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THE JOURNAL of Conventional Weapons Destruction

SOUTHEAST ASIA

HMA IN THE GRAY ZONE

» Underwater Clearance

» Virtual, Augmented, and Mixed Reality in HMA

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20th CBRNE Command

American University of Beirut

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CAU – Kiel University Christian-Albrechts-Universität zu Kiel

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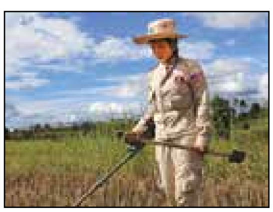

A deminer uses lessons learned through the Cluster Munitions Remnants Survey (CMRS) to clear land in Laos. To learn more about the CMRS, see the article on page 22. *Photo courtesy of Norwegian People's Aid.*

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The Journal of Conventional Weapons Destruction is a professional trade journal for the CWD community, including but not limited to humanitarian mine action, physical security and stockpile management, small arms and light weapons, and other related topics. It is a forum for best practices and methodologies, strategic planning, risk education and survivor assistance.

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Authors who submit articles to *The Journal* are expected to do so in good faith and are solely responsible for the content therein, including the accuracy of all information and correct attribution for quotations and citations.

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IN THIS ISSUE:

Southeast Asia

A MESSAGE FROM CISR

These past six months have been a time of reflection not only for me personally but also for the ever-evolving field of humanitarian mine action (HMA). After ten years of serving as CISR director, I have decided to accept a position as a tenured political science professor at James Madison University and pursue physical, spiritual, and writing goals. It has been an honor working with you as CISR Director during this exhilarating period for the HMA community. My successor, CISR Associate Director, Dr. Suzanne Fiederlein, is taking my position as Interim Director. I wish her and the wonderful, second-to-none team at CISR all the very best in this exciting time.

We have a very full *Journal* for this issue focused on topics including Southeast Asia and the Baltics, humanitarian IED clearance in Afghanistan, the use of augmented and virtual reality (VR) in mine action, as well as mine risk education apps and demining training aids.

SOUTHEAST ASIA

- Ta Thi Hai Yen from Catholic Relief Services writes about their digital game-based MRE application for children ranging in age from eight to twelve. The app has features in both Vietnamese and English and can be downloaded for free from Google Play and Apple.
- Authors Katrin Stauffer (RISKey GmbH) and Christelle Mestre (GICHD) write about the "Long-Term Risk Management Tool and Protocols for Residual Explosive Ordnance Mitigation: A Pretest in Vietnam" and the development of the framework of the Management of Residual Explosive Remnants of War (MORE) project.
- Leading on from the MORE project, Allan Vosburgh writes about GWHF's work in Vietnam, training the Vietnamese Provincial Military Command to international standards with the goal of enabling Vietnamese institutions to transition from proactive clearances to reactive responses.
- Kimberley McCosker and Jan Erik Støa, (edited by Katherine Harrison) (NPA) discuss the joint publication, *Cluster Munitions Remnants Survey: Best Practice in South East Asia*, resulting from close cooperation between HALO, MAG, and NPA where lessons learned and agreed best practices are summarized for survey and clearance of cluster munition remnants in Cambodia, Laos, and Vietnam.
- Bernard Franck, Donna Koolmees, and Sarah French from USAID Okard World Education, Inc. write on the development of their Community-Based Inclusive Development Demonstration Model which implements disability-inclusive policies in Laos. A second article about Laos is from Akihito Ontoku Hayashi (former JICA Advisor to UXO Lao) on improving the prioritization process of clearance activities by various organizations operating in Laos.

SOUTH AND CENTRAL ASIA

- Alexander Tan from HALO writes about the development of a humanitarian IED clearance capacity in Afghanistan, specifically on the manual clearance of victim operated IEDs, and trialing safer and more efficient methods for the targeted clearance of abandoned improvised mines.
- Mohammed Al-Husseini, Masoud Alipour, Hassan Ghaziri (Beirut Research and Innovation Center), and Ali El-Hajj (American University of Beirut) present a real-time video transmission system—the Demining Monitoring System—that can be employed to monitor the activity of deminers during clearance operations.

UNDERWATER DEMINING

- Focusing on the Baltics and underwater demining, Torsten Frey (Leipzig University), Jacek Bełdowski (Polish Academy of Sciences), and Edmund Maser (Kiel University) discuss new tools for mine action operators the challenges of ERW and chemical warfare agents in the sea.

VR IN MINE ACTION

- Sandra Bialystok (GICHD) looks at how a virtual reality experience illustrates how IEDs are impacting people's safe return home through the immersive VR experience *Home After War* produced by NowHere Media and the GICHD.
- Allen Dodgson Tan from the Golden West Design Lab discusses how their team has been applying augmented reality and VR technologies to create the Augmented Reality Ordnance Learning System (AROLS).

And finally, we feature a thought-provoking contribution from Lt. Col. Sean Kadlec from 20th CBRNE Command on the complex gray zone of post-conflict HMA and how using the strengths of the military and civilian organizations, as well as better communication and cooperation, can help to offset each other's respective weaknesses.

Having returned in November from the Fourth Review Conference of the States Parties to the *Anti-Personnel Mine Ban Convention* meeting in Oslo, Norway, I am encouraged by the call for more meaningful participation of landmine survivors and people with disabilities. The World Health Organization estimates that 15 percent of the world population lives with a disability. Therefore, I would like to call on all organizations and governmental entities involved in HMA to set a target for employing survivors and people with disabilities by the Fifth Review Conference. Related to this call for action, the Summer 2020 issue of *The Journal* is seeking articles on victim assistance and the integration of disability rights in HMA. For more information, please see our call for papers at https://www.jmu.edu/cisr/journal/cfps.shtml. We'd love to hear from you.

Ken Rutherford

HMA in the GRAY ZONE

by Lt. Col. Shawn Kadlec [20th CBRNE Command]

How do the military, other government agencies, nongovernmental organizations (NGOs), and the private sector cooperate with each other when they find themselves conducting mine action tasks typically considered the purview of each other's sectors?

As demonstrated in Iraq and elsewhere, armed conflicts rarely end in immediate peace. More broadly, conflict does not only concern direct violence between adversaries. It may involve anything from nonviolent forms of influence (i.e., soft power) to the use of proxy states or nonstate actors, who wage war against each other on behalf of other states (e.g., American and Russian use of proxy forces in Syria). These realities mean humanitarian mine action (HMA) programs will increasingly take place in a *gray zone*—that space between armed conflict and peace, in which military and civilian agencies must operate simultaneously.

In response to the complexity of an operational environment without clearly demarcated states of peace and war, the United States Department of Defense (DoD) conceived what it calls the *competition continuum*; first put forward in the Joint Concept for Integrated Campaigning (JCIC) and then further developed in Joint Doctrine Note (JDN) 1-19. In turn, the U.S. Army continues to refine Multi-Domain Operations (MDO) as the future operating concept for employing its capabilities across the competition continuum, to support U.S. national security policy and goals. The HMA community, along with the broader stability and development communities, should understand these concepts and ideas, because the "competition" in the gray zone is not about delineating military and civilian roles. Rather, it is about military and civilian organizations finding appropriate circumstances in which to best employ their capabilities or to defer to others' capabilities when needed. It behooves the international HMA community—military, government, NGO, and private sector—to develop methods of cooperation and collaboration that apply across the competition continuum. Despite recognizing the need for better civil-military integration, the DoD has not codified a doctrinal concept or idea for how to effectively collaborate with other government agencies, NGOs, or the private sector. However, the private sector and academics have created many models of partnership and collaboration continuums that can serve as an intellectual foundation for developing complimentary efforts between civilian and military organizations. We should look to them as a starting point to improve gray-zone cooperation in circumstances that force the military into overlapping its traditional mission space with those of other HMA operators.

According to editors of *The Journal of Conventional Weapons Destruction*, "[t]he existential differences between conflict and post-conflict are becoming increasingly blurred."[1] The U.S. DoD has defined this space as "competition below armed conflict." It may involve anything from nonviolent forms of influence (e.g., cyberattacks, economic sanctions, security assistance, etc.) to the use of proxy states or nonstate actors, who wage war against each other on behalf of other states. The situation in Mosul, Iraq, exemplifies a gray zone: though the Iraqi military retook Mosul, nonstate actors continued attacking the city with improvised explosive devices (IEDs) and conventional munitions.[2] Syria provides an even more complex example of a gray zone. Within the broader Syrian conflict, the United States, Russia, Turkey, and Iran are using proxy forces to advance their national interests in the region and disrupt their adversaries' interests.[3] As a result, there are limited military forces from these countries operating in Syria, certainly not enough to establish security and to begin stability operations akin to post-war efforts in Iraq or Afghanistan.[4] These circumstances, highlighted by a lack of armed conflict between national militaries, pose "jurisdictional" challenges to military forces, government agencies, and the civilian sector.

Such gray zones, in "limbo" between peace and armed conflict (or, "large-scale ground combat operations" in current U.S. Army parlance), are just enough at peace to dispatch non-military HMA operations into them. However, there is still just enough war to keep military forces deployed in them as well. This may trigger an overlap among military forces and civilian aid organizations conducting mine action (or other stability operations) in the gray zone.

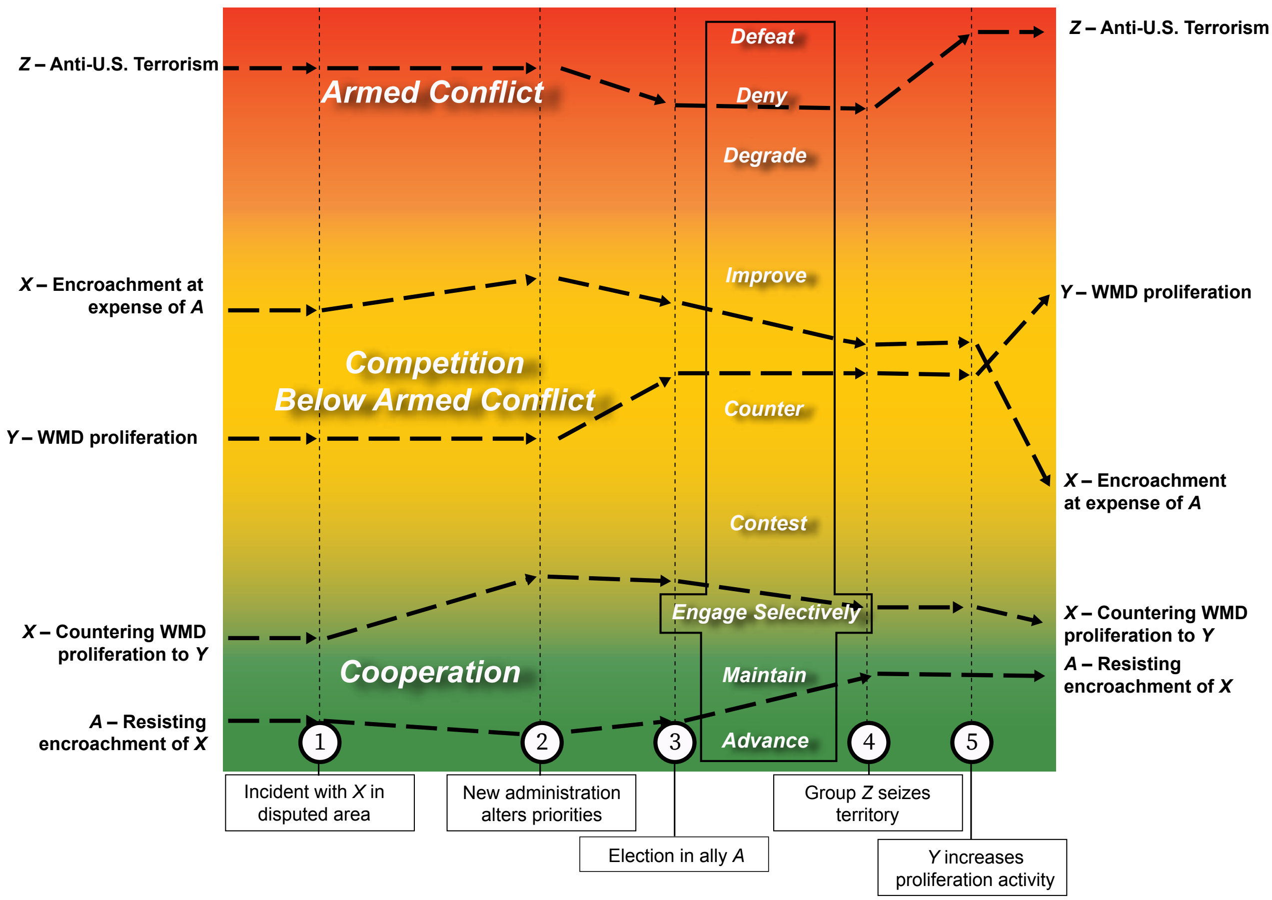

Figure 1. Depiction of the competition continuum and examples of friendly and adversary activities along the continuum. The black boxes enclose military objectives along the continuum.
Figure courtesy of Stephen Marr, Nicholas Hargreaves-Heald, Hiram Reynolds, and Hannah Smith.[5]

