's MDRs passed this initial evaluation, accrediting each rat to operate in a live minefield.

The **CMAC Acceptance Test** occurred after the rats passed their first accreditation and were deployed on a real operational minefield in the Prasat Bakong district of Siem Reap. CMAC performed ground preparation, where vegetation cutting was required, using an armored brush cutting machine at least 24 hours before the rats were deployed to the area. CMAC was cautious and depended on both the initial accreditation test of the rats as well as the close monitoring of the rats during their first three months of deployment. During this period, teams using metal detectors quality controlled 100 percent of the area searched by the MDRs. In this phase, the rats searched a combined area of 53,253 sq m (63,690 sq yd) and found 11 landmines and three items of unexploded ordnance (UXO). It is significant that the manual quality assurance teams did not find any items missed by the rats. Moreover, all mines found by a rat were confirmed by a second rat that independently searched the same area, enabling full clearance.

APOPO's MDR at Work

For the remaining eight months of 2016, APOPO's MDRs sniffed out 67 additional explosive devices, including 43 landmines and 24 UXO, hidden within 225,415 sq m (269,594 sq yd)

Since APOPO and CMAC cleared the mines, Chim Lok and his grandsons can now graze their cattle without fear of injury.

	Manual demining team		MDR team	
Expense	Unit cost (US$)	Monthly cost (US$)	Unit cost (US$)	Monthly cost (US$)
Team leader	350	350	350	350
Deputy team leader	302	302	302	302
Deminer x10	271	2,710	-	-
Deminer x7	-	-	271	1,897
Rat supervisor	-	-	500	500
Rat handler x4	-	-	271	1,084
Rat leasing (500 US$ x 8)	-	-	500	4,000
Total		3,362		8,133
Monthly production	-	8,000 m^2	-	32,000 m^2

Table 1. Cost comparison table based on APOPO/CMAC operations in Cambodia.

of Srae Nuoy in the Varin district. The rats averaged 28,177 sq m (33,699 sq yd) of land cleared each month, with 51,590 sq m (61,701 sq yd) covered in July alone. To provide full clearance, two separate rats independently searched each plot of land, resulting in more than 500,000 sq m (597,995 sq yd) traveled by the MDR team, supported by 11,262 man hours. All rats showed 100 percent agreement in the detection of explosive devices. During this time, 25 percent of the land cleared by APOPO's rats (approximately 56,000 sq m or 66,975 sq yd) was quality controlled with metal detectors, revealing that the MDRs did not leave behind a single explosive item. While the metal detectors discovered more than 22,000 fragments of metal, the rats ignored all fragments that did not contain residual explosives, which undoubtedly contributed to the rats' clearance speed.

MDR Cost-effectiveness Case Study: Siem Reap Province

A reliable comparison between manual demining teams and MDRs is not straightforward; it requires consideration of the different team structures and operational costs. Manual teams typically have more employees, necessitating additional management. Minimum safety distances introduce deployment constraints that disproportionately affect manual deminers, due to the number of deminers required to clear an area, which leads to deployment on several concurrent tasks and increases in transportation and management requirements. Moreover, the need for minimum safety distances is obviated for MDR in some cases, because they are not physically intrusive and are too light to detonate mines. Rat teams require fewer employees but potentially greater management related to rat care. For simplicity, and from APOPO's experience, project management can be equated across both teams. Cost/efficiency comparisons can then rely on operational field costs, assuming all other costs, including brush cutting, are the same. The comparison in Table 1 uses the following factors, which are calculated from experience:

- MDR search 20 x 10 m boxes. Manual deminers clear the grids and indications by the rats.
- MDR teams with eight rats clear 1,600 sq m (1,913 sq yd) per day (average double search) and require 285 sq m (341 sq yd) of manual demining.
- Manual deminers average 40 sq m (47 sq yd) per day and require seven manual deminers to support a team of eight rats.
- Although lease is not currently required, an assumed lease price of US$500 per rat per month has been used to balance the costs of breeding, training, and transporting rats.

Extrapolated productivity figures from APOPO's combined operation with CMAC (as provided in Table 1) show that a balanced operational capacity of rats and manual deminers clears 65 percent more land (24,000 sq m or 28,703 sq yd) than an equally expensive manual demining capacity. Using $1 million on the operational component of a combined capacity and accepting the figures above would enable the release of 3.93 million sq m (4.7 million sq yd), an additional 1.55 million sq m (1.85 million sq yd) compared to manual mine clearance alone.

Looking Forward

Despite initial challenges in exporting MDRs to Southeast Asia and lengthy evaluations, CMAC and APOPO forged a successful and cooperative land clearance campaign in 2016, with APOPO's MDR helping to clear 573,256 sq m (685,608 sq yd) across seven minefields. This land was returned to community use as quickly and cost-effectively as possible. Within 17 days, one of these minefields was cleared and handed back to local residents, where they immediately planted rice crops. CMAC was a supportive and highly-valued partner, prompting APOPO to invest more into strengthening this relationship. Pending available funding, APOPO now aims to expand its MDR team to include more than 30 rats in Cambodia by the end of 2017.

Quality control and operational use of the rats in Cambodia demonstrates that the rats are reliable for clearance and, when integrated with manual demining teams, dramatically increase cost-efficiency. APOPO has the capacity to supply a high number of rats to the mine action sector in Cambodia and values CMAC's partnership while maintaining interest in supplying MDRs to other partners.

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The APOPO MDR working in Siem Reap, Cambodia.

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Cynthia Fast joined APOPO in 2016 as head of training and behavioral research. She holds a psychology Ph.D. and Master's degree, specializing in Learning and Behavior and Behavioral Neuroscience, from UCLA. While a member of the Behavioral and Systems Neuroscience department at Rutgers University, Dr. Fast investigated olfactory learning and perception in rodents. Dr. Fast is a member of the New York Academy of Sciences, Pavlovian Society, Society for Neuroscience, Women in Learning, Association for Chemoreception Sciences, Comparative Cognition Society, and American Psychological Association.

Håvard Bach
Head of Mine Action
APOPO

Håvard Bach is based in Geneva as Head of Mine Action for APOPO. A former Norwegian military engineering officer, he was employed by Norwegian People's Aid in 1992, managing several mine-action programs worldwide. He has worked as head of the operational methods department at the Geneva International Centre for Humanitarian Demining (GICHD) where he managed different studies and projects, including mine-detection animals, mechanical mine clearance, manual mine clearance, and land release. Before joining APOPO in October 2016, he was the chief technical advisor, Operational Methods for NPA.

Paul McCarthy
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Paul McCarthy joined APOPO in 2015 as the program manager for Cambodia. Paul has worked extensively in commercial mine action and private security, supporting large International companies, primarily in the Middle East. Paul served twelve years in the British Army as well as seven years as a U.K. police officer and is currently studying for a Master's Degree in Law.

Christophe Cox
CEO
APOPO

Christophe Cox leads APOPO's team from its headquarters in Tanzania. He has a Master of Science in Product Development & Development Sciences, and developed many of APOPO's technical realizations. Christophe has many years of management experience in East Africa.

Military-NGO Partnerships: Lessons Learned for the 8th Theater Sustainment Command's HMA Mission in Vietnam

by LTC Shawn L. Kadlec and 1LT Richard L. Calvin [303rd Ordnance Battalion]

A Staff Sergeant from the 74th ORD CO instructs trainees for the Vietnam Mine Action Center on explosives and explosive effects during phase one of humanitarian mine action training in August 2016. Interpreters were provided by Golden West Humanitarian Foundation and were instrumental to our success.
All photos courtesy of 74th ORD CO.

In August 2016, U.S. Army Pacific (USARPAC) Explosive Ordnance Disposal (EOD) and medical personnel executed the first phase of a four-year mission in support of Vietnam. The goal of this mission is to develop indigenous, International Mine Action Standards (IMAS) Level 3 certified instructors for the recently established Vietnam National Mine Action Center (VNMAC). USARPAC partnered with Golden West Humanitarian Foundation, an NGO that runs mine action operations around the world. Golden West provided insight and recommendations on equipment purchases, curriculum development, and other aspects of program development as it related to EOD tasks. As USARPAC looks toward the future, its partnerships with NGOs should continue to be an integral component to the mission of developing indigenous VNMAC instructors and the overall VNMAC capabilities and competencies.

In 2013, Vietnam and the United States reached a mutual agreement for the removal of explosive remnants of war (ERW) and further development of Vietnamese mine action capabilities. The 2013 Memorandum of Understanding (MOU) builds upon previous cooperation between the United States and Vietnam and aims "to establish a long-term framework for strengthening humanitarian cooperation between Vietnam and the US of overcoming consequences of explosive remnants of war in Viet Nam." As a result, USARPAC was tasked by U.S. Pacific Command (USPACOM) to provide military trainers to assist the Vietnamese People's Army (VPA) in developing IMAS certified instructors to become cadre at VNMAC. These certified instructors will teach new classes of deminers and EOD technicians to increase Vietnam's abilities to protect their citizens from ERW. The 8th Theater Sustainment Command (TSC) was subsequently tasked with this mission, to include providing personnel and overall resource coordination for the mission. The 74th Ordnance Company (74th ORD CO) was selected to provide the EOD trainers, while the Regional Health Command – Pacific provided medical subject matter experts for emergency trauma training. Upon receipt of this mission, Golden West was contacted for their assistance and insight on EOD training. In addition to helping with pre-mission planning, Golden West provided one EOD trainer and two interpreters who were instrumental in the success of the mission. Unfortunately, USARPAC does not currently partner with any NGOs specializing in emergency medical trauma (EMT) training and mine risk education (MRE).

There are numerous benefits to establishing an effective humanitarian mine action (HMA) military-NGO partnership in Vietnam. For the 8th TSC, NGOs like Golden West provide years of experience and cultural understanding that cannot be rapidly developed, and their presence will remain relatively constant while the personnel within the command is ever changing. Additionally, Golden West is able to monitor and mentor Vietnamese army personnel who have recently completed IMAS Level 1 training in order to ensure they retain the lessons learned and to prepare them for future training from the 74th ORD CO. This continuity function will be key to USARPAC's success due to the fact that USARPAC cannot maintain a quasi-permanent presence in Vietnam.

NGOs benefit from this relationship in several ways. First, collaboration with 8th TSC personnel allows the United States to advocate for NGOs and assist with any potential issues. For example, Golden West has struggled to attain suitable bulk explosives (i.e., TNT) for disposal operations. During a tour of VNMAC and subsequent meetings, the 8th TSC and Golden West personnel were able to communicate directly with senior VNMAC leadership to ensure they understood the issues at hand and that they would need to fix their explosive supply issues. Another potential benefit for NGOs is that when 8th TSC personnel use the NGOs' best practices, it becomes inculcated into the future VNMAC instructors. This will provide VNMAC with personnel who know Golden West techniques. With this relationship, the host nation deminers and NGO personnel will be able to more effectively collaborate and cooperate in clearing ERW. Finally, country-specific collaboration builds the relationship and trust required for operations elsewhere in the region. For example, Golden West provided the Department of States' (DOS) Quick Reaction Force for ERW assessment following a request for U.S. Government support (i.e., Tuvalu following Cyclone Pam). Our current partnership with Golden West provides a solid foundation for future humanitarian assistance and disaster relief operations in which USARPAC EOD personnel may be working alongside and in collaboration with Golden West.

Vietnam benefits from a comprehensive, well-coordinated program that incorporates a myriad of military and NGO/civilian expertise that no one organization can provide. At the conclusion of this mission, the Vietnamese will have fifteen trained personnel to instruct future deminers at their new mine action center. The increased cadre of trained personnel will in turn increase Vietnam's ability to keep its citizens safe from landmines and ERW.

The most recent iteration of our partnership with Golden West—a two week mentorship session in Quang Tri Province—integrated VNMAC students with two teams that had already been trained through IMAS Level 2 by Golden West. VNMAC personnel trained in the field to learn how to conduct battle area clearance (BAC) and live unexploded ordnance (UXO) disposal from their Golden West-trained counterparts. Two soldiers from the 74th ORD CO participated in this training. Observing this live training with the Vietnamese allowed our soldiers to impart their knowledge directly into the Vietnamese standard operating procedures. It also gave our soldiers insight into exactly where we need to amend our curriculum so that VNMAC trainers can mesh directly into future operations with their countrymen and Golden West. Soldiers of the 74th continued into a Golden West-taught IMAS Level 1 course to better understand how to properly teach the course material. Although this step should have taken place before our initial IMAS Level 1 course in August 2016, it provided invaluable insight for future iterations.

A Vietnam People's Army soldier conducts mine detector practical training with their new training equipment provided by the U.S. Department of State and Department of Defense during phase one of humanitarian mine action training in August 2016. Golden West Humanitarian Foundation was a key advisor on equipment purchases.