To better address different sectors' overlapping efforts in that middle ground between war and peace, it is useful to examine the DoD's JCIC, which describes the gray zone as comprising a "competition continuum – a flexible spectrum of strategic relations that range from cooperation to competition below armed conflict to armed conflict itself."[5] The U.S. Joint Staff's JDN 1-19 further describes the competition continuum as "enduring competition conducted through a mixture of cooperation, competition below armed conflict, and armed conflict."[6]

The competition continuum does not replace the artificial peace/war dichotomy of the past with an artificial trichotomy; nor does it envision distinct transition points between cooperation, competition, and armed conflict. Rather, it seeks to describe an environment in which the United States may simultaneously cooperate and compete with other international actors. For example, the United States cooperates with China on anti-piracy operations while competing with China regarding freedom of navigation.[6] Similarly, the DoD could find itself conducting HMA activities in cooperation with adversarial states, or as a competitive response to counter adversary influence in a country or region important to United States interests. Among competitors with the United States, China has a growing HMA program and international outreach (e.g., China recently donated mine-clearing equipment to Cambodia).[7] In response, the United States could refocus or increase spending on military and civilian HMA programs as part of a larger national and international strategy to promote a "free and open Indo-Pacific" as an alternative to China's Belt-Road Initiative.[8] While the civilian HMA community already operates alongside military forces, competition below armed conflict will intensify the geopolitical role of HMA and of other facets of stability operations.

JDN 1-19 also provides a lexicon that defines the geopolitical goals and strategic objectives of military activities along the competition continuum. The three broad ideas of competition—armed conflict, competition below armed conflict, and cooperation—also contain a range of military objectives, which should mirror country-specific policy goals and whole-of-government efforts (see Figure 1). Importantly, JDN 1-19 uses the DoD's *Law of War* manual, which is based on national and international law, as a basis for defining the various forms of armed conflict and lethal activities that span the continuum.[6] Competition below armed conflict and cooperation apply to the civilian-HMA community because this is

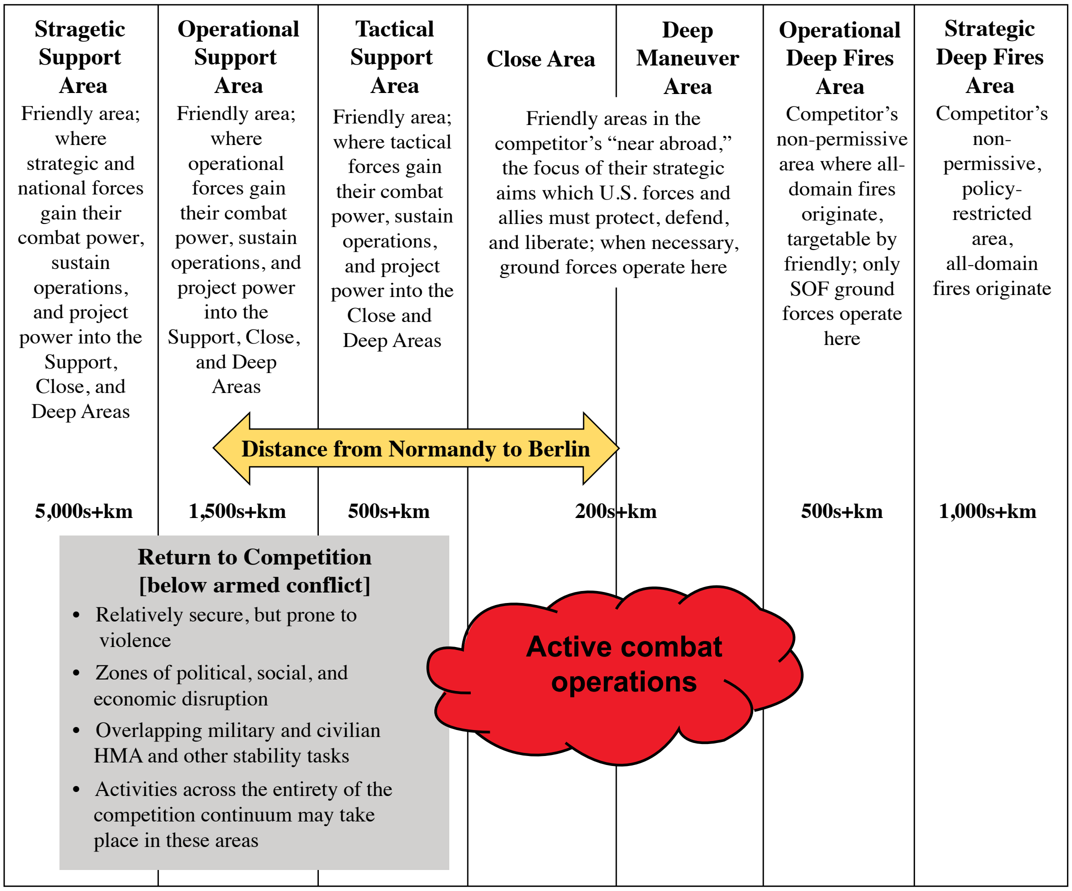

Figure 2. The linear battlefield is typically associated with large-scale ground-combat operations (e.g., World War II).[12] Using World War II as a hypothetical example, HMA activities could have taken place throughout France, Belgium, etc. as the Close and Deep Maneuver Areas progressed into Germany.
Figure adapted from The U.S. Army in Multi-Domain Operations 2028.[13]

where the lines between military and civilian HMA tasks blur in post-conflict and geopolitically contentious environments.

These DoD terms, concepts, and definitions have implications for the international HMA community because the DoD will conduct its HMA activities under this construct and associated legal norms. Specifically, understanding DoD objectives associated with the cooperation and competition below armed-conflict portions of the continuum will allow others to assess DoD's commitment to country-specific HMA programs, and will enable cross-sector organizations to identify appropriate opportunities and methods for cooperation with DoD forces.

Similarly, the Army's MDO concept will affect the HMA community because MDO includes stability operations and HMA activities conducted by Army forces.[9] Within the MDO concept, a *return to competition* provides an example of how the ideas within the Army's MDO concept may affect civilian HMA organizations: "In the return to competition [below armed conflict], Army forces conduct three concurrent tasks: physically secure terrain and populations to produce sustainable outcomes; set conditions for long-term deterrence by regenerating partner and Army capacity; and adapt force posture to the new security environment."[10] To achieve these results though, military forces must also address armed conflict's governmental, social, and economic disruptions in addition to the immediate security situation.[6] HMA helps DoD to address these disruptions and to produce sustainable outcomes through land clearance, securing weapons and munitions, and (re)generating partner-military capabilities and capacities needed for safer living environments.[11] This affects civilian HMA organizations because DoD's HMA activities can influence how the host-nation plans, prioritizes, and supports military and civilian HMA operations over the long term. As a result, military and civilian HMA entities may find themselves more and more intertwined—especially when military-led efforts transition to "whole of government" stabilization efforts, led by the Department of State (DoS) or by other civilian agencies.

How well the diplomatic, information, military, and economic instruments of national power converge across the competition continuum will factor prominently during competition below armed conflict, especially during the

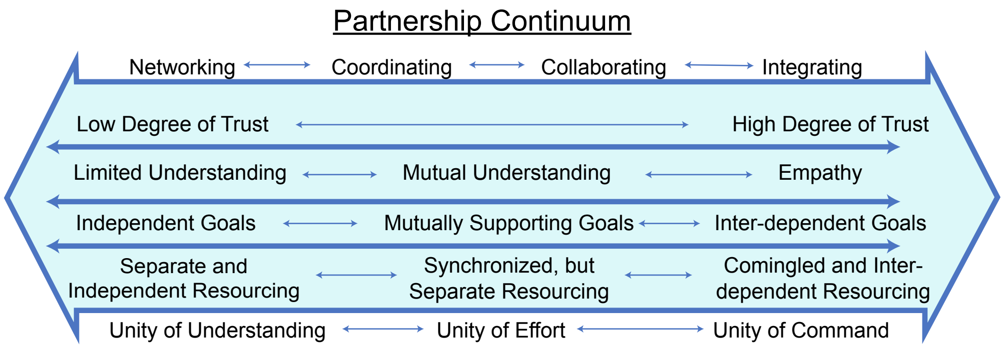

Figure 3. Synthesis of various concepts and definitions of "partnerships" and "collaboration." *Figure courtesy of author.*[14]

unstable periods immediately following armed conflict. The Stabilization Assistance Review (SAR)—a joint report by the U.S. DoD and the U.S. DoS—assessed such convergence in several, recent post-conflict environments and identified how convergence may fail. The SAR recommends that the U.S. Government assign DoS as the lead federal agency for stabilization, with the U.S. Agency for International Development (USAID) and the DoD as supporting elements, due "to the lack of institutionalized DoD mechanisms to enable regular collaboration with interagency and international partners." However, as noted in the SAR, the U.S. Government places security restrictions on government civilians. This limits their ability to deploy to conflict and post-conflict zones.[13] The potential inability of DoS and USAID to establish a forward presence in conflict or post-conflict environments will, presumably, require the DoD to lead the convergence of U.S. Government capabilities with cross-sector HMA programs as part of the overall military effort during the early stages of stability operations in post-conflict environments. DoS will continue to be the lead federal agency for HMA programs and should assume responsibility once the security situation permits. However, it will likely have a military "face" in the immediate aftermath of large-scale, ground-combat operations.

Figure 2 illustrates a linear battlefield common to large-scale, ground-combat operations (e.g., World War II), with the "close area" being the *front line* commonly referred to in Hollywood movies. The operational and strategic-support areas (i.e., the rear)—established once the front line has passed through an area—should be relatively secure and capable of hosting HMA activities. While typically not engaged in direct combat, these support areas remain active zones of military activity in which deep fires (e.g., long-range rockets or ballistic missiles), special operations forces (SOF), or nonstate actors (e.g., insurgents) will use explosive hazards to disrupt military sustainment and stability operations. Furthermore, the political, social, and economic disruption caused by war "create conditions for intense competition among internal, regional, and global actors seeking to retain or gain power, status, or strategic advantage within a new order."[6] Therefore, the security situation in these (loosely defined) post-conflict areas may prevent DoS or USAID personnel from assuming lead responsibility for implementing stabilization activities (including HMA). In these circumstances, the U.S. Army could opt to use a Security Force Assistance Brigade (SFAB) to partner with other security forces and use its explosive ordnance disposal (EOD) or engineer personnel to provide HMA training to military forces or local civilians. If so, communication and cooperation between military forces and civilian HMA organizations would permit mutually-developed (or informed), military HMA programs to transfer to civilian authorities and organizations with minimal impact to the communities affected by explosive remnants of war (ERW).

Regrettably, the DoD does not have a doctrinal concept or idea for a partnership/cooperation continuum to facilitate this kind of communication and collaboration. However, academics, business consultants, and others have written extensively on cross-sector partnerships and collaboration. Synthesizing various definitions and models creates a continuum of potential cross-sector, cooperative relationships (Figure 3). On the left, organizations can limit their cooperation to simply exchanging knowledge and information with each other to achieve unity of understanding. On the right, organizations cede organizational autonomy to integrate as teams with comingled-resources, mutually-determined, and interdependent goals to achieve *unity of command*. Presumably, most NGO-military partnerships will lie toward the left side of the continuum due to many NGOs' adherence to the four humanitarian principles of humanity, independence, neutrality, and impartiality. Conversely, U.S. Government efforts should converge toward unity of command.[14] By operating on a partnership/cooperation continuum, disparate organizations can effectively address the myriad of challenges faced in the competitive gray zone, without sacrificing their organizational values and missions.

Using a partnership continuum allows military and civilian organizations to identify appropriate circumstances for communication and cooperation. Returning to the SFAB example, early communication between its EOD forces and the Office of Weapons Removal and Abatement in the U.S. State Department's Bureau of Political-Military Affairs (PM/WRA) will establish the unity of effort between U.S. Government agencies necessary to effectively transfer HMA programs to civilian authorities once the security situation permits civilians to enter the area. Furthermore, early communication with HMA NGOs identified by DoS will establish the civil-military relationships necessary for unity of understanding. When appropriate, NGO input into U.S. Army SFAB-HMA activities will nudge the relationship toward unity of effort—thereby enabling a more effective military program with a smoother transition to civil organizations. Once on the ground, civilian organizations must determine to what degree they will cooperate or collaborate with military or other government forces, especially when they encounter explosive hazards they are not trained or equipped to identify, render safe, or dispose of (e.g., certain types of IEDs or chemical munitions). If they choose not to train and equip themselves to do tasks typically associated with government forces, then to whom will they report hazards, and how will they cooperate with military or other government agencies in the area, if at all? Thinking of the civil-military HMA relationship as a continuum of options ranging from *networking* to *integrating* allows military and civilian organizations to better compete against explosive hazards (rather than against each other) in post-conflict (and other) environments, while simultaneously sustaining their organizational values and purposes.

In the complex gray zones of post-conflict HMA, more effective operations require better communication and cooperation between military and civilian organizations. Lingering violence often prevents an immediate civilian presence in support areas, where combatants' use of improvised munitions often means civilian HMA organizations are ill-prepared to operate safely. On the other hand, military forces do not typically have the expertise or experience to address war's political, social, and economic disruptions. These realities require ongoing understanding and cooperation between military forces and civilian organizations. To achieve this, the U.S. DoD should further refine the JCIC, JDN 1-19, and the U.S. Army's MDO concept by incorporating an idea for a range of techniques and processes with which it can better cooperate with civilian agencies and organizations. Civilian organizations should review military doctrine and ideas as well, because they may find the DoD's gray zone conceptualization useful. From there, they might also contemplate the proposed partnership continuum, so that they can better prepare themselves to operate just below the level of armed conflict in the murky gray zone of post-conflict environments and alongside the military forces operating in them. Collectively, we can achieve better long-term results using each other's strengths at the right places and times to offset our respective weaknesses. After all, the competition in the gray zone of post-conflict environments is between those who would use explosive hazards to perpetuate instability and those who seek to solve war's political, social, and economic disruptions.

See endnotes page 58

The views expressed in this article are those of the author and do not necessarily reflect those of the 20th CBRNE Command, U.S. Army, or U.S. Department of Defense.

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Shawn Kadlec is a lieutenant colonel in the U.S. Army assigned to the 20th Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Command. He is an EOD officer and former EOD battalion commander with combat experience in Iraq and Afghanistan. As a battalion commander, his subordinate units conducted HMA and C-IED training across the Indo-Pacific region. Lt. Col. Kadlec is a graduate of the U.S. Army War College class of 2019.

A Twenty-Minute Walk Through Fallujah:

Using Virtual Reality to Raise Awareness about IEDs in Iraq

by Sandra Bialystok, Ph.D. [GICHD] | Photos © Felix Gaedtke

In January 2018, filmmakers from the studio NowHere Media travelled to Fallujah, Iraq, with the objective of creating a virtual reality (VR) experience to explain how improvised explosive devices (IEDs) are impacting people's safe return home. In just a few days, they met dozens of people, all of whom had stories to tell. And then they met Ahmaied—an Iraqi father who had returned home with his family about a year earlier. Ahmaied told them about the tragic accident that had happened just a few months prior when his two older sons entered a neighbor's home to collect wood and set off an IED. Both young men lost their lives in the explosion.

Working with a translator from the region and a local crew, and with Ahmaied's permission, NowHere Media and the Geneva International Centre for Humanitarian Demining (GICHD) created the immersive VR experience *Home After War* to tell his story. Using a technique called photogrammetry, NowHere scanned Ahmaied's home by taking thousands of still pictures that were then reproduced to create a room-scale version of his home in the VR environment. This means that when the viewer puts on a VR headset, the impression is that one is actually in Ahmaied's home in Fallujah: one step taken in real life translates into one step taken in Ahmaied's home. More dramatically, in what resembles a hologram effect, Ahmaied appears within his virtual home and tells his story. He invites the viewer inside, and as users walk through the space, peeking around corners and even standing on his roof, they hear about what happened to Ahmaied's family.

This experience came out of the Oculus VR for Good Creators Lab.[1] The Oculus VR for Good initiative pairs not-for-profit organizations with VR filmmakers, providing them with the resources they need to make experiences that shed light on pressing social issues that are presented to a large, global audience. The GICHD was selected to participate in the program in 2017, and the GICHD, NowHere Media, and Oculus used the opportunity to focus on the growing challenges that IEDs pose to redevelopment and civilian safety in Iraq.

In August of 2018, *Home After War* had its world premiere at the Venice International Film Festival. The Venice Festival was one of the first high-profile film festivals to include VR experiences in their official competition. Seven months later, *Home After War* travelled to Austin, Texas, where it enjoyed its North American début at the South by Southwest Festival (SXSW). At this event, *Home After War* won the jury award in the category of "Best Use of Immersive Arts."

Now, just over a year after its official release, there has been time to analyze and reflect on the impact that *Home After War* has had thus far. This article explores some of this influence, not just in the mine action sector but also more widely. It then looks at the ways in which VR might be used by the sector moving forward.

VR: The Empathy Machine

In 2015, VR was nicknamed "the ultimate empathy machine" by Chris Milk,[2] a film producer who worked with the United Nations to create the experience *Clouds Over Sidra*.[3] The term *empathy machine* was most likely initially coined by film critic Roger Ebert years earlier when he wrote that "film is the most powerful empathy machine in all the arts,"[4] and for better or worse, this moniker has been widely associated with VR over the past four years. Although many working in VR today are uncomfortable with this term, it is easy to understand why others gravitate toward this shorthand for describing a medium where state-of-the-art cameras can film in 360 degrees and state-of-the-art headsets allow users to shut themselves off from the current reality and become immersed in another place or time period. Because of this fully-immersive, completely-foreign space, the technology tricks our brains into thinking that we are actually present in this new reality. And by extension, we open ourselves up to the possibility of empathizing with those we meet in these virtual spaces.

Measuring Impact

To capitalize on the empathy-building potential of VR, *Home After War* was created for two target audiences: the general public and decision makers in mine action. Tailoring the story to a general audience was logical given the scope of the project. At film festivals and international VR conferences, guests have been transported to Iraq to meet one person whose life was turned upside down by an IED. By telling Ahmaied's personal story, there is the potential to raise awareness about how the mine action sector is confronting the growing challenge of IEDs in the region. To support this message, a GICHD advisor was present in Venice, Italy and in Austin, Texas, to speak with guests about the current situation in Iraq, explain more about IEDs, and generally answer any questions that might arise after completing the experience. In this way, the hard-hitting and moving documentary was paired with real-life interaction and information sharing.

Mine action decision makers constitute an audience of representatives from donor countries, policymakers involved in mine action and disarmament issues, and other high-level representatives working on human security issues. Indeed, it quickly became clear that telling Ahmaied's story was not only an opportunity to take people to Fallujah (as far as we know, the NowHere Team was the first international media crew to capture the city on film since ISIS lost control in December 2016), but also to show the interlinkages between mine action, displacement, reconstruction efforts, and victim assistance. One intention of *Home After War* was to initiate a conversation within this targeted audience. The goal was to start a discussion about IEDs from a place of empathy. To support this growing discussion and bring the experience to the greatest number of mine action professionals in one place, GICHD exhibited at two high-profile events for the mine action community: the *Anti-Personnel Mine Ban Convention* (APMBC) Seventeenth Meeting of States Parties, 26–30 November 2018, and the 22nd International Meeting of Mine Action Directors and U.N. Advisors, 5–8 February 2019, both held at the United Nations in Geneva. Decision makers and leaders—representatives from embassies, missions, and other U.N. agencies—more generally were also able to view *Home After War* at the United Nations Visitors Centre in New York, when the piece was included in the UNMAS exhibition *Safe Ground* for six weeks in spring 2019. Among other mine action events, the piece was also exhibited at a Swiss Army Humanitarian Mine Action event, Humanity and Inclusion's 25th anniversary *Pyramide de chaussures* in Lyon and Paris, and at a public open house of the German Federal Foreign Office.

Defining an audience and presenting it with a new communication tool is one thing; however, measuring the effect of that tool is another matter entirely. While it is possible and relatively straightforward to record numbers of viewers or track online engagement, measuring whether content has impacted behavior is difficult. Indeed, change in behavior is rarely related to a single event but is far more often the product of ongoing interactions and encounters that are woven together into a tapestry of experiences that ultimately shapes who we are and what we believe. In an attempt to partially unweave this tapestry, the GICHD has been measuring the impact of *Home After War* through a three-pronged approach: tracking reach, engagement, and action.

Reach is the simplest of the three categories. Keeping track of reach means recording where the experience has gone and how many people have seen it. These are of course important numbers to have but do not show the extent to which the experience has impacted the individual. The engagement category digs deeper into unearthing meaningful impact. The four metrics in this category that GICHD is tracking—award nominations, awards received, media mentions,

and panel invitations—indicate different ways viewers are inspired to bring the message of the experience to their circle. Finally, *action* indicates the deepest form of impact. In these cases, individuals hear about the experience from a third party and reach out to NowHere Media and GICHD to use the experience for their own outreach and education efforts. The numbers in Table 1 reflect that current impact assessment as of October 2019. To that end, it has only been since about February 2019 that the action category could be measured; understandably, the experience had to be released and seen before results in this category could be examined.

Numbers to Date

Even the combination of these indicators only tells part of the story's impact around the globe. In part this is because tracking the meaningful impact of VR is a nascent field. Just as was the case for social media managers nearly a decade ago, we need time to develop a clearer understanding of how people consume VR content and are affected by it before developing standard measures on impact and reach. That said, being "on the ground" at mine action events and film festivals and watching people's individual reactions to the piece has been inspiring. We have had Middle East desk officers based in their capitals thank us for taking them to see—for the first time—where their beneficiaries actually live. And we have spoken to Iraqis who have not been home for many years weep for the homes they once knew. Sharing these intimate moments has been an immense privilege, giving us confidence that VR can have a strong role in shaping people's emotions as well as their decisions to make change in the world.