There are numerous challenges to establishing an effective military-NGO partnership. The immediate lesson learned by 8th TSC was the need for early and frequent communication between all parties at all levels of command. On the ground, Golden West personnel did not fully understand USARPAC's mission and desired goals. This is attributable to both poor communication practices and our own lack of exact objectives. Email is a sufficient means of exchanging information, but it is a poor substitute for verbal communication. More face-to-face contact was required throughout the planning process, to include 8th TSC attendance in similar classes conducted by NGOs. Second, there are a number of contractual and funding challenges associated with Department of Defense (DoD) regulations that place strict limitations on DoD funds being used to pay NGOs. While the Office of Weapons Removal and Abatement in the Department of State's Bureau of Political-Military Affairs (PM/WRA) has significantly more latitude to fund NGOs, there are still challenges and limitations on maintaining long-term continuity in the selected NGO vendor. Finally—while not the case in this instance—there can be a reluctance for NGOs to be seen actively engaged and coordinating with military forces. This latter concern may be more applicable to post-war conflicts, but it must be recognized and is best dealt with prior to crisis situations and resolved on a case-by-case basis.

The lack of effective civil-military partnerships, including NGO-military partnerships, was cited by James Stephenson (former USAID director for post-war reconstruction in Iraq) as a key contributing factor to the numerous failures in post-war Iraq. Collectively, the triad of partnerships between NGOs, the U.S. military, and the Vietnamese military will develop inter-organizational and international trust. This will allow the triad to effectively operate together anywhere in the world should we be called upon to work together to mitigate or respond to natural or man-made disasters or post-military conflict. Within Vietnam, the benefits are immediate and tangible with the creation of VNMAC and the certification of its trainers. While there are no current NGO partnerships with USARPAC for MRE and EMT care, the DoS has funded NGO efforts within these areas in Vietnam. Development of NGO partnerships within these two pillars of HMA will assist in developing a comprehensive mine action program that implements all three components of HMA. Coordination through USPACOM with DoS and Vietnamese authorities will make these partnerships possible and effective.

Through USPACOM and in coordination with DoS and Vietnamese Peoples' Army, the 8th TSC must continue to build effective NGO partnerships in Vietnam in order to maximize the potential of VNMAC as quickly as possible. In addition to selecting a long-term EOD partner, the DoD—in partnership with DoS—would be well-served to select NGO partners for EMT training and MRE in order to achieve the same potential benefits as the EOD partnership with Golden West. Once selected, the 8th TSC and subordinate units need to establish early and effective communication with our NGO partners and VNMAC in order to ensure long-term mission success. The most important benefits will accrue to the Vietnamese people, who will see their country free of landmines and ERW that threaten their livelihoods and the well-being of their children. Vietnam gains a credible military capability that can be utilized throughout their homeland and the world in support of United Nations Peacekeeping operations, humanitarian assistance, disaster relief, and other military operations. The United States also gains a trusted, credible partner capable of meeting mutually beneficial national objectives.

The views expressed by the authors' are their own and may not reflect the official policy or position of the Department of the Army, Department of Defense, or the U.S. Government.

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1LT Richard L. Calvin is a platoon leader in the 74th ORD CO, a subordinate company to the 303rd ORD BN (EOD). 1LT Calvin has been an Army EOD officer for two years and has conducted EOD training missions throughout the Indo-Asia-Pacific region. In addition to HMA training in Vietnam, the 74th ORD CO conducts EOD operations and training with Partner Nation EOD forces throughout the Indo-Asia-Pacific Region. 1LT Calvin is a graduate of the United States Military Academy.

Mine Action in Burma: Building Trust and Incremental Gains

by Greg Crowther, Josephine Dresner, and Michael Aaron [MAG, Mines Advisory Group]

A key informant shares his information with the MAG Community Liaison Team, using a Community Safety Map as a reference tool, Daw Ta Yoe village, Loikaw township, Kayah State.
All graphics courtesy of MAG (Mines Advisory Group).

Burma has long been known to be heavily contaminated by landmines and explosive remnants of war (ERW), with 3,693 casualties reported since 1999.[1] The area is a complex and dynamic environment for humanitarian organizations, with multiple overlapping and interlinked conflicts between a number of disparate Ethnic Armed Organizations (EAO) and the Burmese Armed Forces, fought over several decades. In this context, international humanitarian mine action (HMA) operators have not been able to provide any form of technical response; there is currently no mine action coordination center, no agreed national standards, and no demarcation, technical survey, or clearance operations recognized by HMA operators.

This article describes how, in a complex and challenging environment, MAG (Mines Advisory Group) has slowly built relationships with relevant stakeholders and, over a three-year period, moved from undertaking baseline assessments to delivering mine risk education (MRE) and conducting community safety mapping. In addition, MAG advocated for and received permission to undertake non-technical surveys in Kayah State in eastern Burma. This has enabled MAG to record and map hazardous areas, the first time this has been possible for any mine action organization in Burma, giving both a better understanding of the nature, location, and impact of the problem, and providing a model for building trust and developing mine action activities in the country. MAG is sharing findings and lessons learned on an ongoing basis as part of its commitment toward transparency, effective coordination, and the aim of informing complementary non-technical survey efforts, future technical survey efforts, and clearance activities.

From Mine Risk Education to Non-Technical Survey

One of the greatest challenges in HMA is protecting people from landmines and ERW in situations where clearance is not possible or where the threat cannot be removed quickly. MRE aims to reduce the number of accidents by working with at-risk groups to recognize and avoid dangerous areas, items, and risk-taking behaviors. In Burma, MRE and community safety mapping have helped communities reduce risk and have enabled MAG to form relationships and build trust with stakeholders to gradually establish a dialogue on landmines and their impact.

Through baseline assessments, villages were defined as high, medium, or low priority based on the perceived threat (see Figure 1, page 40). This helped prioritize MRE activities and allowed MAG to develop operational plans. Through repeated visits and MRE sessions with different community members, MAG teams were able to build trust with people previously reluctant to talk about landmines. Non-technical survey activities were also informed by the existing safety mapping process, through which the community is encouraged to produce a simple sketch map identifying dangerous areas. This allowed MAG to define **probable areas of contamination**, which MAG presented to the Department of Social Welfare (DSW) to advocate for the pilot and target locations for non-technical survey.

Approval was obtained to conduct a four-month pilot non-technical survey in government-controlled areas in Kayah State, and in July 2016, MAG commenced the first non-

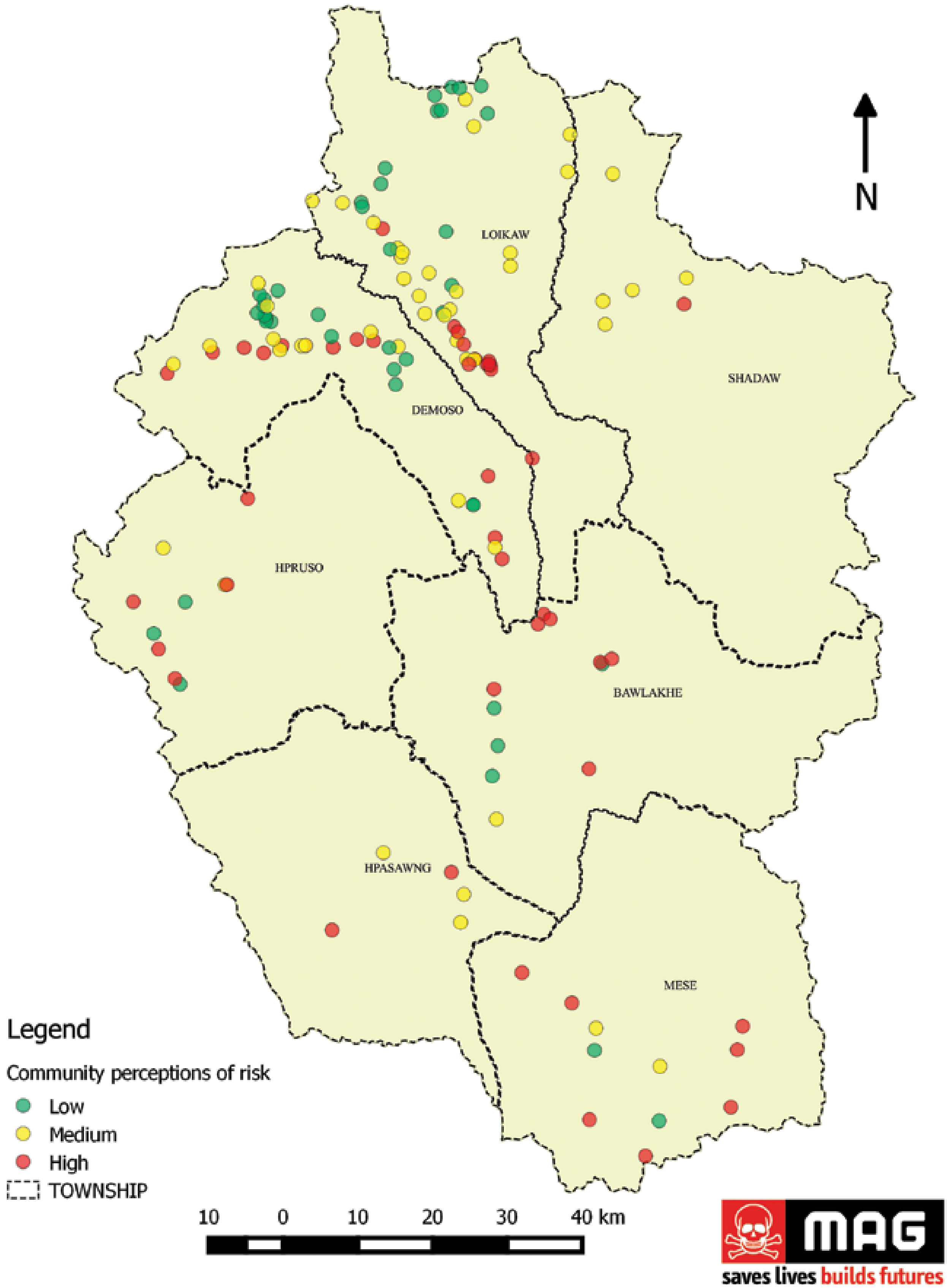


Figure 1. Community perceptions of risk in Kayah State: a map derived from the Conflict History and Situation Assessment conducted by MAG prior to delivery of MRE and undertaking of non-technical survey. This allows MAG to identify villages perceived to be high, medium, or low risk.

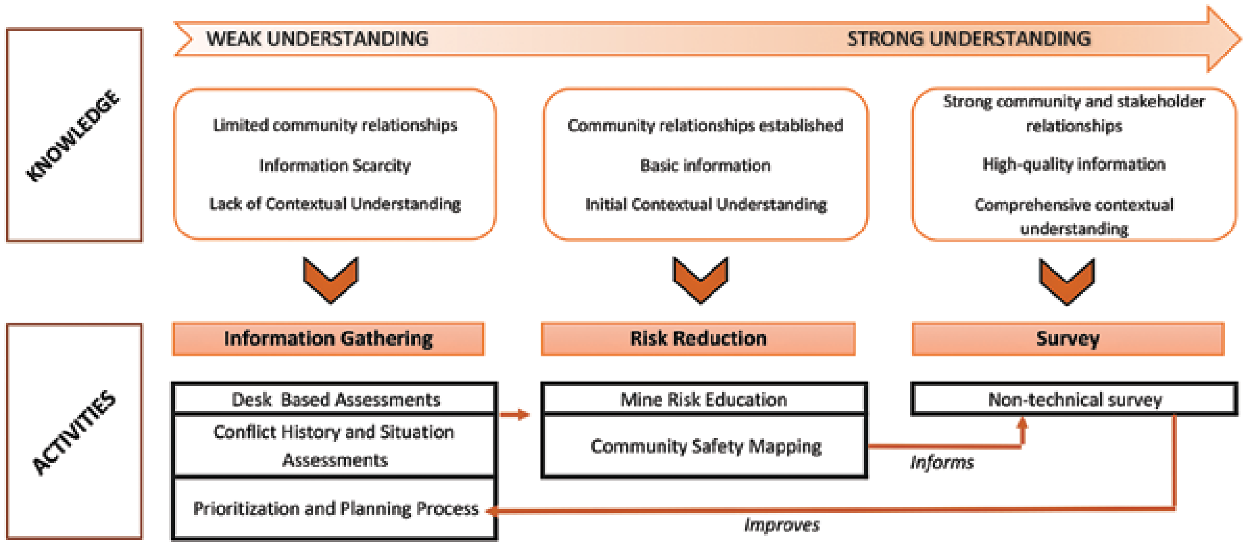
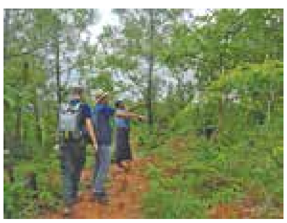


Figure 2. Diagram of process.

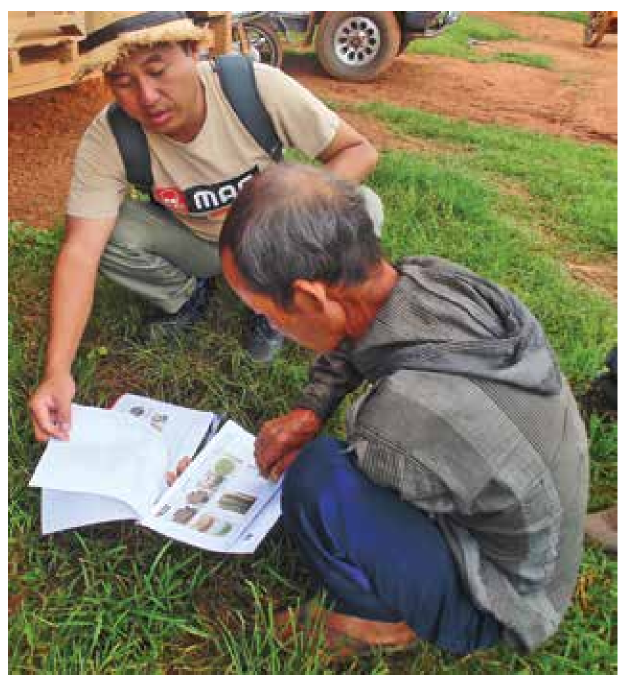


The village leader indicates the former location of a military camp. He had carried landmines for the Burmese military and delivered them to the top of this hill, Daw Ta Yoe village, Loikaw township, Kayah State.

technical survey of contaminated areas in Burma. Surveys were conducted in Loikaw township, focusing on 16 villages in two village tracts, Lawpita and Hparlaung, leading to the identification of 47 hazardous areas. The response from affected communities was positive, often including requests for follow-up assistance, such as marking. MAG also kept other key actors in Kayah informed of its activities, notably the Karenni National Progressive Party, the main ethnic organization in the state, and its social arm, the Karenni Social Welfare and Development Center (KSWDC). Again, MAG found that its updates were well received. The positive reception of non-technical survey activities by all stakeholders and the large number of hazardous areas identified highlighted a need to undertake non-technical survey in a broader geographical area.

In December 2016, MAG presented its consolidated monthly reports to the DSW and was given permission to expand non-technical survey activities to a further 74 villages in 16 village tracts, across six townships in Kayah State. Of 93 hazardous areas identified since starting non-technical surveys, MAG surveyed and mapped 78 by the end of June 2017 with a total area of 77,782 sq m (93,026 sq yd). MAG is now developing a partnership with the KSWDC to undertake further baseline assessments and begin community safety mapping in non-government controlled areas, where contamination is believed to be heavier.

This process, illustrated in Figure 2, has enabled MAG to move from a situation where understanding of the overall context was weak and contacts with affected communities were limited to a situation where understanding is strong and relationships with all key stakeholders are good. The initial assessments inform the MRE and community mapping activities, which in turn provide information that helps plan



A key informant is shown ERW recognition sheets to help identifiy an item that he had previously moved to what he believed was a safer place, Parlaung village, Loikaw township, Kayah State.

An LTM-76 AP fragmentation mine that was laid across a path leading toward a remote village. The path is no longer used, since there was an accident several years ago, near Lawpita village, Loikaw township, Kayah State.

A key informant shows the hazardous area around an electricity pylon. No fences or signs warn the local population, Pa Ra Hi Ta village, Loikaw township, Kayah State.

non-technical survey activities. The information gathered during the non-technical survey improves the content and informs the planning of ongoing MRE activities, which remain vital, particularly while clearance is not yet permitted.

Initial Findings in Kayah State

Although the number of surveys conducted so far is relatively small and exclusively in government-controlled areas, it was possible to identify some initial findings regarding the nature of the contamination, where landmines were used, and how they impact local people.

Nature of the contamination. Explosive hazards found during non-technical surveys undertaken so far consist mainly of anti-personnel (AP) blast and fragmentation mines, such as the India/British LTM-76 (see photo). Other ERW, such as mortars and grenades, were also found in limited numbers.

Location. Landmines have been used repeatedly around electricity pylons. Although the pylons are not always located in former conflict areas, landmines were laid strategically for protection against sabotage—this is a strong indication that survey should be conducted near other key infrastructure such as hydropower dams and development sites. Former military camps and bases are also key locations affected by landmines and ERW. Disused tripwire mines were found on paths between villages, and land used for livelihood activities was reported as being affected by scattered contamination.

Impact. Communities are aware of the presence of landmines near pylons, and some have basic fencing. However, children's movements are restricted due to concerns that they might enter these areas. The threat to infrastructure workers is significant, and military support is often required to ensure their safety, increasing the complexity and cost of otherwise straightforward maintenance activities. Landmines and ERW impede access to land needed for livelihood activities including agriculture and hunting, and pose a risk to livestock. Trade and access to markets are hindered by the perceived or actual threat of landmines on paths between villages. There is also a psychological impact, as the presence of landmines contributes to an atmosphere of fear and acts as a constant reminder of former conflict.

Risk-taking behavior. Communities are often found to have moved items from the immediate area and placed them in locations perceived to be less risky. However, before MRE was widely delivered in Kayah, it was not uncommon for items of unexploded ordnance (UXO) to be collected and stored in or near homes.

Relevance of the Approach in Burma

As well as expanding its activities in Kayah State, MAG is drawing on its experience there to inform activities in Southern Shan State, Taninthayi Region, and Kayin State. Although political and conflict dynamics vary significantly across Burma, sustainable progress is consistently dependent on the approval and agreement of a wide range of actors. Securing access to mine-affected areas, particularly those under mixed or non-governmental control is challenging. Activities involving mapping, whether community-based or conducted through formal non-technical surveys, are particularly sensitive. As a result, permission to undertake different activities is often given incrementally—for example, beginning with baseline assessments and then progressing to MRE in a limited geographical area.

The assessments provide a platform to discuss the discovery of dangerous items or the occurrence of accidents, allowing communities to become increasingly comfortable talking about mine contamination with MAG's teams. At the same time, the initial data collection informs prioritization of areas and enables more targeted follow-up activities. Early community engagement also informs the appropriate local approach, allowing MAG to identify who is most at risk in communities, what types of communication and messaging will be most effective, and how best to maintain and strengthen relationships with community leaders. Data collected during this phase is an important advocacy tool with government authorities and ethnic armed groups.

Sustained engagement in Southern Shan State has enabled increased geographical access. While in Taninthayi Region, MAG developed a patnership with the Karen Department of Health and Welfare, and subsequently received permission to undertake baseline assessments and community safety mapping in several areas. Positive community responses are important factors in building trust with these key stakeholders, along with the local liaison led by MAG's national staff. Partnerships with community-based organizations and national NGOs are also important, facilitating access, and providing potential national capacity for the delivery of mine action activities.

MAG is committed to ensuring that lessons learned during these activities are shared with the mine action sector, and that methodologies are standardized to the extent possible. Early establishment of a coordinated approach to information management is essential. As the sector develops and coordination structures are established, the information gathered in these early stages of non-technical survey will be vital to assisting in the planning and prioritization of mine action resources in Burma.

Conclusion

Implementation of non-technical surveys in Kayah State and the first formal identification of hazardous areas in Burma represent a significant step forward for mine action in one of the world's most heavily mine-contaminated countries. It also offers an opportunity to replicate a successful approach in other parts of the country. Demining is a sensitive topic, particularly given its link to the peace process at national and local levels. Moreover, sustainable progress can only be achieved through detailed context analysis, accompanied by a sensitive approach when engaging with communities and other actors. With these factors in mind, significant progress in understanding the extent, nature, and location of contamination can be achieved in preparation for future clearance efforts.

See endnotes page 66

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Social Inclusion of Marginalized Communities: Mine Action in Laos

by Tina Kalamar [Gender and Mine Action Programme]

A complex array of factors including gender, age, disability, ethnicity, geographical location, language, religious affiliation, and economic and educational status are enabling or constraining social inclusion of people in different contexts.[1] This paper presents a case study that illustrates how mine action can both contribute to and benefit from greater social inclusion.

Mine action affects various domains of people's lives, be it economic, cultural, or social. In this study, the link between social inclusion and mine action in Laos was examined using the concept of intersectionality—the critical insight that "class, gender, sexuality, ethnicity, nation, ability, and age operate not as mutually exclusive entities, but as reciprocally constructing phenomena that in turn shape complex social inequalities."[2] Intersectionality emphasizes the importance of contemplating what it means to have a marginalized status within a marginalized group and to include those who are most likely to be left behind. Therefore, an intersectional analysis of the different aspects of diversity in a given context can help to identify groups of people who might be excluded from the benefits of mine action. This study addressed the following questions: How do mine action operators in Laos contribute to and benefit from greater social inclusion and how can this be further improved by applying the intersectionality approach?

The approach chosen for the study was a mixed methods approach. The data was gathered with semi-structured interviews and questionnaires with two international mine action NGOs operating in Laos. The information is based on the analysis of 41 responses to a questionnaire given to their local staffs working in office support and operations, out of which 24 were male and 17 female. Six semi-structured interviews were conducted with a program officer, translator, community liaison coordinator, human resources manager, and two persons working in the area of victim assistance. Out of six interviews, five were conducted with national staff and one with international staff.

There were certain limitations to the study. Unfortunately, some important mine action operators in Laos were unable to participate. There were also regional limitations, since the data was obtained through the organizations that were operating in the districts of Xiengkhouang, Vientiane, Savannakhet, and Khammouane provinces. Furthermore, out of 41 survey respondents, 38 identified as Lao Loum, which is the majority group. However, two of the five national staff interviews were conducted with members of ethnic minority groups. Despite these shortcomings, the author believes that the data is representative enough for the study to provide a general insight and guidance on how mine action enables the social inclusion of marginalized groups in Laos.

The following section presents the challenges and best practices related to social inclusion through mine action activities in Laos. It illustrates how the analysis of overlapping dimensions of diversity—age, ethnicity, gender, language, disability status, geographical area—is beneficial for the work in mine action as well as for combating social inequalities.

Looking Through the Lens of Intersectionality

Laos, the country that experienced the heaviest aerial bombardment in history, is also one of the region's most ethnically and linguistically diverse countries.[3] Among the different ethnic groups, there are great disparities in their access to resources and opportunities. Most ethnic minority groups in Laos inhabit remote areas and many of them experience high levels of marginalization.[4] One of the interviewees stated, "based on our experience, [the] Hmong minority faces more discrimination compared to Lao Loum and Khmu minority … not many Hmong people can work as government staff or even in civil society organisation[s] or even participate in school and economic development."[5] The interviewees indicated that

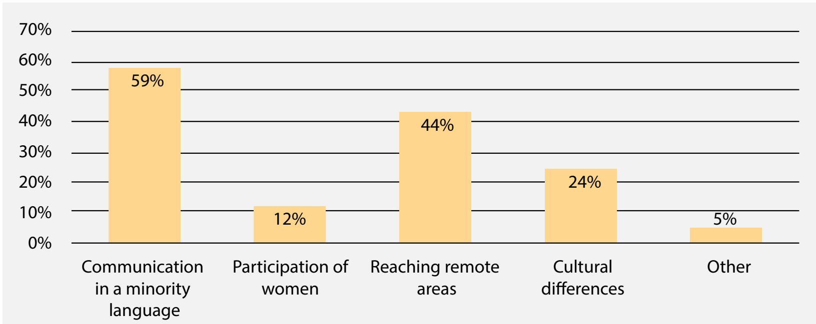

Figure 1. Obstacles encountered at work.
All figures courtesy of the author.

people of different ethnicities on the teams, and 80 percent of participants responded that there are situations where minority language skills are especially needed. The reasons stated are that to work in a multi-ethnic environment, language skills, and familiarity with the cultural particularities are required. The interviewees emphasized that ethnic minority staff facilitate the working process and help avoid cultural and linguistic misunderstandings, the unexploded ordnance (UXO) contamination significantly affects the areas where the ethnic minorities live and expressed their support for recruiting and working with ethnic minorities. Furthermore, they noted that the current national staff is predominantly Lao Loum, Khmu, and Hmong, and that these are also the communities they frequently work with. This is influenced by the fact that in the provinces where they operate, either Khmu or Hmong are the main minorities. However, several interviewees stated that many projects focus only on these three largest ethnic groups and that there is a need for more ethnically diverse staff.

Ethnic diversity is also reflected in a high degree of linguistic diversity.[6] Only around half of the population in Laos speak the official national language, Lao. The interviewees stated that there is a higher chance of encountering language barriers in remote communities, where Lao is spoken less frequently than in the urban areas. They also indicated that in the remote areas, children can often speak the official language due to their access to education, while women and older generations usually have lower language skills than men and younger generations. Moreover, the likelihood of someone knowing the national language depends on their geographical area and ethnicity. For example, one of the interviewees said that “Khmu people are more easily understood (in Lao) than Hmong people, so mainly when we go to Khmu community we just speak Lao to them and more or less they will understand it.”[7]

As demonstrated through the analysis of the survey, communicating via the minority language, reaching remote areas, settling cultural differences, and ensuring the participation of women are perceived as workplace obstacles by the national employees.