REACH	
Total viewers	> 500
Number of film festivals	27
Number of mine action meetings and conferences	9
Number of public events and museums	5
Continents reached	4
Countries reached	14
Cities reached	40
ENGAGEMENT	
Award nominations	12
Festival awards received	7
Media mentions	30
Invitations to deliver high-level presentations (i.e., film festivals, international conferences)	13
ACTION	
Number of invitations by mine action partners to show experience at their events	7
Requests from museums to use experience for an exhibition	2

Table 1. Impact numbers for *Home After War*.

What's Next?

After collaborating with VR experts on the *Home After War* project, it is exciting to think through other ways that VR could be useful to the mine action sector. In mine action especially, the ability to create

a world that contains only virtual hazards has enormous potential for expanding training opportunities. Over the past few years, the GICHD has experimented with creating two-dimensional virtual worlds for such purposes, and *Home After War* has given the GICHD the insight with which to transform these virtual worlds into immersive ones as well.

The Explosive Weapons Effects Simulator, for instance, was launched in 2018 by the GICHD in partnership with Fraunhofer EMI. The user is given the option of selecting from five different weapon systems (122 mm BM-21 multi-barrel rocket launcher; 152 mm and 155 mm artillery guns; 81 mm, 82 mm, and 120 mm medium and heavy mortars; 115 mm, 120 mm, and 125 mm tank guns; and MK82 aerial bombs), and then from five different populated areas (ranging in size from hamlet to large city). After selecting a target in the fictitious populated area, the potential primary and secondary effects of the chosen weapon would have on that area are visualized. This tool is by no means meant to be a game but rather a visual device that demonstrates the impact of using non-precision weapons in populated areas through the safe, anonymous space offered by this virtual world. *Home After War* has demonstrated one option for how to move from the virtual, flat environments of the Explosive Weapons Effectives Simulator into a fully immersive virtual space. By including VR as a training or educational tool as well as benefiting from its storytelling potential, there are multiple options for how to integrate this technology into the operational activities of the GICHD and other organizations.

The GICHD is not the only organization in the sector to push innovation with this new technology. As is demonstrated in this edition of *The Journal*, Golden West is working in augmented reality (AR) and VR to push training efforts forward and create virtual spaces where people can learn safely and effectively. Training development is a wide-open space in which VR can be effectively used—new environments, new forms of contamination, and even complicated scenarios can be quickly rendered and visited through this technology.

Home After War is just the beginning. In just a few years the technologies that created Ahmaied's home will already seem antiquated. However, the telling of Ahmaied's story and others like it will always be critical for shedding light on pressing humanitarian challenges: testing the limits of innovation through this form of storytelling has the potential to contribute to a safer tomorrow.

See endnotes page 58

Sandra Bialystok, Ph.D.
Digital Media Coordinator
GICHD

Sandra Bialystok, Ph.D., has been working in communications in mine action since 2014, when she joined the GICHD, where she is now the Digital Media Coordinator. She runs the GICHD's multiple websites and social media, and advises on new channels and tools, including virtual and augmented reality and mobile applications. Bialystok holds a doctorate, and a master's degree in comparative literature from the University of Toronto and a master's from Oxford University.

Augmented and Virtual Reality for HMA EOD Training

by Allen Dodgson Tan [Golden West Design Lab]

In Vietnam, Golden West has deployed the Augmented Reality Ordnance Learning System (AROLS) for use in training the provincial explosive ordnance disposal (EOD) teams. Here an EOD operator is seen reviewing an animation of how a cluster munition functions in the field before taking actions on a live unexploded ordnance (UXO). Through these experiences, we see the potential usefulness of augmented reality (AR) as an operational tool in the near future.
All images courtesy of the author/Golden West Humanitarian Foundation.

At the Golden West Design Lab in Phnom Penh, Cambodia, our team has been working on applying augmented (AR) and virtual (VR) reality technologies to explosive ordnance disposal (EOD) for approximately three years with the support of the Office of Weapons Removal and Abatement in the U.S. State Department's Bureau of Political-Military Affairs (PM/WRA). This work grew from our success with the Advanced Ordnance Training Materials (AOTM) program, which produces detailed and functioning training aids of ordnance fuzes using 3D printing technology. The AOTM products were able to provide new training capabilities to programs across the world, and we believed AR and VR might offer similar opportunities.

Similar to how 3D printing has changed the accessibility of physical, engineered products, recent leaps in AR and VR technologies made by Oculus, HTC, Google, Samsung, and others have suddenly made the production of accessible consumer-grade applications possible. With capable platforms available, the challenges to implementation were similar to those we faced with the AOTM product line:

- ◊ identifying clear design constraints that addressed the needs and limitations of the humanitarian mine action (HMA) sector
- ◊ creating blended technical teams capable of producing our products
- ◊ creating the customer support infrastructure required for effective commercialization
- ◊ marketing these technologies to the HMA community

As we have seen with other bespoke HMA solutions, effective commercialization remains one of the most difficult problems to solve. For technologies that make it through the research and development phase successfully, considerable barriers to success remain. We are continuing to improve this process at the Design Lab and our formula has created a second sustainable product: the Augmented Reality Ordnance Learning System (AROLS).

Use Case

The applications of AR and VR technologies are so far reaching and fundamentally game changing that we can expect some of the same organic spillover into the HMA sector as seen with drone and mobile technologies. These kinds of solutions were not designed specifically for the HMA community but were general advancements in human technology. Given the wide range of possibilities AR and VR offer, they will eventually apply to almost all aspects of what we do. At this early stage, however, our lab is focused on an area where we believe significant room to increase safety and efficiency exists in the near term: EOD operator training.

When we analyze the HMA EOD workflow, there is room for improvement throughout. This begins with initial EOD-technician training, whose quality can vary significantly based on instructor, candidate profile, curriculum, classroom resources, and national standards. Effective areas for intervention through new technologies are most immediately possible in the classroom resources and in the curriculum. Through the International Mine Action Standards (IMAS), the community works to address the curriculum issue; we focus on classroom resources.

The cause for high variability in EOD classroom resources is mostly obvious. Funding remains the key issue as it relates to a school's ability to purchase or produce expensive inert ordnance training aids. The other issue is that there are inadequate resources for this task.

In EOD, we are required to understand abstract concepts (e.g., explosive effects and the effect of physical forces on fuze mechanisms during the arming and firing sequences). It has always been a challenge to convey these concepts to students from diverse educational backgrounds. The ability to do so often relies solely on the ingenuity of individual instructors. An illustrative example is how some instructors seek to illuminate the concept of centripetal force by spinning a rubber band around a pen. For less readily demonstrable concepts—such as spalling from squash-head projectiles—even the best instructor can find themselves without adequate tools to reach students.

This is where we targeted our first products using AR and VR. By leveraging our lab's unique blend of digital engineers, mechanical engineers, and in-house EOD expertise, AROLS was designed to provide digital solutions to deepen student understanding of fundamental concepts. By providing these products on commercial off-the-shelf (COTS) platforms, we are able to create nearly universal availability, decreasing the gap between training programs of varied resource levels.

Augmented Reality Ordnance Learning System (AROLS)

With a clear understanding of the limitations of conventional EOD training and the resource constraints of the HMA sector, our team designed our first product to run on Android smartphones: ARLOS, a platform that can be purchased and repaired in nearly every corner of the globe. Utilizing a software framework developed by Oculus and Samsung, the GearVR, we created a software package that allows users to visualize the functionality of explosive ordnance fuzes on any table using simple markers.

Employing AROLS, users see static ordnance items and animations of their functioning appear in front of them in photo-realistic renderings, which blend seamlessly into the natural environment. This effect makes the virtual ordnance seem as though it is there, giving an unparalleled realism, which increases the learner's chances of retention. It is the difference between watching a video of a process and actually witnessing it firsthand. This system is currently in use in HMA EOD programs worldwide, though the official launch took place at the GICHD Technology Workshop in November 2019.

How it Works

Currently AROLS has 121 unique nomenclatures that include 21 highly-detailed animations. The AROLS app can be downloaded from the Google Play Store to any high-end Android device and can be used with or without a VR headset. Once downloaded, the app

This image is not Photoshopped or manipulated in post-production. You are viewing a screenshot from a fourth device looking at the same AROLS marker, using the same equipment as the other three users seen in the photo. The landmine on the table is displaying the same way to all four users. Using small group techniques, users can explore ordnance functioning together.

The newly-released plastic marker cards (right) are portable and durable. The menu cards (left) allow users to select ordnance items to display on the marker cards by simply scanning a QR code instead of searching through a menu. This form of non-language-based user interface enables the system to be readily used by almost anyone with two minutes' training. While marker cards are not required to use the AROLS system, they provide a more reliable user experience and are recommended. They can be purchased separately though the Golden West website for a minimal fee, or users may print them using an ordinary PC printer from a provided PDF file.

must be activated through an annual subscription purchased online requiring an identification card and credit card—steps necessary to ensure that users of potentially sensitive EOD information are identifiable. Once purchased, this app can be used an unlimited number of times on the device, potentially serving a classroom of students with only a few devices.

In addition to the app, users need a *marker card* to put on the table. This marker allows the app to recognize the surface orientation and relative scaling. This is how the software understands where to place the virtual object and what the size needs to be. While other technologies (surface mapping) exist in higher-end devices (e.g., the Microsoft HoloLens), the reliability of these technologies on smartphones remains unacceptable at this time.

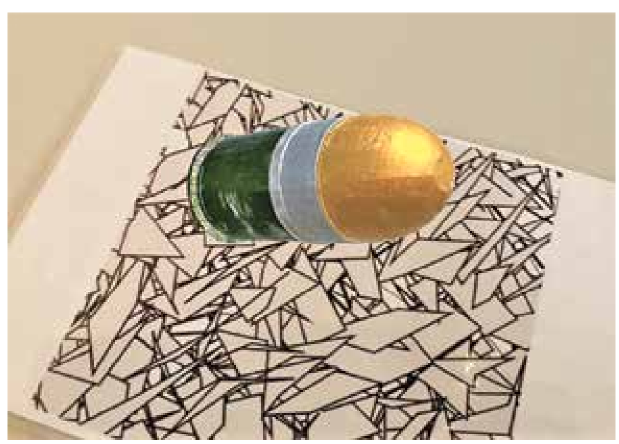
We produce a set of marker cards made from durable plastic that can be purchased separately online, or users can download a free printable PDF file. Users in areas without printing accessibility can also use commonly available currency as markers: the U.S. one-dollar note, the five-euro note, and the British five-pound note. Additional custom markers are possible upon request though we expect a transition away from the marker-based system within the next few years, as systems like Google ARCore become more capable.

Virtual EOD Training Room

For scenario-driven training, it is the virtual space that offers the most profound opportunities. The virtual world is a blank canvas on which we can create any world or situation. Applying this to HMA EOD, we took a similar approach to the AROLS process and looked for areas where simulation could create significant leaps in student and/or operator capabilities.

The concept we created is the Virtual EOD Training Room. This system utilizes the HTC Vive to deliver a room-scale VR experience allowing users to become fully immersed in a complex training scenario. Most importantly, the system allows instructors to create these scenarios in minutes using a simple pick and place interface. It is through empowering non-technical users to quickly create these scenarios that we provide a tool capable of adapting to the ever-changing set of tactics, techniques, and procedures required for EOD operators.