The quantitative and qualitative data indicate that mine action workers value having staff from different ethnic minorities that speak different minority languages. Ninety-three percent of participants responded that it is important to have

especially in rural areas. Additionally, the knowledge of minority languages ensures that groups unable to speak the majority language due to lack of education or a generational gap, such as women and elders, can be reached by the program. For example, one interviewer stated that the government prohibited the translation of mine risk education (MRE) material into the local language, and therefore stressed the importance of having staff who speak more languages and can communicate with the community directly. Regarding community liaison activities, one interviewer said that “if we have one ethnic staff working for us, then we go to [the] ethnic village, to Khmu or Hmong community because it eases communication and the community understands the process better.”[8] This demonstrates the importance of having members in the non-technical survey, MRE, and community liaison teams who have the necessary language skills and familiarity with local cultural particularities to adequately interact with all members of ethnic minority communities, share messages on safe behavior, and obtain more complete and accurate information, be it on the socioeconomic situation or on the contamination by UXO from all groups.

A majority of the interviewees stressed the important role of the local authority when working in remote areas. For example, a respondent stated that “the [organization] cannot enter the village without the village chief’s permission” and that the ethnic staff can potentially negotiate with the local authority more effectively.[9] A good relationship with the local authority can be fruitful in that changing mindsets of the larger community leads to greater social inclusion of minority women and persons with disabilities. An interviewee stated that “the population of the community believes in this local authority, so if the authority takes the role strongly that everyone should have equality and the same rights, the change is possible.”[10]

The previously presented examples indicate how ethnicity, language, and geographical location intersect. A further

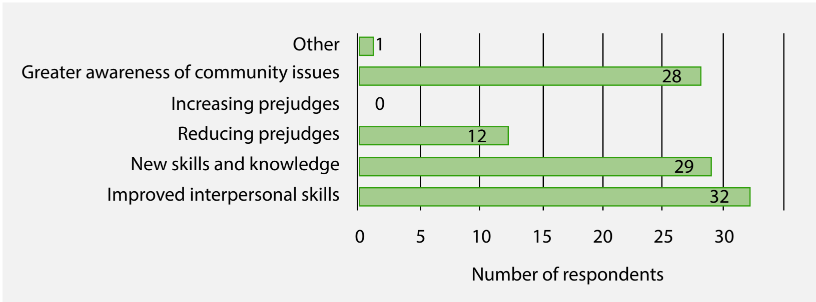

Figure 2. Influences of working with colleagues from different ethnic communities.

important dimension identified was gender. The interviewees stated that the gender aspect is particularly sensitive in remote areas, where the women's status and roles are often highly unequal to those of men, which influences the work of mine action. For example, in community liaison activities, victim assistance, and when recruiting women as deminers, the organizations encountered difficulties in reaching out and transmitting the information directly to women. It was stated that when working with remote communities "the process has to go through the local authority, and then the local authority refers only to the heads of the families, which are mostly men."[11] And also "when our community liaison officer sets a meeting in a village the number of males will be higher than the number of females."[12] The interviews and surveys also indicated that the clearance work is often perceived as a male role, and that it is deemed inappropriate for women to be away from the family during the required three-week working cycles.

Interviewees discussed how organizations overcome sociocultural obstacles and disclosed some of their best practices in promoting women's participation in mine action activities. One of the interviewees suggested that in order to better reach women when doing community liaison activities, women should take the lead in the project. He suggested organizing a small activity like handicraft production where women would feel more comfortable in speaking out. Furthermore, one of the interviewees stated that their organization employs female staff in community liaison teams because "women and children are talking to women much easier, that's why we deploy men and women together to work in different villages."[13] Another positive example of recruiting women from poor families as deminers was shared, where the organization targeted women with very low education. Some of these recruited women did not speak the official Lao language, therefore a translator facilitated communication. It was added that with time these employees improved their knowledge of the national language, which improved both their language skills and economic status. Moreover, in one of the interviews it was reported that one of the NGOs has a female provincial operations management staff member, which is one of the highest positions national staff can obtain and includes responsibility for managing mixed teams, female teams, and male teams. The interviewee stated that the female manager originally had "problems with getting the respect she deserved, but with time it improved."[14]

This data indicates that the interplay between ethnicity, gender, and disability status is an additional dimension that deserves attention. The government of Laos estimates that there are about 600,000 people with disabilities throughout the country, most of whom are victims of UXO and other explosive remnants of war (ERW).[15] The interviewees working with UXO and ERW survivors observed that women and children with disabilities are faced with additional discrimination in comparison to men. One interviewee noted that, regarding women and children with disabilities, "they are faced with more difficulties and they have no role to play in the family and in the community."[16]

On the one hand, an interviewee stated that "people believe that disability is something bad and for instance if one family has children with a disability then it is believed that the family has bad luck and then the community will complain and they will discriminate against them."[17] On the other hand, another interviewee mentioned that, after Laos ratified the U.N. *Convention on the Rights of Persons with Disabilities* (CRPD) in 2010, numerous training courses were conducted, which positively contributed to the reduction of discrimination against persons with disabilities, including victims of UXO and ERW. While the change in people's attitudes toward people with disabilities was, to a large extent, observed more in the urban areas, there was a positive instance of promoting social inclusion of persons with disabilities given by one interviewee who said their organization employed Hmong minority persons with disabilities and tried to give them jobs, for example as camp guards for the teams or in office support.[18]

These were the identified challenges and best practices related to social inclusion through mine action in Laos. But could working in mine action also have other benefits for the daily life of individuals and for the society at large?

As demonstrated by the survey analysis in Figure 2, the recruitment of diverse ethnic and female staff has the potential to benefit the staff's interpersonal skills and knowledge, increase awareness of community issues, as well as reduce prejudices of the employees.

Conclusion and Recommendations

Implementation of non-technical surveys in Kayah State and the first formal identification of hazardous areas in Burma represent a significant step forward for mine action in one of the world's most heavily mine-contaminated countries. It also offers an opportunity to replicate a successful approach in other parts of the country. Demining is a sensitive topic, particularly given its link to the peace process at national and local levels. Moreover, sustainable progress can only be achieved through detailed context analysis, accompanied by a sensitive approach when engaging with communities and other actors. With these factors in mind, significant progress in understanding the extent, nature, and location of contamination can be achieved in preparation for future clearance efforts.

This article discusses the usefulness of looking at mine action programs and activities through an intersectional lens. The findings suggest that it is not only important for NGOs working in mine action in Laos to consider the great ethnic diversity of the country, but also dimensions of further disadvantage, such as gender, disability, geographical location, age, and language. Because the non-Lao-Loum women and girls, persons with disabilities, and people living in rural areas are subjected to additional discrimination, an analysis of the interplay of these diversity factors is important to achieve their inclusion as well as to improve mine action work. The findings indicate that mine action operators in Laos benefit from employing and working with the marginalized groups, because the knowledge of minority languages and cultural particularities proved to be of great importance in mine action, especially when conducting survey, MRE, victim assistance, and clearance in rural areas. At the same time, mine action operators can contribute to greater social inclusion through employment opportunities, improving knowledge and skills, increasing cultural sensitivity, and even contributing to the eradication of harmful traditional beliefs, such as misconceptions about disability.

The following is a non-exhaustive list of recommendations on how to increase social inclusion through mine action based on the findings for Laos:

- Apply the intersectionality approach, i.e., look at how different aspects of diversity interact to construct social inequalities by ensuring that recruitment and training grant full access to marginalized individuals or groups within ethnic minorities.
- Increase the number of mine action projects that focus on ethnic minority communities, especially in rural areas.
- Ensure that the non-technical survey and community liaison teams employ both male and female members who have the necessary language skills and familiarity with cultural particularities to adequately interact with the local communities, share safe behavior messages and obtain more complete and accurate information from all groups.
- Collect and analyze employment data by ethnic group, age, sex, and disability status.
- Increase the employment opportunities for women and ethnic minorities, especially targeting the members of underrepresented ethnic groups, minority women, and people with disabilities.
- Advertise available positions in communities where projects are implemented, especially targeting remote rural areas.
- Apply a human rights-based approach to ensure compliance with relevant international legal treaties such as the *International Convention on Civil and Political Rights* (ICCPR), *International Covenant on Economic, Social and Cultural Rights* (ICESCR), *Convention on the Elimination of all Forms of Discrimination Against Women* (CEDAW), Committee on the Elimination of Racial Discrimination (CERD), and CRPD, aiming especially at protecting and promoting the rights of women, ethnic minorities, children, and persons with disabilities.

See endnotes page 66

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Epidemiological Study of Landmines/ ERW Accidents and Victims in Kachin, Kayah, and Shan States, Burma

by Julien Zwang, Ph.D. and Pascal Simon [Danish Refugee Council / Danish Demining Group]

In Burma, there is no systematic and organized victim information system (VIS) of landmine and explosive remnants of war (ERW) victims, and few studies have been conducted on the topic, in particular in Kachin, Kayah, and Northern Shan States (NSS), where most of the accidents have recently occurred. Between 2015 and 2016, casualty reports compiled by the Mine Risk Working Group (MRWG) chaired by the Department of Social Welfare (DSW) showed that the number of mine/ERW victims increased by 58% in the country, particularly in Kachin and Shan States, while the number of victims decreased in Kayin State. Documenting victims' profiles and risk behaviors are needed to help design victim assistance and mine risk education (MRE) programs. To collect this information, Danish Refugee Council/Danish Demining Group (DRC/DDG) conducted an epidemiological study in Kachin, Kayah, and NSS to analyze data collected about mine/ERW victims and accidents.[1]

Method

The study combined a qualitative analysis using an anthropological approach and a quantitative analysis of mine/ERW victims recorded by DRC/DDG using the Information Management System for Mine Action (IMSMA) standards. The qualitative part of the study was conducted in Kachin and NSS from April to May 2017 and used the Washington Group Short Set of Questions on Disability to assess the type and the severity of the functional impairments of the victims. Risk ratios (RR) and adjusted odds ratios (AOR) using multivariate analysis were measured. Confidence intervals (CI) were calculated at 95% (95% CI), and comparisons were considered statistically significant when the p value was below 0.05 ($p < 0.05$). Data were analyzed using Statistical Package for Social Science (SPSS).[2,3]

Ethics

Informed oral consent was obtained from all study participants after explaining the interview content, and discussions only started after the respondent agreed. For people under 16 years old, consent was sought from a family member, who was present during all interviews. All interviews were anonymous, and the names were not recorded for confidentiality.

Results

Overall, 290 mine/ERW victims were included in the study in 211 separate accidents occurring in rural areas up to May 2017. In-depth interviews were conducted with 35 victims, and 255 victims' data were analyzed from a mine/ERW victim register. As a total, over three-quarters (77%) of the accidents happened in Kachin State, 15% in Kayah, 5% in NSS, and 3% in other regions. A higher number of accidents were reported since 2014 in Kachin State, in particular in Bhamo district (Mansi and Momauk townships) and Mhonyin district (Mogaung and Mhonyin townships).

A traditional IDP home.
All graphics courtesy of DRC/DDG.

Profile of the Victims

Adults accounted for 83% of the victims, adolescents 13%, and younger children 4%. Most of the victims were farmers (40%), laborers (11%), or students (11%), while army soldiers represented 8% of the victims. Males were over five times more at risk for mine/ERW accidents than females (84%, 16%, respectively, RR 5.83, $p = 0.001$).

The fatality rate among all mine/ERW victims was 24%. Nearly two-thirds of survivors (60%) had to stop their routine activities because of the severity of the disability caused by the accident (59% of the farmers, 61% of the laborers, and 68% of the soldiers). The fatality rate in students was higher (38%) than in other population groups, and 54% of the student survivors had to drop out of school. Unemployment was multiplied by fourfold, and 67% of the survivors were unemployed following their accident.

Landmine accidents caused extreme livelihood hardship for the extended family, particularly in cases of severe injuries or death of the victim, since 80% of the adult victims had children. Of the victims, 62% were settled and 33% were internally displaced persons (IDP). In Kachin State, IDPs (who represent a smaller population compared to settled villagers) are over nine times more at risk for an accident (RR 9.49, $p = 0.001$) than settled villagers, while in NSS only settled villagers had a landmine accident (as recorded in the DRC/DDG database).

Seasonal trend. Over the years, rural populations were significantly more at risk of suffering mine/ERW accidents in April and May (RR 1.72, $p = 0.001$) compared to other months, while the number of accidents significantly decreased (RR 0.41, $p = 0.001$) during the first part of the rainy season (from June to August).

Place of accident. All accidents took place in rural areas, mostly in the forest (31%), on a foot path (17%), or on the side of a path (13%). Other accident locations (< 6%) were in villages, along a riverbank, or on grazing land, fields, farming land, residential or military areas.

Activities at the time of accident. At the time of an accident, the most frequent activities were travelling on foot (28%); collecting firewood (13%); tending animals (12%); travelling by vehicle such as bullock cart, motorcycle, or bicycle (8%); military duty (7%); or hunting or fishing (7%).

Compared to settled victims, IDPs were slightly more at risk of having an accident while travelling on foot (RR 1.32, 33%, 25%, respectively, $p = 0.141$). IDPs were also more at risk than settled victims of having an accident while hunting or fishing (11%, 5%, respectively, $p = 0.042$). On the other hand, settled victims were at significantly higher risks for accidents while tending animals (5%, 16%, respectively, $p = 0.008$) and tampering with landmines and ERW (0%, 4%, respectively, $p = 0.063$) compared to IDPs.