An example of this would be an urban post-conflict IED-clearance scenario. In conventional training, this would take place in a parking lot, football pitch, or at best, an expensive specialized military training facility. Fellow team mates would likely be posing as various characters and the operator would be asked to pretend buildings were



A screenshot from a device viewing a 40 mm rifle grenade up close. Objects appear to users as though they are floating on the marker.


An early proof of concept showing how AR can assist users in placing tools. Here you see a mock .50 cal dearmer, which was placed in position for an attack on the mortar fuze using only the AR system for reference. In the near future, tools similar to this will shorten times on target and lower the potential for technical errors during EOD operations.

arranged differently or cars were not where they are. It would be a giant game of make believe where nearly all the critical details and nuance critical to understanding real-life threats were absent.

Utilizing VR, not only are we able to create and build environments that are exactly what the instructor would like to mimic, but we can create the dynamic details critical for EOD scene management. These could include a person on the roof talking on the phone, random crowds of civilians mobbing a scene, or security elements parking too close to suspected IEDs. These are the elements that make operational EOD so difficult, which, until now, have been nearly impossible to replicate in a training environment.

While we have completed the proof-of-concept phase for this system, the development with key customers is still ongoing. Therefore we are only prepared to present this short conceptual overview of the system; however, we remain open to opportunities for partnership. Any interested parties are encouraged to reach out to our lab.

The Near Future

As we complete AROLS, we look to the next leap in the application of AR. Our ability to create usable products is wholly dependent on the consumer-electronics industry and their ability to deliver suitable platforms for our sector. This means platforms that are not only capable but cost-effective and durable. Fortunately, the AR space is rapidly evolving, and each year we see significant improvements.

The next step for our lab is to move from the training space into the operational space, a move that tracks the development of the technology itself. As AR goggles become more suited to field conditions, we can start applying EOD operational assistance tools to these platforms. We have completed a proof of concept in which a user that is wearing AR goggles can position a dearmer for an attack against a fuze without needing to use handheld measurement tools. The user sees an overlay of the appropriate tool placement in their vision and is able to match the actual dearmer to that overlay, thereby aligning the shot correctly without tools.

In the next phase of our digital EOD tools, we will link the OrdHUB ordnance technical database to the AR systems. This will allow users to both search and visualize search results through their head-mounted AR displays. The ideal workflow will be a hands-free interface that allows users to identify ordnance by looking at it and then retrieving all relevant information and assistance for tool or disposal charge placement overlaid on the ordnance item. It is through these types of tools that we will eventually create a universal standard for the delivery of EOD services.

For more information about Golden West Design Lab's augmented reality and virtual reality HMA-EOD training, please contact Allen Dodgson Tan at allen.tan@goldenwesthf.org.

Allen Dodgson Tan
Director of Applied Technology
Golden West Design Lab

Allen Dodgson Tan is the Director of Applied Technology for the Golden West Humanitarian Foundation, a California-based nonprofit dedicated to destroying explosive remnants of war. He founded the Golden West Design Lab (Phnom Penh), which produces innovative, award-winning products in Cambodia that are used by governments and organizations worldwide. Prior to working in Cambodia, Tan served seven years in the United States Army, as both an infantryman and an EOD operator with a combined 26 months of combat duty in Iraq and Afghanistan. Tan holds a master's of science in risk management from Boston University (Boston, Massachusetts) and a bachelor's of science in business administration from Franklyn University (Columbus, Ohio).

Long-Term Risk Management Tools and Protocols for Residual Explosive Ordnance Mitigation:

A PRETEST IN VIETNAM

by Katrin Stauffer [RISKey GmbH] and Christelle Mestre [GICHD]

The transition from proactive survey and clearance to reactive risk management represents a crucial moment in the life of a mine action program. Relevant frameworks and standards, including the International Mine Action Standard (IMAS) 07.10, usually require that all reasonable effort is applied and a tolerable level of risk with regards to a mine or explosive ordnance (EO) threat is achieved in order to move to a residual state. Such a transition requires the application of risk management principles, as stressed in the IMAS 07.14: Risk Management in Mine Action.[1]

CONTEXT-SPECIFIC RISK MANAGEMENT METHODOLOGY

Despite the existence of such frameworks, there is no universally accepted methodology that would help determine what the tolerable level of risk is and how to manage residual risk. In the framework of the Management of Residual Explosive Remnants of War (MORE) project, coordinated by the Geneva International Centre for Humanitarian Demining (GICHD), a methodology has been developed and piloted with the aim of enhancing national authorities' capacities to identify, evaluate, and manage residual risk.

Appreciating the context-specific nature of tolerable risk, defined as a "risk which is accepted in a given context based on current values of society,"[2] the GICHD and risk-management consultant Katrin Stauffer developed a methodology whereby instruments and tools could be used according to the needs of a country or area facing such transition. The infancy of the methodology required it to be pretested in a country facing this challenge as a basis for further research and future application.

LONG-TERM RISK MANAGEMENT IN VIETNAM

Vietnam's highly EO-contaminated provinces have been proactively surveyed and cleared at different levels, and in some locations the question of transitioning to a reactive risk management strategy in a residual state has begun to arise. As the country is not a party of the *Anti-Personnel Mine Ban Convention* (APMBC) or the *Convention on Cluster Munitions* (CCM), the national authority responsible for mine action—the Vietnam National Mine Action Centre (VNMAC)—is left to determine a tolerable level of risk and the appropriate point in time to change from a proactive survey and clearance to a reactive risk management strategy.[3]

In the framework of the MORE project, an initial methodology was presented by the GICHD to VNMAC and relevant stakeholders. It was jointly refined over an eighteen-month process, during which VNMAC took a leading role in determining relevant instruments and tools for its context. National ownership was a key principle of the process to ensure that the results would benefit Vietnam. This approach allowed for greater engagement of relevant parties and proved crucial in contributing to the sustainability of the process.

Under VNMAC's leadership, the province of Quảng Trị was selected for the pretest. It is known as the most heavily contaminated, yet one of the most active and well-organized provinces with regards to mine action activities. Many of its districts have undergone survey and clearance, most of the population has benefitted from explosive ordnance risk education (EORE) activities, and high-quality data is available. These optimal preconditions led to the selection of Cam Lộ and Hải Lăng Districts for the pretest, which was conducted in May 2019.

ASSESSING AND MANAGING RESIDUAL RISK: METHODS AND FINDINGS

The pretest introduced the proposed risk management instruments and tools to the reality of operations in contaminated areas in Quảng Trị, as well as local population's reactions and beliefs regarding EO threats. Instruments and tools used in the pretest formed part of a holistic approach hereafter described as the long-term risk management (LTRM) framework. The robustness of the methodology—adapted to the local context and based on extensive research and reliable data—proved crucial in building a credible process.[4]

IDENTIFYING THE TOLERABLE LEVEL OF RISK

The methodology relied on indicators to recognize a residual state. A location has not reached a residual state until achieving a set of indicators (according to the predetermined tolerable level of risk as

<table>
<tr><th colspan="13">CAM LỘ DISTRICT</th></tr>
<tr><td></td><td colspan="4">Threshold 1</td><td colspan="4">Threshold 2</td><td colspan="4">Threshold 3</td></tr>
<tr><td>Indicator 1, option A</td><td colspan="4">No residual state</td><td colspan="4">No residual state</td><td colspan="4">No residual state</td></tr>
<tr><td>Indicator 1, option B</td><td colspan="4">No residual state</td><td colspan="4">No residual state</td><td colspan="4">No residual state</td></tr>
<tr><td>Indicator 1, option C1 (top 20)</td><td colspan="4">No residual state</td><td colspan="4">No residual state</td><td colspan="4">No residual state</td></tr>
<tr><td>Indicator 1, option C2 (top 20)</td><td colspan="4">Residual state</td><td colspan="4">Residual state</td><td colspan="4">Residual state</td></tr>
<tr><td>Indicator 2</td><td colspan="4">Residual state</td><td colspan="4">Residual state</td><td colspan="4">Residual state</td></tr>
<tr><td>Indicator 3</td><td colspan="4">Residual state</td><td colspan="4">Residual state</td><td colspan="4">Residual state</td></tr>
<tr><td>Indicator 4</td><td colspan="4">Residual state</td><td colspan="4">Residual state</td><td colspan="4">Residual state</td></tr>
<tr><td>Overall rating
(with option a-C2 for indicator 1)</td><td>A</td><td>B</td><td>C1</td><td>C2</td><td>A</td><td>B</td><td>C1</td><td>C2</td><td>A</td><td>B</td><td>C1</td><td>C2</td></tr>
</table>

Table 1. Simplified overview of evaluation results in Cam Lộ District, per indicator/option and threshold including a proposal for an overall rating and related further actions.
All graphics courtesy of GICHD.

agreed upon by the relevant national authority). The methodology also stressed that the same indicators should be used to evaluate the risk after the residual state is achieved.[5]

The proposed indicators considered socioeconomic, psychological, and financial impacts of an EO threat. Indicators aimed to understand if EO threats were still causing victims (looking at the death probability rate in different ways: Indicator 1 options A, B, C1, and C2),[6] if they were still having a psychological impact on affected people (effect on well-being: Indicator 2), and if they influenced their behavior (land use: Indicator 3). Furthermore, it was considered if people had the chance to benefit from EORE activities (Indicator 4), and if the cost-benefit ratio of mitigating an EO threat in conjunction with the progression of land prices was appropriate (Indicator 5). The pretest examined indicators against different thresholds to evaluate which one would be the most reasonable option to determine the residual state. Dialogue with relevant stakeholders allowed the authors to review the indicators and thresholds that were then used in the pretest.[7] The data used to trial indicators was collected through desk research using national and provincial statistics as well as field survey with the affected population.

Pre-test results from Cam Lộ[8] indicate that whatever threshold is applied, as long as option C2 from Indicator 1 is used, the district could be considered as having achieved a residual state. These results corroborate general perceptions of the surveyed population in Cam Lộ and are understandable as the district has been fully surveyed and clearance mostly completed. In all other cases (if options A, B, or C1 of Indicator 1 are considered) in Cam Lộ, the authors recommend that proactive activities continue, at least to a certain extent.

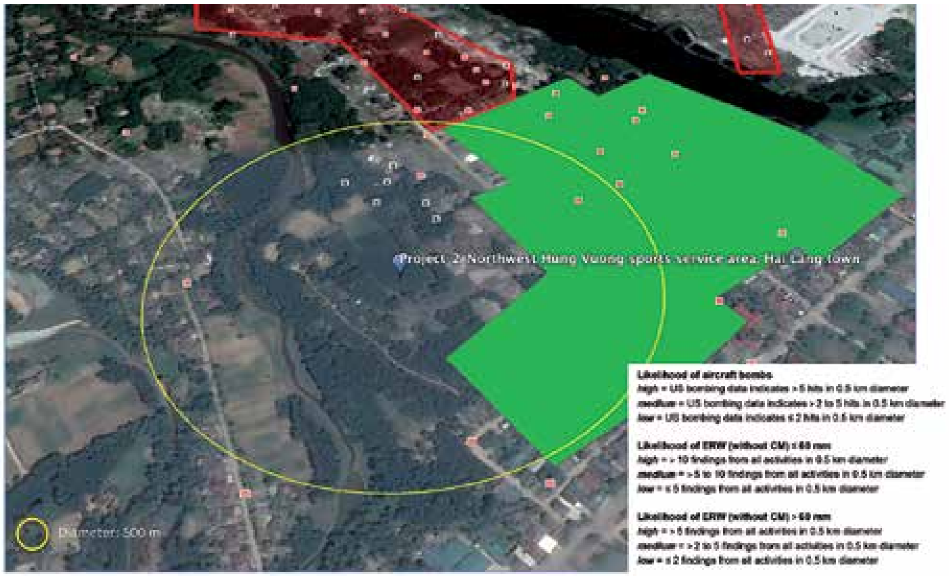
The pretest results also shed light on some indicators' limitations. Options A and B of Indicator 1 tend to be very conservative, demanding a zero/near zero tolerance for EO victims, which might not be achievable as scattered unexploded ordnance (UXO) may always cause accidents/incidents despite completed clearance to recognized national or international standards. In addition, Indicator 3 on land use did not help evaluate a residual state in Cam Lộ. In fact, while respondents reported having dramatically changed their well-being after proactive clearance was conducted (Indicator 2) and highly benefitting from EORE activities (Indicator 4), they reported using the land regardless of a potential EO threat and despite effects to their well-being (Indicator 3).