Perception of danger. According to respondents, "in conflict zones, there is no mine sign indicating dangerous areas," and the vast majority of the victims did not think that the place of the accident was hazardous (79%). Compared to adult victims, younger victims were at higher risks (AOR 3.53, 95% CI 3.20–3.88, $p = 0.051$) of believing that the location of

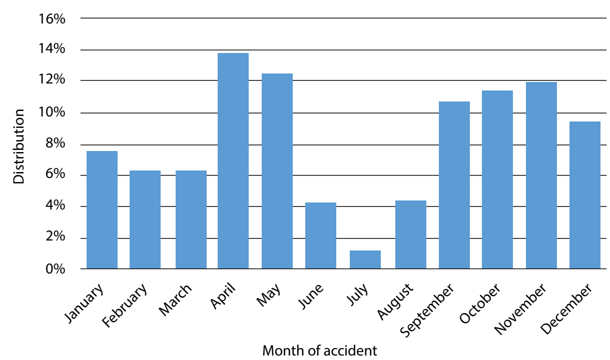


Figure 1. Month of the landmine/ERW accidents.

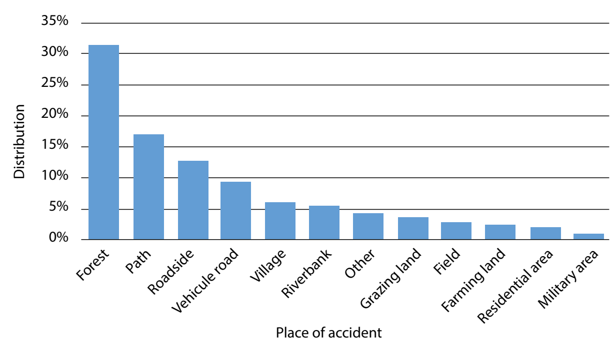


Figure 2. Place of the landmine/ERW accidents.

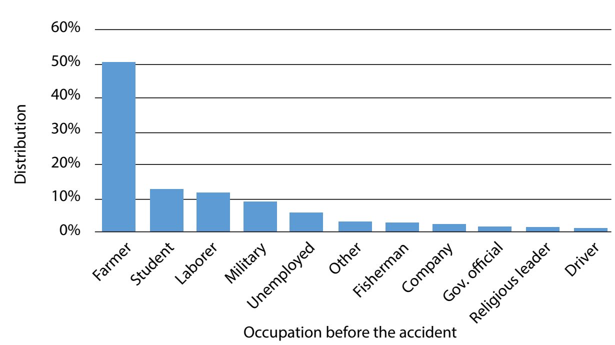


Figure 3. Activity at the time of the accident, landmine/ERW victims.

their accident was not a hazardous area (91%, 76%, respectively). Among victims who were conscious of the danger, the most frequent activities during the accident were military duty (30%) and travelling on foot (29%), while for those not conscious of the danger, the activities were travelling on foot (29%) and collecting firewood (15%).

Reasons for entering hazardous areas. For most of the respondents, the perception of danger was distorted by their extreme poverty and livelihood, which led to unsafe behaviors. Most of the respondents had an accident in hazardous areas because of economic necessity (51%), because of no other access (8%), or by peer pressure (8%). Despite knowing they were travelling across hazardous areas, farmers still need to make a living and cannot abandon their livelihood activities (farming, fishing, or collecting leaves in the forest). Despite understanding that the area was potentially dangerous, some people thought that going to the same area or using routine strategies by walking on the same path would reduce the risk of having an accident. The perception of danger was also related to the knowledge of the number of accidents occurring in the area. Other reasons for entering hazardous areas (33%) were when victims had to flee their village because of hostilities or were engaged in forced labor or military duties.

Medical Assistance

The fatality rate among mine/ERW victims was 24% with no difference between genders. Half of the deceased were killed in situ, while the other half died during medical evacuation or at the medical facility.

Among mine/ERW survivors, 40% had multiple injuries. A large majority of the survivors (62%) had an injury below the knee and 21% above the knee. Other injuries involved the arm (19%), finger (14%), and abdomen (12%). The prevalence of each other injury—eyesight, back, head/neck, chest, pelvis, and hearing—was below 10%. In many cases, landmines' metallic fragments were not all removed by the medical services, in particular in Kachin State. Leaving fragments in the body increases the risk of severe pain, which prevents victims from working.

Comparing the prevalence of injuries between survivors and deceased victims (not in situ, i.e., during evacuation or at the health facility), we observed that multiple injuries increased the risk of fatality (AOR 4.36, 95% CI 1.11–17.06, $p = 0.023$). Other risk factors for fatality were an injury above the knee (AOR 5.12, 95% CI 1.46–17.90, $p = 0.005$) or at the abdomen (AOR 4.74, 95% CI 1.26–17.88, $p = 0.013$). Most of the victims (52%) could not reach the first hospital in less than four hours, while 28% took from two to four hours to reach a hospital and 20% took less than two hours. Overall, victims of an accident in Kachin State were at higher risks for fatality (AOR 2.79, 95% CI 1.18–6.61, $p = 0.020$) than in other states, and teenagers (AOR 2.84, 95% CI 1.29–6.27, $p = 0.010$) were at higher risks for fatality than other age groups.

Tea leaf garden.

Alternative Livelihood

Particularly for persons with a severe disability or for family members of a deceased victim, home-based livelihood activities seemed to be a good way to generate an income and avoid travelling to hazardous areas. To promote home-based livelihood activities, DRC/DDG provides support to victims by donating two piglets or a cash grant to open a small shop in front of the house.[4] For the respondents, these home-based solutions are good livelihood alternatives as it is safer than travelling to hazardous areas or, for IDPs, than returning to their village of origin that could be contaminated by landmines and where the conflict can resume.

MRE and Perception of Populations Most at Risk

For respondents, while landmines are theoretically supposed to target military personnel, the groups most at risk of accidents in Kachin and NSS are rural, low-income people of all ages. Respondents indicated that, even if they are aware that the area might be dangerous, they still have to take a chance for their daily livelihood and the survival of their family.

Piglets donated by DRC/DDG to landmine survivors as an alternative source of income

Respondents noted that receiving MRE training increases awareness about the dangers of landmines and can reduce casualties. Respondents also indicated that adults who receive MRE training can also teach their children safe behaviors in hazardous areas.

Conclusion

The mine/ERW study conducted in Kachin, Kayah, and NSS identified a total of 290 mine/ERW victims combining both quantitative and qualitative techniques. All mine accidents happened in rural areas and involved IDPs as well as settled villagers.

Recent casualty reports showed that the number of mine/ERW victims increased in Burma, mainly because of a surge of accidents recorded in Kachin and NSS. Moreover, in Kachin State, IDPs are nine times more at risk of mine/ERW accidents than settled villagers while in NSS, the victims were settled villagers.

During ongoing armed conflicts and without mine/ERW clearance activities, vulnerable people from rural areas are forced to travel to hazardous areas for their livelihood needs, indicating that they are prone to extreme poverty and that their perception of danger is distorted because of financial necessity.

Overall, people from rural areas have frequent accidents because they are more exposed to landmines and ERW while walking on a footpath or driving a vehicle in hazardous conflict areas or next to armed groups' camps on their way to livelihood activities (collecting leaves or firewood, farming, fishing, or tending to livestock). Tampering with or using artisanal explosives are also unsafe behaviors that were reported.

IDPs traveling on foot to their villages of origin (to check their homes or their livestock) face increased risks of mine/ERW accidents. In addition, IDPs are at a higher risk of mine/ERW accidents when they are fleeing the conflicts while their home village is besieged by armed groups and must escape to the forest, or while they are walking outside an IDP camp to collect food in the nearby forest.

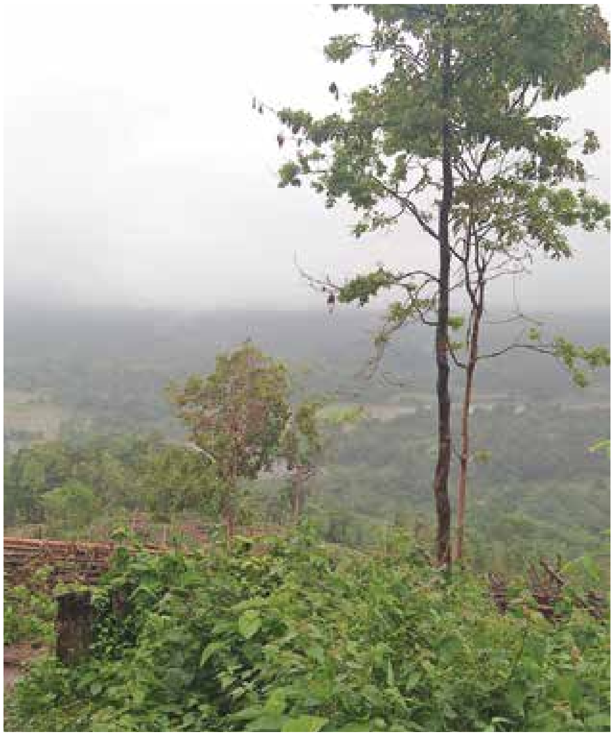
Remaining mine/ERW metallic fragments that are not removed from the victims' bodies indicate a need for better health care services and infrastructure. Poor responses from medical services after an accident might lead to irreversible and severe pain as well as physical impairments. Unemployment could be the consequence of these disabilities, resulting in economic hardship for the family as 60% of the survivors had to abandon their professional activity after the accident and 80% of the adult victims, including deceased victims, had children at the time of the accident.

Combatants, who were supposed to be the primary targets for landmines, often receive better medical assistance in military medical facilities than other population groups. High fatality rates in mine/ERW accidents, particularly in Kachin State, are probably due to the remoteness of the accident locations and poor transportation infrastructures, which increase the time of evacuation.

Recommendations

Mine risk education. Because of an increase in military activities at the end of 2016 and the beginning of 2017, some areas still subject to armed conflicts lack MRE training and victim assistance, and the number of accidents has recently increased in Kachin and NSS. MRE training sessions in IDP camps and villages should therefore be continued and strengthened. MRE should also be included in school curriculums to increase awareness about the danger of landmines and ERW, and reduce unsafe behaviors among children and youth. While taking into account seasonal variations (increased risk of accidents from April to May), MRE programs should primarily focus on IDPs who are at higher risk of accidents while traveling on foot to their village of origin.

Advocacy. Overall, we recommend raising awareness of the study results and subsequent training on disability-inclusive development (i.e., including marginalized and excluded groups as stakeholders in development processes) to State level authorities (district, township, and village). By creating more awareness of mine/ERW victims with disabilities, especially relating to livelihoods, and the access and inclusion of persons with disabilities in educational and health programs, the situation in Burma will improve.



Hills in Kachin State.

Victim assistance and rehabilitation. The remoteness of accident locations and the poor transportation infrastructures in Kachin and NSS increases evacuation times and highlights the difficulties victims have in accessing medical services. Mapping available services and delivering training on referral pathways (i.e., efficient lines of communication between health services) is recommended, in particular for medical emergency and physical rehabilitation services. Information campaigns on access to services would be an asset for landmine victims with severe disabilities to promote access to health and medical rehabilitation as well as economic and education services.

In a context of extreme poverty faced by mine/ERW victims and their families in Burma, forthcoming interventions should focus on inclusive vocational training programs and livelihood opportunities. Mine/ERW victims' reintegration assistance should preferably be community-based, conflict sensitive, and delivered through local organization networks providing vocational training, small business grants, and livelihood support. Grants for surgical support could be provided to survivors with metallic fragments remaining in their bodies to help relieve them of severe pain, which in turn limits their job opportunities.

Psychosocial support should be delivered through community-based organizations, and the creation and strengthening of self-help or peer support groups should be applied to increase social cohesion, dissemination of information, and awareness raising on the rights of persons with disabilities. Persons with disabilities must be included in the provision of assistance services, especially services essential to basic needs (primary healthcare, food distribution, water access, sanitation, and hygiene). This includes the consideration of mine/ERW victims with disabilities in a humanitarian crisis. Physical and communication accessibility must also be considered. For mine/ERW victims with severe food shortages, food aid interventions should first focus on children and persons with severe disabilities.

Victim information system. Without a national mine/ERW accident notification system, the methodology used to record the accidents by mine action organizations is likely to underestimate the number of victims. While these organizations have developed a simple system to collect information on the victims through their own networks to guide their strategic interventions, a national, organized, and systematic victim information system complying with international standards should be established.

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Field Notes

Bridging a Critical Mine Action Information Management Gap: Complex Conflict Environments

by Isam Ghareeb Barzangy [iMMAP]

Historically the Republic of Iraq is one of the most severely landmine, explosive remnants of war (ERW), and improvised explosive device (IED) afflicted nations in the world. Though possessed with a robust humanitarian mine action (HMA) program in the three northern Kurdish governorates before the Iraq War (2003–2011), the remainder of the country was largely without any HMA focus until the removal of the Ba'ath regime. Iraq's border with Iran contains major military minefields and ERW, while small arms and innumerable stockpiles of ammunition remain throughout the country. High levels of landmine, ERW, and IED contamination are a major challenge for the government and HMA responders, and increasingly impair mobility among segments of the civilian population, placing the Iraqi people in an untenable situation. The Iraqi political process remains gridlocked, which negatively impacts the work conducted by Iraqi government institutions, including the Directorate of Mine Action (DMA) in Baghdad.