The significance of these findings and decisions on which indicators and thresholds to consider to determine the reasonable level of risk require further discussion among stakeholders. It is also suggested that indicators and thresholds be reviewed and further tested, sample size increased, and other areas tested (including districts where proactive activities are ongoing but have not been completed) in order to refine the LTRM framework.

MANAGING RESIDUAL RISK

Once a residual state is achieved, mine action programs transition to a reactive risk management strategy. Residual contamination poses a risk that cannot be accepted when an item of EO (hazard) interacts with a specific land use (activity) in a specified area (location).

Figure 1. In a reactive risk management approach, contamination is only addressed if the combination of the hazard, the location, and the activity poses a risk that is not acceptable.



Contamination / Activity matrix

Contamination	Likelihood	No human activity	Surface activity, non-mechanical	Surface activity, mechanical	Intrusive activity, ≤ 30 cm	Intrusive activity, > 30 cm – 1 m	Intrusive activity, > 1 m
Aircraft bombs	High	0	0	0	0	0	2c
	Medium						
	Low						1a
Other ERW (> 60 mm)	High	0	0	0	1b	2b	2b
	Medium						
	Low				1a	1a	1a
Other ERW (≤ 60 mm)	High	0	0	1b	2a	2a	2a
	Medium						
	Low			1a	1a	1a	1a
Cluster munitions	Confirmed	0	0	1b	2a	2a	2a
Mines	Confirmed	0	2a	2a	2a	2a	2a

Required action

0	No action required (land use poses no threat).	1a	No action (residual risk). In case of findings = EOD call-out and reassessment.	1b	Site-specific assessment to clarify land use / work steps.
2a	Conduct site-specific assessment to identify the exact perimeter of the planned intrusive work ≤ 30 cm and conduct clearance to that depth (and / or propose other risk mitigation measures).	2b	Conduct site-specific assessment to identify the exact perimeter of the planned intrusive work > 30 cm – 1 m and conduct clearance to the estimated maximum penetration depth of the expected ammunition > 60 mm (and / or propose other risk mitigation measures).	2c	Conduct site-specific assessment to identify the exact perimeter and depth of the planned intrusive work > 1m and conduct clearance to that depth (and / or propose other risk mitigation measures).

Findings from database (findings counted manually)

Aircraft bombs: **low**	Other ERW > 60 mm: **low**	Other ERW ≤ 60 mm: **high**

Figure 2. Form B1: Mapping of (residual) contamination, Northwest Hùng Vương sports service area, Hải Lăng Town.

This may happen when construction work on a specific site exceeds the standard clearance depth or occurs on a site where no area clearance has been done (e.g., outside of cluster munition footprints). To address this, a detailed analysis should be led and mitigating measures considered. For this purpose and as part of the LTRM framework, two different forms were developed.

Form "B1" proposes to establish a general risk assessment for a specific site, in relation to a specific planned activity. It allows the survey team to determine the likelihood of encountering different types of ammunition (low, medium, or high according to different thresholds), and indicates whether the expected residual EO threat poses a relevant risk to the planned activities, offering standardized follow-up procedures. Form "B2" captures main outcomes of form B1 and requires a more detailed analysis of the EO threat, which is done by looking at the characteristics of the planned land use and the ammunition (type, condition, expected depth, etc.) present. It facilitates the comprehensive analysis of the threat and ensures that detailed risk mitigation measures are proposed.

The tools were tested on six different development sites and proved to be useful and easy to use. More work and further testing are however needed in order to gain further insights in regard to the applicability of different thresholds and mapping methods.

RECOMMENDATIONS AND CONCLUSION

The pretest was a stepping stone in the assessment of the LTRM framework's feasibility and relevance in Vietnam. It confirmed that the overall methodology to evaluate the tolerable level of risk, including tools to manage residual risk, is applicable and generates informative results. It also allowed the GICHD to draw important lessons learned for the improvement of the LTRM framework while demonstrating its potential. The robustness of the methodology proved to be essential to build a credible process, with the key contribution of VNMAC demonstrating their innovative and solution-oriented thinking. The technicality of the framework however calls for greater efforts to strengthen ownership over the LTRM concept, as it was observed that its purpose was not thoroughly understood by all stakeholders involved.

As demonstrated in the pretest, the differentiated contamination in Vietnam prompted the need for tailored instruments and tools to be adapted to the realities in the different provinces, under the leadership of VNMAC. The coordination of such efforts at the provincial level proved to be a key success factor for the research. For future implementation of the LTRM framework in other contexts, it is highly recommended that pre-existing regulatory frameworks—responsibilities, processes, and procedures—are in place.

The pretest also demonstrated that the LTRM framework's instruments and tools rely on the availability of data. Failure to gather and analyze reliable data may hinder the possibility to determine whether a residual state has been achieved or not. Comprehensive high-quality data is a pre-condition for the use of the LTRM framework.

If well-coordinated and using appropriate high-quality data, the

LTRM framework is paramount to evaluating and managing residual contamination, and can determine when and where the risk is higher. This framework is not time-bound, allowing the relevant authority to evaluate whether a residual state has been achieved at any time during ongoing proactive survey and clearance (according to the predetermined tolerable level of risk). The relevant national authorities can create context-specific instruments adapted to evaluate risk on a specified area, recognizing that people's perception, knowledge, and approach to risk vary among place and situation. The same extent of proactive activities might not be necessary in every area or district in order to address the residual state.

By providing the tools to evaluate when an area achieves a residual state and how to manage residual contamination response, the framework provides evidence for decision-makers that helps them prioritize and determine where to allocate resources, based on the agreed long-term risk management approach.

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General information					
District / Commune / Coordinates	Hải Lăng	Hải Lăng town	107.245448/16.696373	Date of assessment:	02 April 2019
Assessor company / Team / Name	MAG	TFM, Head Office		Henry Mariner	
Project name / Planned activity	The infrastructure of Techmart development area - service and sports Northwest Hùng Vương road, Hải Lăng. Category: road		Construction (intrusive activity > 30 cm – 1m)		
Result of general risk assessment	*Expected contamination:*	Aircraft bombs: low likelihood/other ERW: low likelihood of > 60 mm and high likelihood of ≤ 60 mm			
	Required action:	2a for ≤ 60 mm (clearance down to 30 cm or other risk mitigation measures)			

Site-specific residual contamination

History of the site / Information from NTS	Hải Lăng town saw frequent bombing runs by the US during the war; through the course of infrastructure expansion many have been discovered and removed. There was also heavy ground fighting resulting in widespread contamination from cluster munitions and other UXO. Due to the high population, these areas have been prioritised by international NGOs. Three areas surrounding the proposed site are marked on the map, these have been confirmed to contain UXO and only the one in green (encroaching the 500 m radius) has been cleared (to a depth of 30 cm).
Planned activities (detailed process steps and construction plans, if available)	This proposal is still very much in the early stages – currently the area is made up of residential buildings (very small, one level, little to no foundations) and garden areas. As a result, the inspecting team was unable to gain physical access to the exact proposed building point, instead circling the 500 m radius and observing the current level of infrastructure. With information available at this point it is understood that the site will be converted into sports fields – this will require ploughing and laying of turf, using light machinery. It is unknown at this stage if larger building work will be required or indeed if it is planned.

Detailed risk assessment

Expected ERW category	Worst expected ammunition type / effect	Sensitivity			Expected condition			Likelihood of encountering ammunition		Overall rating*	Expected depth	Work steps at risk	Expected worst case
Other ERW ≤ 60 mm	40 mm / HE			X			X	X		X	0 – 30 cm		Unplanned explosion on the surface during work.

Possible measures for risk mitigation:

We currently do not know the size of the area required for conversion to the sports ground; regardless, the exact footprint should undergo technical survey (if it has not already – data unavailable) to establish the extent of contamination (if any). Following TS, battle area clearance can be conducted to a depth of 30 cm including 50 m fade-out for any cluster munitions discovered.

If building work is required, then a detector calibrated for a deeper search (up to 1 m) should be swept over the foundation footprint. Domestic EOD teams (MAG / NPA / PeaceTrees Vietnam / Quảng Trị military) are on standby and coordinated by QTMAC in the event that any suspect items are discovered by the local population.

All construction workers should have limited working knowledge of "suspected UXO" so that on discovery, construction workers can cease all operations, avoid moving or tampering with the object and call QTMAC for immediate assessment and, if required, RSP and removal.

Stakeholder discussion and decision:

Sensitivity	Notable disturbance needed for ignition	Some disturbance needed for ignition	Little disturbance needed for ignition
Expected condition	Not likely to function anymore	Partially still functioning	Likely still functioning
Likelihood		Medium	High

* Overall rating: 3 x green = **green (no action required)** / 3 x red = **red (action required)** / every other combination = **yellow (discuss risk acceptability with stakeholder)**

Figure 3. Form B2: Site-specific risk assessment, Northwest Hùng Vương sports service area, Hải Lăng Town.

Katrin Stauffer
RisKey GmbH

Katrin Stauffer is an independent consultant to the GICHD, working on risk management and country-specific case studies covering different aspects of land release. Prior to providing consultancy services for the mine action sector with her company RISKey, she worked in communication and marketing and served as EOD Technician/EOD Diver IMAS Level 3 in the Swiss Armed Forces. In this function she has been deployed in different military and humanitarian missions, among others as in-kind Technical Advisor to UXO Lao and as Operations and QA Officer/ Adviser to UNMAS DRC. In addition, she held the position of the Head of Terminology and Doctrine at the EOD CoE of the Swiss Armed Forces. Stauffer holds a bachelor's degree in Graphic Design and Art of the Bern University of Art, Switzerland, a bachelor's degree in Service Marketing and Management from the University of Lucerne, Switzerland, and a master's degree in Risk, Crisis, and Disaster Management from the University of Leicester, United Kingdom.

Christelle Mestre
Programme Officer, Strategies and Standards
GICHD

Christelle Mestre is Programme Officer in the Strategies and Standards Division at the GICHD, working on residual contamination, strategic planning, the development of national capacities, and projects that link mine action to broader human security. Prior to joining the GICHD, she worked with Interpeace, an international peacebuilding organization, where she supported country programs in Sweden and Guinea-Bissau, as well as program development efforts in South Sudan and Myanmar. Mestre holds a master's degree in Socioeconomics with a focus on Development Studies and a bachelor's degree in Arabic Studies and History from the University of Geneva, Switzerland.

CLUSTER MUNITION REMNANT SURVEY IN SOUTHEAST ASIA

by Kim McCosker and Jan Erik Støa, edited by Katherine Harrison
[Norwegian People's Aid]

Cluster munitions in Laos.
All figures courtesy of NPA.

Efficient and effective land release is a core global priority for MAG (Mines Advisory Group), Norwegian People's Aid (NPA), and The HALO Trust (HALO), as significant and ongoing investment of resources and expertise continually improve procedures and approaches. *Cluster Munitions Remnants Survey: Best Practice in South East Asia* is the result of many years of close cooperation between MAG, NPA, and HALO on survey and clearance of cluster munition remnants (CMR) in Cambodia, Laos, and Vietnam. Ahead of the 9th Meeting of States Party (9MSP) to the *Convention on Cluster Munitions* (CCM), held in Geneva in September 2019, operational and programmatic staff from the three organizations met to discuss key lessons learned during twelve years of surveying cluster munitions in Southeast Asia. The identified lessons and agreed best practice were summarized in a joint publication that was also presented at a side event during the 9MSP in Geneva attended by government delegates, national mine action authorities, international mine action and U.N. organizations, and civil society. The publication and side event were generously funded by the Government of the United States.

THE SOUTHEAST ASIAN CONTEXT

Within Cambodia, Laos, and Vietnam (hereinafter referred to as Southeast Asia), there is predominant, long-standing contamination from CMR. This contamination has some defining characteristics that present a specific context for operators to address. CMR found in Southeast Asia are typically BLU-type munitions between forty and sixty-five years old, with a detonation failure rate of up to 30 percent. Combined with the density of the bombing, this high failure rate has resulted in dense, surface-level contamination from aged munitions. The presence of munitions over many decades has also led to large amounts of historic data released to support clearance efforts, including accident data, information from previous tasks, and bombing data.

This context requires an evidence-based survey response based on a comprehensive desk assessment to consider all available historic data, a thorough Non-Technical Survey (NTS) to ensure all evidence is identified, and a Technical Survey (TS) targeted only where actual evidence is identified, not feared or suspected. Combined, these steps are referred to as Cluster Munition Remnants Survey (CMRS).

DEVELOPMENT OF CMRS IN SOUTHEAST ASIA

Based on operational experience, and the shared belief that a well-managed, locally-adapted response should be used to target survey and clearance of cluster munitions, MAG, NPA, and HALO have worked closely on the development of CMRS.

The first cluster munition survey operations were conducted by NPA in Southeast Asia in 2008. Much of the thinking that informed the designs of earlier surveys was based on addressing landmine contamination; however, lessons could be learned from cluster munition survey and clearance in Lebanon in 2006, South Sudan in 2005, and as far back as Kosovo in the late 1990s. Risk assessments quickly identified that the nature of the threat was significantly different from landmines, most notably in that teams could freely walk on the ground in areas with suspected contamination from CMR. As such, NPA's explosive ordnance disposal (EOD) teams in Vietnam conducted random TS in any direction from an identified CMR as early as 2008 and, parallel to this, NPA's Lao PDR programme was using full battle area clearance (BAC) teams to conduct similarly random searches using CMR as a starting point. This resulted in a slow and unsystematic search that did not provide the accuracy required for effective land release. Random TS did not sufficiently capture all available evidence and was unable to estimate the scope of contamination reliably. Clearance was still response-based, which resulted in huge inefficiencies in resource use as teams revisited villages multiple times. The need for a systematic, evidence-based survey was clear, and CMRS was developed progressively through multiple stages over many years. Previous versions used lessons learned to incrementally improve the accuracy of the methodology. Progress through various stages is detailed further in the Geneva International Centre for Humanitarian Demining's (GICHD) study, *A Study of Land Release in Quảng Trị Province*.

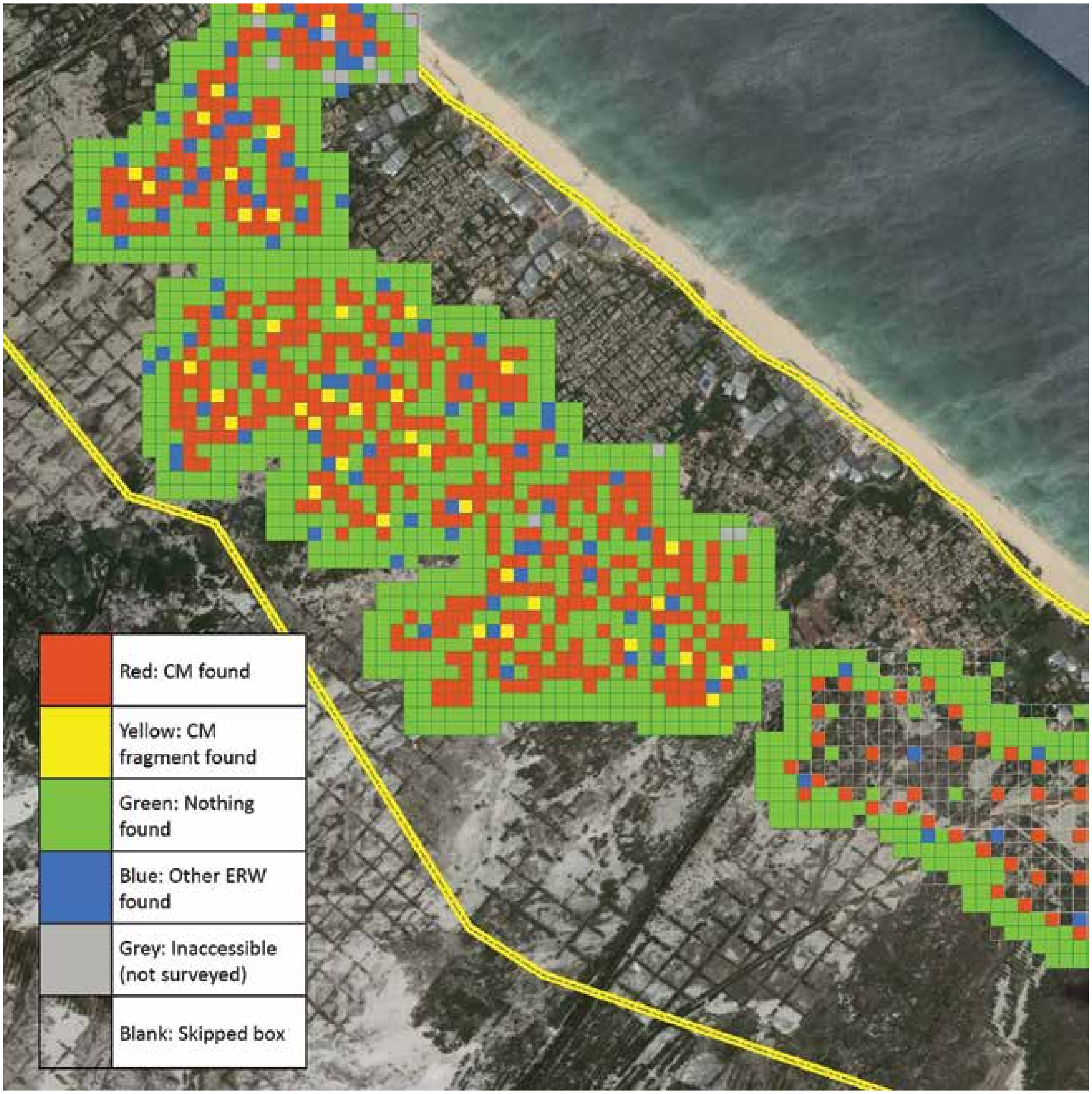
Variations in country contexts and operating environments mean that defining a universal CMRS methodology is not possible. However, by recognizing what constitutes best practice, operators and other stakeholders can work to ensure that, where implemented, CMRS adheres to an agreed set of base criteria and principles. This best practice is summarized in the following section.[1]

NPA personnel conducts TS. By sharing successes and challenges, the CMRS process can be incrementally improved to deliver more accurate results and more efficient clearance operations.

OVERVIEW OF BEST PRACTICES IN CMRS

CMRS is defined as the application of all reasonable effort through NTS and TS procedures, to identify and define a confirmed hazardous area (CHA) from CMR contamination. The key output of CMRS is a defined boundary of a CHA based on direct evidence of CMR contamination, which will be used to support planning for and prioritization of future BAC activities.

NTS is the application of all reasonable effort used to collect information in order to identify direct evidence of contamination. NTS, as a part of CMRS, should always include a thorough desk assessment of all available data including bombing data, historical operational, and accident data as well as any other relevant information (including development plans and data from commercial or military operators) prior to field deployment. Bombing data from the United States Air Force (USAF) should not be used as direct evidence due to the inaccuracy and methodology of recording this data; however, USAF bombing data can be used to inform operators as to the type and number of munitions that may be present in the area. NTS should be ongoing throughout the survey process, allowing teams to swiftly change activities depending on the situation and information they are investigating. NTS can also be conducted alongside



Red boxes indicate a cluster munition found, yellow boxes cluster munition fragments, green boxes nothing found, blue boxes the presence of other ERW.

TS over a longer period of time, which allows teams to make continued, informed assessments of results. Socioeconomic and impact data collected throughout the CMRS process and confirmed during end-of-survey assessments provides the necessary data to help prioritize CHAs during clearance.

To ensure correct, up-to-date information is acted upon in one continuous process, TS should begin as soon as possible following the completion of NTS and should be inducted using a system of boxes based on a 1 km by 1 km grid map. The standard TS search box is 50 m by 50 m for a total of 2,500 m^2, and each search box has a unique identification number. The search pattern within each box may vary, depending on vegetation cover, topography, detectors being used, and soil mineral content; however, it should be systematic in approach and implemented to ensure that a minimum of 50 percent of the box will be covered. When the search is complete, the box is color-coded, based on the colors in Figure 1, to map the presence of CMR. If a CMR is found, the search in that box will stop, and the box will be marked red on the map. The team will then move on to a new designated box.

Boxes may be “skipped” in areas of dense contamination. In some areas of Southeast Asia, cluster munition strikes are so dense that strike footprints overlap, creating CHAs that are millions of square meters in size. This can result in a large number of red boxes, particularly toward the center of a CHA. As such, one or more boxes can be skipped so the boundary of the CHA is identified with less survey effort inside the footprint. This is a significant advantage to the CMRS methodology that drastically reduces the time and effort spent on survey inside contaminated areas, which require clearance and more accurately estimates for the amount of clearance required.

CMRS should be carried out by specially-trained or multi-skilled teams, with appropriate tools and experience. The teams take responsibility for all activities associated with the task of clearance, including desk assessments, community liaison, TS and NTS, EOD, and impact assessment. The confidence and experience of the operational team is critical to the implementation of CMRS. A team leader must have the training and resources available to make confident decisions and recommendations at each step.

A key element of CMRS is applying all reasonable effort to gathering information on the presence and impact of CMR from key informants within villages. Teams should spend sufficient time in a village to support the development of stronger rapport and trust between team and community members. This encourages more open sharing of information on the location and impact of CMR. Teams should also be able to conduct demolitions, to encourage more active information sharing by affected community members, who will see their information directly informing operations.

Cooperation between all stakeholders and a transparent information management system are essential to the availability and accessibility of information.

Ultimately, the survey and clearance of CMR should be based on continued threat assessment, evidence-based decision-making processes, ongoing quality assurance through verification of decision making, and close coordination with all stakeholders. CMRS is considered complete when an end-of-survey report is accepted by the national mine action authority.

CMR CLEARANCE

CHA boundaries based on direct evidence will ultimately result in a better-prioritized, more-efficient clearance process. Clearance remains the best means of ensuring quality control of the CMRS process and accuracy of the CHA polygon produced. After analyzing the results of clearance activities, CMRS procedures may be adjusted if results do not provide sufficient or accurate information to the clearance team. The feedback loop between clearance and CMRS is critical to avoiding under- or over-estimating the size of the CHA, and to verifying the accuracy and quality of survey results. For this feedback loop to be effective, clearance should be conducted as soon as possible after CMRS.