The current protracted conflict in Iraq relating to the Islamic State in Iraq and Syria (ISIS) has resulted in the displacement of 3.3 million people and a significant increase in contamination. ISIS has employed mines and IEDs in large quantities in both urban and rural areas, targeting security forces, humanitarian aid workers, and HMA operators, making it extremely dangerous for them and also for returnees.

While landmine, ERW, and IED contamination is extensive in areas taken back from ISIS, the absence of a coordinated information management system exacerbated the level of risk to both the humanitarian actors and the returnees. Due to the geopolitical situation, the majority of retaken areas fell under the shared responsibility of the two national mine action authorities in Iraq: DMA in Baghdad and the Iraqi Kurdistan Mine Action Agency (IKMAA) in Erbil. This shared responsibility created a **Gray Area** in which coordination and information management were absent, preventing organized, coordinated, and evidenced-based HMA activities.

iMMAP in Iraq supports a comprehensive range of HMA information management and capacity-building services to address ERW and IED contamination during and after complex emergencies. Recognizing the urgent need for an information management center, iMMAP in Iraq took the initiative with direct support from the Office of Weapons Removal and Abatement in the U.S. Department of State's Bureau of Political-Military Affairs (PM/WRA) to mediate and establish a memorandum of understanding (MoU) between the two national mine action authorities, DMA and IKMAA, on 14 September 2015. The MoU authorized iMMAP to set up an information management center to manage and coordinate HMA activities within the retaken areas (Gray Area), which fall under the shared responsibility of DMA and IKMAA. This MoU is the first document signed between DMA and IKMAA since 2003.

Due to the armed conflict and the expansion of the Gray Area boundaries, the MoU has resulted in the establishment of a **Joint Operations Room** (JOR) led and coordinated by iMMAP. JOR provides centralized planning, operations coordination, and information management support directly to HMA organizations working in the Gray Area, filling information gaps and enhancing the HMA response.

The JOR has the following functions:

* **Information Management.** iMMAP manages and hosts the dedicated Information Management System for Mine Action (IMSMA), which collects information on hazardous areas and HMA activities conducted by organizations in areas recently retaken from ISIS. iMMAP assists IKMAA and DMA with collecting and processing data as well as organizing required training for organizations working in the field. iMMAP submits all field reports to the IMSMA server for the Gray Area and hands over datasets to DMA and IKMAA offices after a final verification. The humanitarian community

can benefit from this information.

- **Centralized Planning, Strategizing, and Coordination.** This allows for a safer process of the returnees to an environment that is currently highly contaminated with IEDs. For instance, clearance may be ongoing in an area where civilians are returning. Thus, the areas where civilians are returning are prioritized for clearance.
- **Gray Area Coordination.** The iMMAP Erbil office organizes and hosts monthly coordination meetings for all stakeholders involved in the Gray Area. The purpose of these meetings is to update all parties about the current status of ERW and IED contamination in the Gray Area, recent progress, clearance achievements, and the coordination and collaboration mechanisms of the stakeholders in the Gray Area. The participants include the national mine action authorities, nongovernmental organizations (NGO), security forces, U.N. agencies, and representatives of the international coalition forces.
- **Clearance Activity Monitoring.** The clearance activity monitoring team consists of DMA, IKMAA, and iMMAP personnel, and conducts site visits on a regular basis to monitor the clearance activities of mine action operators in the Gray Area. The team documents findings and makes recommendations to the relevant authorities to enhance the clearance process and recommend actions to improve the health and safety procedures of mine action operators.
- **Mine Action Technical Working Group.** iMMAP organizes and hosts meetings for the mine action technical working group on a monthly basis, which invites all mine action stakeholders in the Gray Area to update the group on the current status of ERW and IED contamination and to share experiences from operational activities conducted throughout the area. Participants discuss the latest strategies and tactics practiced by the armed groups and exhibit the items found during clearance activities. The purpose of the meetings is to enhance the safety of the clearance teams.

Achievements	Quantity
Non-technical survey (NTS)	14,642,157 sq m
Calculated contaminated area	8,828,842 sq m
Reported cleared area	3,536,164 sq m
Number of recorded hazards	1,027
Number of recorded completion reports	874
Number of destroyed devices	7,012
Number of recorded NTS reports	114
Number of recorded risk education reports	3,157
Number of beneficiaries	117,896

Figure 1. Quanitfying the achievements.[1]
Figure courtesy of the author.

Summary of Achievements

- The Gray Area MoU has been fundamental to minimizing the mine action information management gap that existed before the commencement of the MoU.
- The MoU is enabling a planned, prioritized, timely, and evidence-based mine action response that allows for safer return of civilians. It has improved coordination and collaboration of the national mine action authorities.
- The waiver for the registration pre-condition has allowed HMA organizations to work in the Gray Area immediately given that they are registered in either of the national mine action authorities. Prior to this, HMA organizations had to wait months in some cases to complete the registration process in both offices of DMA and IKMAA and to obtain authorization to work in the Gray Area.
- Recognizing that mine action is a collective effort, the MoU has enhanced relations and national collaboration for strategic planning and adherence to conventions.

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Isam Ghareeb Barzangy
Country Representative of Iraq & Senior Technical Advisor
iMMAP

Isam Ghareeb Barzangy is currently the iMMAP country representative for Iraq and senior technical advisor. Barzangy has held positions from 1999 to 2011 with the United Nations Office for Project Services in various countries in the field of mine action database programming and information management. Barzangy completed his bachelor's degree at the University of Salahaddin in Erbil, Iraq, and his Master of Business Administration from Robert Kennedy College in Zurich, Switzerland. Barzangy completed the CISR Senior Managers' Course in ERW and Mine Action in May 2016.

Addressing the Explosive Hazard Threat in Northern Syria: Risk Education on Landmines, UXO, Booby Traps, and IEDs

by Louise Skilling and Marysia Zapasnik [DCA]

Explosive hazards pose a great threat to civilians in Syria. A rapid return of displaced people usually occurs as soon as an area is declared **newly taken**. During this period, there is limited medical and explosive clearance capacity although there are high risks from explosive hazards, including booby traps and improvised explosive devices (IED) specifically targeting civilians in their homes. This article focuses on addressing the threat of explosive hazards in northern Syria and draws on risk education material designed by humanitarian mine action organization DCA to target adult returnees in Syria.

IED risk education to recent returnees in northern Syria, 2016.
All graphics courtesy of DCA Syria.

Syrian Context

Since the beginning of the Syrian civil war in 2011, hundreds of thousands of people have been killed. The United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) estimates the conflict has displaced 11.3 million people—6.3 million within Syria and 4.8 million as refugees. Parties to the conflict repeatedly breach international humanitarian law and international human rights law. In some instances, civilians and civilian infrastructure appear to have been directly targeted during attacks.[1] The extensive use of explosive weapons during the six years of conflict poses a grave threat to Syrians, first responders, humanitarian operations, and livelihood activities. The situation in Syria is highly complex and constantly changing. This is illustrated by the map of Syria in Figure 1 and the various actors controlling different territories of the country as of 7 June 2017.

Explosive Contamination in Syria

Analysis of explosive contamination resulting from the conflict in Syria has shown that the types of explosive weapons used are varied and include landmines, various ordnance (e.g., artillery), cluster munitions, booby traps, and IEDs.[2,3] According to Action on Armed Violence (AoAV), Syria is one of the states most affected by explosive violence, with 86 percent of fatalities between 2011 and 2016 being civilians.[4]

The International Mine Action Standards (IMAS) define an IED as:

> *A device placed or fabricated in an improvised manner incorporating explosive material, destructive, lethal, noxious, incendiary, pyrotechnic materials or chemicals designed to destroy, disfigure, distract or harass. They may incorporate military stores, but are normally devised from non-military components.*[2]

Almost any object can be made into an IED or a booby trap. They can be found anywhere and are usually intended to be undetectable and designed to target the unwary.

A booby trap is defined by IMAS as:

> *An explosive or non-explosive device, or other material, deliberately placed to cause casualties when an apparently harmless object is disturbed or a normally safe act is performed.*[2]

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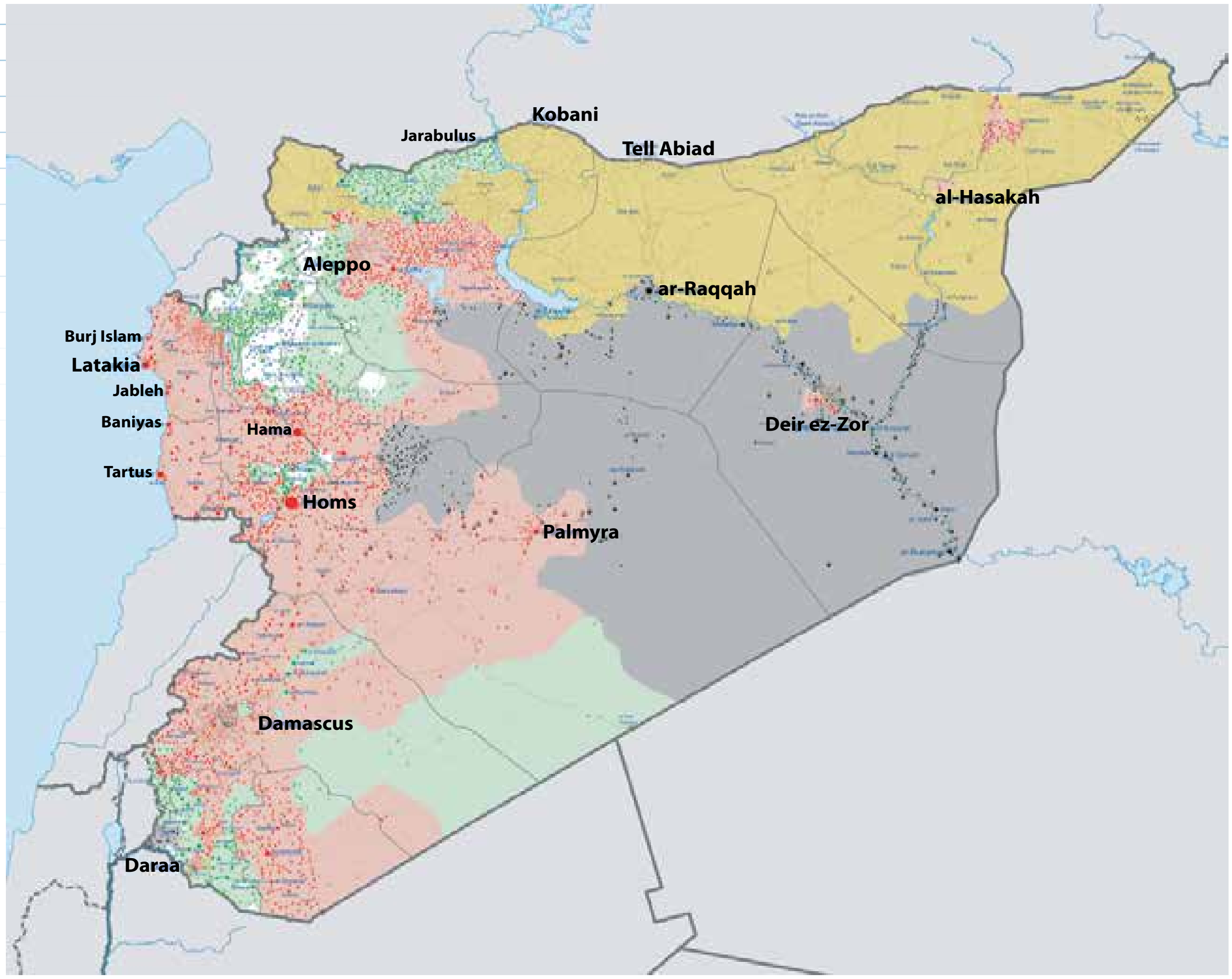

Figure 1. Territorial control of Syria by various actors as of 7 June 2017.

A few weeks after the end of the hostilities in Kobane, northern Syria, a humanitarian worker described the situation as follows:

> *The streets were littered with explosives – people had to watch every step they took … as more families returned to rebuild their lives, reports of incidents involving explosives became a daily occurrence. Some victims made it to a medical facility and survived, but many did not. It was devastating to witness that for people who had already lost so much, there was still more to lose.*[5]

It has been suggested that organized armed groups like the Islamic State of Iraq and Syria (ISIS) have no intention of distinguishing between civilians and combatants. Placing explosive devices in residential homes and specifically targeting displaced populations planning to return home would strongly suggest attempts to create fear among the civilian and displaced population.[6] This was evident from the attack ISIS claimed on the displaced populations gathering to discuss returning home to Al-Bab town on 24 February 2017, which resulted in 70 fatalities.

The international community has stressed the ongoing critical need for humanitarian mine action in Syria through risk education and clearance.[7,8] IMAS defines mine/ERW risk education as:

> *Activities that seek to reduce the risk of death and injury from mines and ERW, by raising awareness and promoting safe behavior. These activities include information exchange with at-risk communities, communication of safety messages to target groups, and support for community risk management and participation in mine action.*[2]

At this time there is debate within the mine action community whether the topic of IEDs (including IED risk education) should be mainstreamed throughout existing international standards or whether a separate set of standards needs to be developed.[9] It is DCA's point of view that IED risk education should be incorporated into existing international standards.

Risk education to rubble clearers in northern Syria, 2016.

Rapid Return of Displaced Populations to Newly Taken Areas

The Syrian Democratic Forces (SDF) captured the city of Menbij from ISIS on 12 August 2016. During ISIS's control of Menbij, explosive devices were planted in doorways, refrigerators, televisions, water taps, toys, and under clothes and mattresses. Needs and Population Monitoring (an information management tool that tracks and assesses the needs of displaced populations within Syria) estimated that 13,220 displaced people returned between 13 August and 7 September 2016, increasing the total population of Menbij to 86,448 during the month of August in 2016.[10,11] Between August and September 2016 Human Rights Watch recorded 69 civilians who were killed by explosive devices in Menbij, 19 of which were children.[7]

Medical data relating to incidents that occurred in Menbij during August 2016 showed a dramatic increase in the number of injuries related to blasts from explosive devices in the last three weeks of the offensive, reaching a peak in the week following the SDF's announcement of their full control of the city when a large proportion of displaced people began rapidly returning to the city. The high rate of injuries and deaths caused by explosive hazards in Menbij directly correlates with the returning of the displaced population. Incidents peaked in mid-August 2016 but then appeared to drop significantly. According to local authorities, this was a result of most residents returning to the city that month and then becoming acutely aware of the risks posed by explosive devices.[5]

In the *Medecins Sans Frontieres*' (MSF) report, "Set to Explode: Impact of Mines, Booby Traps and Explosive Remnants of War on Civilians in Northern Syria," a resident from Jirn describes how his relative was killed when he returned home. "In July 2015, he came back alone to check on the situation before allowing his family to join him. When he tried to open the door of his house, the whole house exploded. He died and his family has still not returned. He wasn't the first one," the resident said.[5] It is evident that IEDs and booby traps were placed by the departing organized armed group to target civilians, cause maximum damage, and create fear amongst residents intending to return to their homes.

Land and property grabbing is a common issue within emergency situations; and in the context of Syria, this appears to be a significant concern amongst the displaced population.[12] The Global Protection Cluster (an organization dedicated to coordinating protection-related responses to displaced populations) reports that explosive hazards and **housing, land, and property** issues are within the top three protection concerns for Syrians in 2017.[13] This may explain the

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Risk education to children in northern Syria, 2015.

urgency for displaced populations in Syria wishing to return to their homes as soon as they perceive it safe to do so.

Risk education can support civilians returning to their homes and their everyday routines. When areas are newly taken and the displaced population chooses to return, there are limited health care facilities and inadequate medical emergency assistance should an incident occur. Through raising awareness about the threats posed by explosive hazards, the risk of injury and death to civilians can be minimized.

Risk Education Campaigns

DCA began its humanitarian mine action activities inside Syria through local implementing partners in 2014 and directly in 2015. As well as clearance actvities in Kobane, DCA conducted risk education activities and campaigns in Al Ladhiqiyah, Idlib, Aleppo, Ar Raqqah, and Al Hassakah governorates in northern Syria. In 2016, DCA provided tailor-made and audience-specific risk education to more than 68,000 at-risk boys, girls, men, and women using a variety of different modalities. Safety messages shared during direct sessions were augmented by awareness raising campaigns using conventional media, such as radio and televison as well as social media.

Needs and risk assessment. DCA has designed risk education campaigns for the Syria response based on needs and risk assessments conducted within the targeted locations and via liaison with members of the mine action sub cluster and United Nations Mine Action Service (UNMAS) Syria. Risk education materials were pretested with the local population, taking into consideration the local context in relation to the appropriate language to be used and the conservative nature of the area. DCA developed an internal monitoring and evaluation system to conduct quality assurance and quality control in the locations where risk education is delivered.

Adult returnee risk education material. DCA's risk education campaign includes designing material specifically to

Figure 2. Adult returnee poster.

target adult returnees. The explosive threat posed to civilians in Syria involves landmines, unexploded ordnance (UXO), booby traps, and IEDs, or a combination of these explosive items; as a result, risk education materials targeting adult returnees have been designed to include all explosive threats. As seen in Figure 2, the different categories of explosive items are distinguished on the poster. Considering the limited time and opportunities that were available to target those returning home, this was considered the most efficient and effective approach to raising awarness about the threats posed by explosive hazards.

For the risk education materials, all photographs were taken of explosive items from relevant areas in Syria, including IEDs. While any object can be made into an IED, and the designs are continually evolving, images of IEDs relevant to the geographical location and time period were provided. The text above the IED images clarifies that these are only some examples, highlighting that these are not an exhaustive representation of IEDs. This is similar to displaying images of explosive remnants of war (ERW) on risk education material, as it is not possible to illustrate all of the different colors, materials, sizes, and shapes of explosive hazards that could pose a risk.

Risk education material should also provide information on what to do if suspicious items are found. However, the clearance capacity within Syria is limited and varies between geographical locations. Another consideration is that the power dynamics are frequently shifting at the local level. For these reasons it was decided the simple message **report to the local authority** if suspicious items were found would be used. This information will hopefully direct reports of suspicious items to clearance assistance if it is available locally while remaining nonpartisan.

The IED threat and the approach required for IED risk education varies in different countries, contexts, and periods of time. Risk education campaigns in Syria should be tailored for the geographical area, specific target group, and phase of the conflict. Messages and materials that are currently considered appropriate will need to be reviewed as the context evolves. Risk education, including raising awareness of IEDs and booby traps is crucial to the humanitarian response in Syria in order to minimize the number of fatalities or injuries caused by explosive hazards to displaced and returning civilians.

See endnotes page 67

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R&D

Research and Development

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AN APT DEMINING MACHINE

by Andy Smith [University of Genoa, Italy]

WWI demining machines.
All graphics courtesy of the author.

This paper introduces a new machine for use in support of humanitarian mine action. Developed under the EU FP7-TIRAMISU R&D initiative, the machine is reliable, easy to deploy, and has a low cost of ownership. It is designed to withstand anti-personnel (AP) mine detonations as it drives over an area preparing it for manual demining. Small and highly maneuverable, it can climb steeper inclines than other machines and drive over roads to deploy without an expensive transporter. With dual driver controls, it can be remotely controlled when working in hazardous areas. This article describes how it is appropriate and reports on its performance in testing/acceptance trials in Croatia. It also describes current plans to extend its utility as a C-IED tool.

Armored machines have been designed for military breaching of minefields since WWI and used to make relatively safe routes for soldiers or vehicles to pass through minefields. For many, these machines seemed a logical starting point for the development of machines suitable for use in post-conflict area clearance, so military flails, tillers, and rollers were adapted for use in demining. Generally expensive to buy, maintain, and use, these machines were not able to destroy all mines and ordnance as required to meet the clearance requirement in the International Mine Action Standards (IMAS), so they have never been suitable for stand-alone use.[1]

Purpose-designed demining machines are generally intended to withstand the detonation of anti-tank (AT) mines with repairable damage. This design aim adds greatly to cost, weight, and fuel requirements. Commercially available machines have tended to be heavily armored and designed to detonate the mines under their

Left, a blast damaged Aardvark flail in Libya and right, blast damaged demining machines in Angola.



A backhoe in Afghanistan, an articulated hydraulic mulcher arm on the back of a Werewolf mine protected vehicle (MPV) in Angola, and an Arjun raking excavator in Sri Lanka.

tool, not under their tracks or wheels. The tool will be damaged but is designed to allow fast repair. Some can withstand multiple detonations before the cumulative shock-wave damage necessitates an extensive overhaul. Thus, all the large demining machines are only more-or-less AT mine resistant. Their size and weight make the machines difficult to deploy, and their running costs, including fuel and repairs, are very high. Just importing them to the country of use can add significant costs and involve lengthy delays. Often oversold as clearance machines, many large machines are abandoned when the cost of repair and maintenance is too great to justify their continued use.

To reduce costs and avoid some of the deployment problems involved with larger machines, smaller variants have been designed specifically for use in mine action. Usually, designers seek to make these machines able to withstand an AT mine detonation. Extensive armoring and a large engine made the machines heavier than is ideal, and their weight limited the power available for them to climb hills or meet their design purposes with minimum damage to the environment. These machines invariably also need expensive transporters to move them around, so even the best purpose-designed smaller machines suffered many of the same problems of access and total cost of ownership that arise with larger demining machines. In terms of withstanding AT mine blasts, successful designs are limited in that any large detonation beneath a small machine will usually send it into the air, and severe damage will occur when it lands. Quietly acknowledging this, most designs are radio controlled so that risk to the operator is avoided.

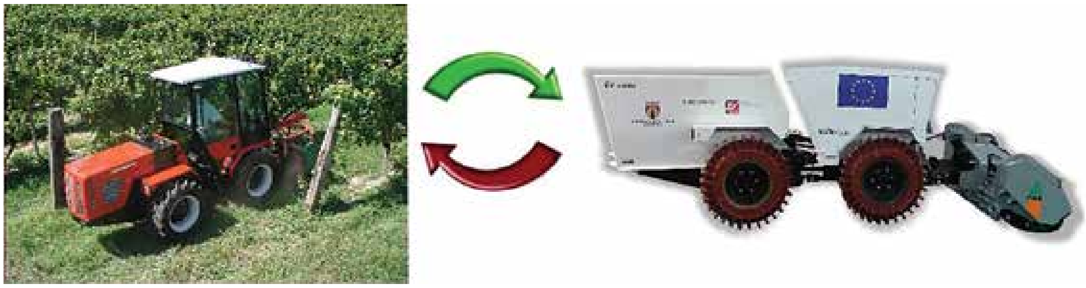
The fact that most machines fail to withstand AT blasts without incurring severe damage raises the question of whether it is necessary to try to withstand AT mine blasts. Based on existing plant and agricultural machinery, a range of machines have been made that do not enter hazardous areas until after they are processed. Their success are often largely ignored, because many are not commercially available.

The first such machine may have been an old tractor with a side cutter attached and some light armoring. This was used to cut undergrowth on road verges in front of manual deminers in Cambodia in 1997.[2] Around the same time, mine-protected military vehicles were converted to cut undergrowth in Angola, while converted backhoes were used in Afghanistan.[3] The excavator's bucket was later redesigned for vegetation removal and area preparation by an Indian INGO in Sri Lanka, where Arjun raking excavators were widely used until 2011.[4]

These machines, while armored, rely on the long reach of hydraulic arms to avoid having to drive over uncleared ground. Some, such as the Arjun, could withstand AP blast mines under the tracks, but none could have withstood AT mines. However, where there is no AT mine threat, it is efficient to drive the area preparation machine over the ground and so prepare a wide area. Avoiding risk to the operator is generally achieved by either using heavy armoring or a remote control system, but that has not always been the case.

For example, in 2014, it was impossible to get the Burmese government's permission to import any demining equipment at all. For a particular task involving small gelignite pressure mines, a small area preparation machine was made that removed the undergrowth and detonated some devices in advance of manual

The Groundhog area preparation machine made for a particular task in Burma.



The tractor and the conversion to a demining machine.

demining using the Rake Excavation and Detection System (REDS), a long-handled raking system.[5] This task-specific machine, only suitable for that threat on level ground, did the job well. The two-wheeled rice tractor on which it was based is back working in Burma's rice paddies now.

The converted rice tractor was appropriate for that task because the unusually small threat could be confidently predicted and the ground was relatively flat. For wider application, a more versatile machine would be needed. The ideal small machine should be able to follow narrow paths, climb steep inclines, and be radio controlled when working in areas with unknown hazards. It must be protected against AP blast and fragmentation mines but does not need to withstand AT mine detonations, if only because the evidence shows that this would be impossible to achieve anyway. In many post-conflict contexts, where armored machines were not widely used, the threat from AT mines is very low.[6]

AN APPROPRIATE SMALL MACHINE

At that time, the "Locostra" tractor was unfinished and unproven. Supported under the EU TIRAMISU Research and Development project, the design has been a collaboration between an Italian tractor manufacturer, Pierre Trattori, and the Engineering Department of the University of Genoa. Throughout the project, the design team was guided by end users and by staff of the Centar Za Testiranje, Razvoj I Obuku (CTRO - Centre for Testing, Development and Training) in Croatia.[7] Toward the end of the TIRAMISU project, the machine matured and received a bigger engine, more armoring and cameras, and a new name. Because the machine seemed singularly appropriate for its purpose, it became known as the Area Preparation Tractor (APT).[8]

The developers of APT do not pretend that it is a mine clearance machine. The APT will detonate some mines but, like all other demining machines, will also leave mines and almost all ordnance behind. It is designed to climb hills, maneuver around obstacles, and withstand AP mine detonations while preparing the ground for the thorough manual search and clearance that will follow.

The machine makes manual demining faster by removing the undergrowth and preparing the ground surface with a mulching attachment. When mines detonate as it works, that can help to identify the hazardous hotspots in an area. When tripwires are shredded and fuzes are broken from fragmentation mines, risk to the deminers is reduced. Most demining accidents occur when excavating an explosive hazard so loosening the ground surface reduces risk by making subsequentexcavation easier.[9]

The APT is based on a popular and proven agricultural tractor that is widely used in Italian vineyards with steep inclines. Small, with a low center of gravity, the tractor is steered via wheels and an articulated chassis. The combined steering means that it can maneuver tightly around obstacles without having to leave a wide area unprocessed.

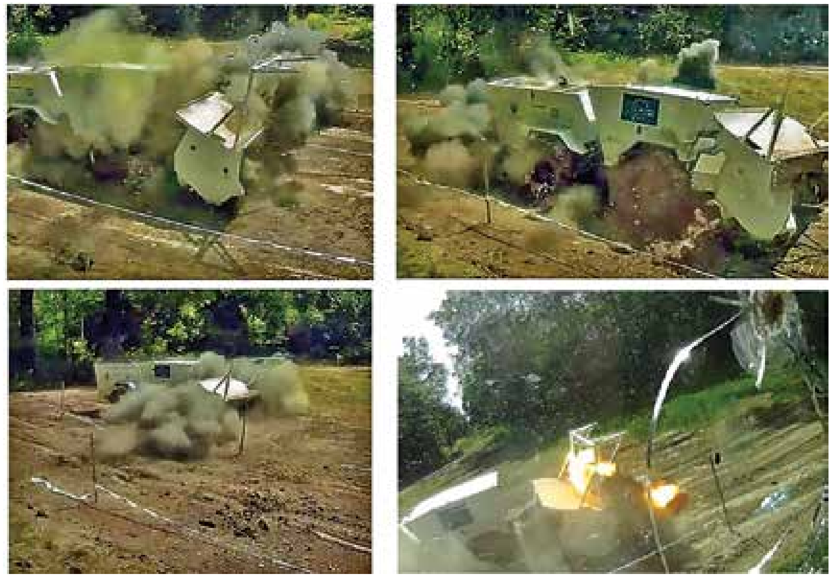
The machine has innovative blast-resistant wheels that successfully absorb the energy of AP mine detonations without the shock wave damaging the bearings and chassis. Its engine, hydrostatic drive, and articulated chassis have proven robust and reliable in years of hard agricultural use. The radio control system is also robust and has proven reliable over several years in the construction sector.

Its hydrostatic drive means that it can move forwards and backwards with the same ease and speed, allowing the user to choose the best approach for a specific use. For example, it can make sense to cut breaches into undergrowth and then return along the same path, processing the area a second time.

With dual radio and manual controls, the top of the cab armor lifts off so that it can be driven conventionally over roads to the working area, then radio controlled to work in hazardous areas. This allows the total cost of ownership to be low because it need not include an expensive transporter. Its ability to deploy itself also avoids a common problem with large machines when the combined weight of the machine and its transporter causes damage to roads, bridges, and culverts.

The APT can be fitted with a wide range of other tools and tow a trailer carrying its blast-resistant wheels, demining equipment, water, and other base-camp essentials.[10]

In May 2015, the first complete prototype APT machine was shown at the 2015 CTRO Symposium in Croatia. After the symposium, it was subjected to a series of independent explosive tests at the CTRO test site. Multiple blast and fragmentation mines were detonated beneath the wheels and the working tool in “worst-case” positions without any impact on the machine’s ability to perform.[11] In later analysis, there was no evidence of shock wave transfer to the bearings or chassis.[12] Having performed well in the explosive tests, the same machine was later field tested by CTRO over five days. Testing took place on abandoned agricultural land and in a forest that was a suspected hazardous area (SHA).[12,13]



Stills from a video of the testing using real mines.[14]

Side-to-side area preparation was augmented by cutting breaches through the heavily vegetated area. Dense vegetation was cut, and the ground surface was processed. The work included testing deployment approaches and operator training materials. The testing was successful and a CTRO accreditation certificate was issued.[13] Minor refinements that are planned include reshaping the armor for easier removal and access to the engine, as shown in Figure 1.

Stills from a video of APT during field trials.

The University of Genoa has extensive experience in robotics and has plans to develop a lifting C-IED platform that includes a dozer blade, large manipulator arm, small manipulator arm with disrupters, winch, and extra cameras. APT C-IED’s generous power (more than 100 horsepower) allows it to carry and power multiple devices electrically, by direct rotation power take off (PTO), or hydraulically. This means that proven or preferred manipulator arms and disrupter devices can be used.

The C-IED platform can simply replace the mulcher on a demining APT or can be fitted to a dedicated C-IED APT with upgraded (rifle resistant) armor and refined decontamination features.[15]

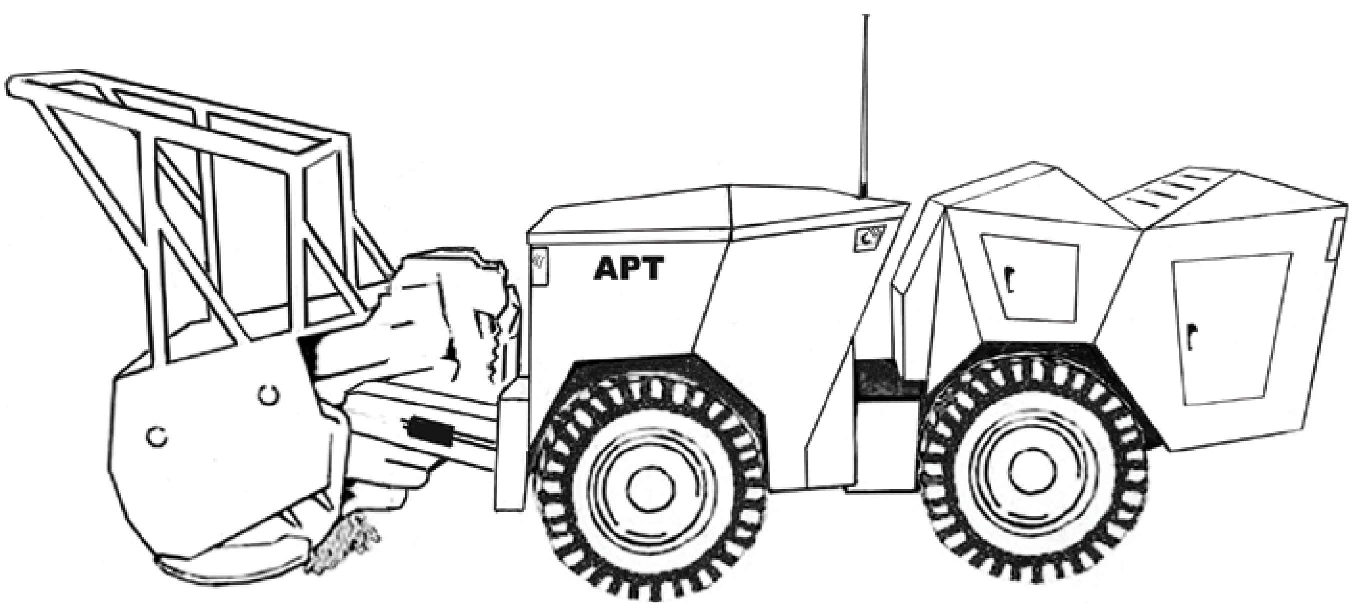


Figure 1. Sketch showing the shape of the refined armor.

In close collaboration with a leading provider of C-IED training to humanitarian mine action organizations, the C-IED APT will be developed to be able to

- move rubble and obstructions aside (delicately when appropriate),
- conduct a rapid camera survey of an area, producing accurate map records,
- investigate suspicious objects either robustly or delicately,
- collect ordnance that may not be considered safe to move by hand,
- disrupt potential IEDs with either a water charge, frangible or solid projectile: each of three disrupters feature three pre-loaded barrels (25.4 mm and 40 mm),
- fire a closed grapnel and line that can then be used to pull the target,
- place explosive charges to disrupt or destroy IEDs,
- attach hooks and a winch cable to drag heavy items to another place,
- deploy cutting equipment able to cut an additional entry into a vehicle/container,
- deploy a commercial off-the-shelf freeze neutralizing kit,
- gain safe entry to a vehicle for internal camera inspection,
- carry a multichannel (selective) wireless signal jammer to prevent wireless initiation systems being used in the vicinity,
- carry and place smaller robots when access through small openings is required.[16]

One advantage it has over all other similarly sized C-IED machines is the ability to be driven by an on-board operator to the area of need. Its small footprint and maneuverability allow it to drive over sidewalks when traffic is gridlocked following an incident. It can push or lift debris aside to access an area, and its flexible chassis and ground clearance allow it to move over rubble to get where it is needed.

See endnotes page 67

For more information about the Demining APT, contact andrew.vian.smith@edu.unige.it at the University of Genoa. For more information about the C-IED APT, contact Matteo Zoppi at zoppi@dimec.unige.it.

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A.V. Smith (AVS, Andy Smith) works part-time with the University of Genoa in Italy as a research assistant and is currently working on munition disruption systems in Palau. He has worked in demining for twenty years, starting as a personal protective equipment (PPE) designer in 1996 and rapidly becoming a deminer/surveyor and then a Technical Advisor, trainer, program manager and UNDP country CTA. The founder and keeper of the Database of Demining Accidents (DDAS), he has also developed and put into production the most popular PPE used in HMA. His work during 2016 included writing extensive field risk management training materials for GICHD.

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4. "Ukraine." *Landmine and Cluster Munition Monitor* 2016. Accessed 1 June 2017. http://bit.ly/2siiqPU.
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Bridging a Critical Mine Action Information Management Gap: Complex Conflict Environments by Ghareeb Barzangy [from page 53]

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Addressing the Explosive Hazard Threat in Northern Syria: Risk Education on UXO, Landmines, Booby Traps, and IEDs by Skilling and Zapasnik [from page 55]

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An APT Demining Machine by Andy Smith [from page 61]

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2. The author saw this in use with HALO Trust in 1996/7.
3. Notably by the demining INGO Menschen gegen Minen (MgM).
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6. Much of Myanmar, Colombia and Tajikistan are examples, but there is often confidence of the absence of an AT mine threat in many places elsewhere.
7. The author had designed the prototypes of its wheels in 2011.
8. The author uses the following definition of "appropriate technology": Technology is appropriate when it can achieve the desired end; is tailored to fit the psychosocial and biophysical context prevailing in a particular location; is suitable to the social and economic conditions of the geographic area; is affordable to both buy and use; and can be managed and maintained using local skills.
9. Study of the Database of Demining Accidents (DDAS) confirms this: Accessed 17 May 201http://bit.ly/1f7H60s. 7.
10. The APT can be used with COTS agricultural equipment, magnet arrays, detector arrays and a dedicated counter-IED platform.
11. The mines used were: 5 x PMA 1A, 5 x PMA 2, 5 x PMA-3, 1x PMR-2A and 1 x PROM-1.
12. Report available upon request from the author.
13. It was verified as cutting vegetation (up to 10cm Ø) at a rate of 2739 m2 per hour in the test area.
14. There are some video clips of the testing in a short film online at http://bit.ly/2rfr3gu. Accessed 17 May 2017.
15. The current plan is to protect against 5.56 NATO BALL ammunition (steel core). Enhanced protection will add between 500 and 1000kg in weight depending on whether shaped-charge amelioration is required.
16. The C-IED specialist training organisation is PCM ERW Risk Management & MAT Kosovo LLC, contact info@pcm-erw.com.

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Physical security and stockpile management (PSSM) in Honduras.
Photo courtesy of the Department of State.

EDITORIAL IEDs and IMAS

The evolving nature of humanitarian mine action—particularly in areas such as Iraq and Syria—has generated debate as to whether new standards on improvised explosive devices (IED) should be included in current international mine action standards, or whether such standards specific to IEDs should stand alone. Are new IED standards even necessary? Due to the nature of IEDs, how would the development of new standards affect current mine action efforts?

SPOTLIGHT Western Hemisphere

Central America became the world's first landmine-free region in 2010; however, the proliferation of illicit small arms and light weapons (SA/LW) and stockpile security management issues still threaten socioeconomic development and impede post-conflict recovery efforts.

How have negotiations between governments and nonstate armed groups affected the demining process in Central and South America? How has the surge of humanitarian demining activities in post-conflict situations affected clearance rates? What lessons learned can be taken from the ongoing demining operations conducted by military forces and their collaboration with newly accredited civilian deminers?

Countries of particular interest include Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, and Peru.

FEATURE Physical Security and Stockpile Management (PSSM)

What are the most common challenges faced by organizations attempting to curb the illicit spread of SA/LW weapons? What lessons learned can be shared with the broader stockpile management community? Potential topics relating to PSSM include ammunition disposal, stockpile management, surplus reduction, improved marking and tracing capabilities, and the destruction of illicit and obsolete SA/LW.

Regions of particular interest are Africa, Eastern Europe, and Latin America.

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