The close operational partnership between NPA and MAG in Quảng Trị Province, Vietnam, is an excellent example of this best practice. In Quảng Trị, NPA survey teams create CHAs that are cleared by MAG BAC teams. MAG and NPA routinely share all operational data and regularly conduct joint analysis to identify areas of improvement in the methodology. Through this partnership, operators were able to confirm that the boundary of the CHAs produced during CMRS were accurate and could be used to inform planning and prioritize clearance resources.

WHAT COMES NEXT?

All three NGOs are seeking to further develop the CMRS methodology by trialing changes in its implementation. Examples of ongoing trials include investigations into the optimal team size, utilization of new animal and mechanical detection assets, improved digital reporting procedures, and desktop mapping of evidence points to create an initial CHA boundary.

Continued collaboration, discussion, and sharing of lessons learned is critical to support the most effective and efficient adherence to CCM obligations and to increase the safety and socioeconomic development of cluster munition-affected communities in Cambodia, Laos, and Vietnam. MAG, NPA, and HALO will continue their close partnership in Southeast Asia and will seek to update the CMRS best practices document to reflect improvements to operational efficiency.

Involvement of stakeholders outside of the MAG-NPA-HALO partnership is of fundamental importance to the application and improvement of CMRS. Bringing together national and provincial authorities, other survey and clearance operators, and the donor community to discuss the best implementation of cluster munition survey and clearance in the region is critical for promoting its robust implementation, fostering strong national ownership, and ensuring the continual refinement of methodologies. This was most recently facilitated by the Government of the United States, which brought seventy-one stakeholders from Southeast Asia and further afield together in Quảng Trị Province, Vietnam, at the Second Regional Workshop on Cluster Munition Remnants Survey. At this workshop, the focus was to document best practices in CMRS in Southeast Asia as well as develop concrete plans of actions for each of the three countries. This workshop was a follow-up to the first, which was organized in June 2017, also funded by the Government of United States. Moreover, early donor support from the United States and Norway was key for NPA's efforts us to be able to develop CMRS.

CMRS methodology draws from the International Mine Action Standards (IMAS) and internationally agreed mine action principles to enable the most effective application of land release in a cluster munition context. However, CMRS is not currently included as a specific standard or Technical Note (TN) in IMAS and is instead covered under the general principles of IMAS and across several standards. This is primarily due to the development of IMAS being based on a landmine contamination context, and the significantly different nature of the threat being addressed in Southeast Asia. All operators work with national authorities to ensure National Mine Action Standards (NMAS) in Southeast Asia adhere to IMAS as closely as possible, and encourage NMAS to outline and define key requirements specific to CMRS. At the same time, MAG, NPA, and HALO believe that there is scope for IMAS to be revised to provide stronger standards for the implementation of CMRS in Southeast Asia and as such, a TN for mine action is being prepared to suggest revisions to the current IMAS, and will be submitted to the IMAS Review Board with a view for formal adoption.

Finally, it is important to consider CMRS methodology in different and emerging contexts. There is strong indication that CMRS methodology may have application in other locations with heavy cluster munition contamination, including southern Iraq and southern Lebanon. Areas with dense, surface-level contamination from CMR will likely require a systematic, evidence-based survey response based on the identification of CHA boundaries instead of single items to provide a basis for informed clearance. By sharing successes and challenges in implementation and discussing lessons learned, the CMRS process has, and will continue to be, incrementally improved to deliver more accurate results and provide a basis for more effective and efficient clearance operations.

See endnotes page 59

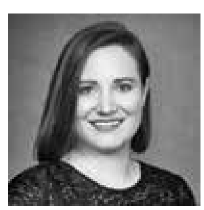
Kimberley McCosker
Former Programme Coordinator, Lao PDR
Norwegian People's Aid

Kimberley McCosker worked for three years with NPA in Lao PDR as Programme Coordinator and Project Manager, supporting the implementation of cluster munition remnants survey and clearance projects in six provinces. Prior to joining NPA, McCosker worked as Programme Manager for Handicap International in Cambodia and as a freelance photojournalist. McCosker holds a Bachelor of Photography from Griffith University's Queensland College of Art and a Bachelor of Journalism from Queensland University of Technology.

Jan Erik Støa
Country Director, Vietnam
Norwegian People's Aid

From 1989 to 2000, Jan Erik Støa attended military schools and served in the Norwegian Army. During the service as officer, Støa participated in different UN missions in Bosnia, Kosovo, and Lebanon, Somalia. Following retirement, Støa worked for two years with the Norwegian Refugee Council and was seconded to UNICEF in Sierra Leone and UNHCR in Eritrea. In 2002, Støa started work for Norwegian Peoples Aid (NPA) in the NPA head office. He has also worked on short contracts for DCA and FSD. In NPA, Støa has worked for two years as desk officer and he has also spend time in different field positions, from technical advisor, senior advisor, operations manager, program manager, and country director.

Katherine Harrison
Programme Coordinator, Lao PDR
Norwegian People's Aid



After first joining NPA in 2013, Katherine (Katie) Harrison took on the position of Programme Coordinator with the NPA Lao PDR team in January 2020. Harrison formerly served as Senior Policy and Research Advisor with NPA, where she was the primary researcher and author of numerous country reports for NPA's Mine Action Review publications 'Clearing the Mines' and 'Clearing the Cluster Munition Remnant's. Since 2006, she has worked on a range of mine action and humanitarian disarmament initiatives, including with organisations Action on Armed Violence, Landmine Action, and the Women's International League for Peace and Freedom. She holds a Master's (with distinction) in Diplomacy and International Strategy from the London School of Economics and Political Science, and a Bachelor's (with honours) from the University of Chicago in Political Science.

Providing IMAS Training to Local Military Forces and Mitigating Long-Term ERW Risks in VIETNAM

by Allan Vosburgh [Golden West Humanitarian Foundation]

Residual risk from unexploded ordnance (UXO) is a by-product of all modern conflicts. Developed by the Geneva International Centre for Humanitarian Demining (GICHD), the Management of Residual Explosive Remnants of War (MORE) program seeks to characterize risk and carefully examine the factors involved in reducing long-term risks from munitions.[1] MORE looks at many factors, including the impacts of time on munitions, explosives, and fuzing systems. Other critical considerations are the resources available to manage residual UXO and best practices from former conflict areas used to successfully overcome the risk reduction challenges. In Vietnam, the Golden West Humanitarian Foundation (Golden West) conducts a program training the Vietnamese Provincial Military Command (PMC) to conduct explosive ordnance disposal (EOD) to international standards with the goal of building long-term capacity.

One constant of modern conflict is that explosive remnants of war (ERW) are pervasive and enduring. World War I-era ERW is recovered daily from the fields of Belgium and France. World War II-era bombs still shake London decades after the Blitz ended. Golden West and others still recover United States and Japanese bombs from Pacific Islands more than 70 years after the war ended.

Conflict in Vietnam ended in 1979, but the impact of years of war remain. The international community has worked hard to conduct clearance of ERW, but long-term risk in Vietnam is a reality. Despite the Quảng Trị provincial goal of clearing all priority UXO sites by 2025,[2] UXO will exist in Vietnam for a very long time. While the frequency of UXO reporting will likely decrease as time passes, building a permanent capability to quickly and safely respond to these reports is critical to future public safety.

One important component of the MORE program is a long-term aging study of munitions that looks at how time impacts risk via the degradation of explosives, propellants, and fuzes.[3] Recently, Golden West worked with Vietnamese provincial officials (including the Quảng Trị Provincial Military Command), the Vietnam National Mine Action Centre (VNMAC), GICHD, and FENIX Insight Ltd., to conduct analysis of munitions collected in Quảng Trị Province. Golden West facilitated cutting of the munitions, enabling detailed analysis by experts

Quảng Trị PMC EOD Operations Center.
All images courtesy of Golden West Humanitarian Foundation.

from FENIX Insight Ltd. and Vietnam's Institute of Propellants and Explosives in Hanoi.

As noted by GICHD's MORE program, proactive ERW clearance (large-scale survey and clearance) eventually gives way to a reactive process involving responses to individual incidents. Post-conflict responses by the international community provide significant capability during the proactive phase of ERW remediation. Once an active transition to a reactive phase begins, clearance opportunities begin to fall off, numbers reflecting land cleared and UXO recovered plummet, and donor interest inevitably evaporates. When this happens,

Quảng Trị PMC EOD response vehicle.

Quảng Trị PMC EOD ammunition storage container.

large foreign-funded clearance organizations may become economically unsustainable and ERW infrastructure must be reduced. According to the GICHD, this reduction has been in proportion to the residual risk remaining, and the challenge is to provide a proportional response. National capacity has to be sustainable, and building capability with the PMC local forces is one possible solution to that challenge.

During the transitional period, risk to the populace remains high, but national level assets to respond to this risk are limited. Having international support available made it possible for the Ministry of National Defense and VNMAC to address other priorities and delay the development of national-level UXO programs. The ability to generate the skills necessary to provide EOD response teams at the provincial, district, commune, and village levels is essential. Community outreach is best done by the provinces and conducted by the enduring local forces who are an integral part of the provincial community.

Golden West concentrates on building capacity in order to enable enduring Vietnamese institutions to accept the challenge of transitioning from proactive to reactive responses (as predicted by MORE). With support from the Office of Weapons Removal and Abatement in the U.S. State Department's Bureau of Political-Military Affairs (PM/WRA), Golden West promotes training to international standards and contributes technologies that are appropriate for Vietnamese requirements.[4] Our partners in this effort are the Quảng Trị Provincial People's Committee, Department of Foreign Affairs (DOFA), the Quảng Trị Mine Action Centre (QTMAC), and the Quảng Trị PMC. All of these enduring institutions have worked hard and shown exceptional vision and confidence to make the PMC EOD program in Quảng Trị a success and a potential model for other provinces in Vietnam.

The PMC of Quảng Trị is a key partner in this program. Responsive to provincial leaders for defense, disaster assistance, and economic development, the PMC is also an important element of the People's Army of Vietnam. In this role, the PMC is a component of Vietnam's 4th Military Regional Headquarters in Vinh.[5] PMC EOD teams are an intrinsic part of their communities, playing a major role in disaster relief during flooding and major storm events. Relations with the community are strong and we have witnessed many instances where local residents approach PMC EOD teams during an incident, reporting additional, previously unknown UXO.

When Golden West first engaged Quảng Trị's PMC, their teams were unorganized, under-utilized, poorly-equipped, had no reliable dedicated transportation, and had ineffective field medical support. Most of all, the PMC was not often tasked by QTMAC or the provincial authorities because they were perceived as not being as well trained, equipped, or available for responses as the international HMA organizations working in the province. That perception has undergone a marked change since 2016 when Golden West first partnered with the PMC.

Golden West provides IMAS EOD Level 1–3 training for Quang Tri's PMC. The program goals are to substantially improve PMC EOD technical skills, improve documentation of UXO recovered, destroyed, and reported to QTMAC, improve detection training and tools, better field medical support to PMC EOD forces, and improve PMC's relationships with both QTMAC and other international nongovernment organizations (INGOs) working in Quảng Trị Province. Since the project began, Golden West has trained fifty-three EOD personnel: thirty-seven IMAS EOD Level 1 technicians, as well as eleven IMAS EOD Level 2 and five IMAS EOD Level 3 supervisors. Not all of these operators are still on the team, because some have been transferred to the QTMAC to conduct important quality control functions. By the end of 2019, Golden West plans to conduct an additional two classes of ten district-level PMC personnel for an IMAS Level 1-based munitions identification class for a total of twenty students. These additional personnel will enable PMC engineers in the districts to provide better UXO reporting to the PMC EOD team, making inputs to the QTMAC and tasking of EOD responses more effective. Golden West also plans to conduct an IMAS EOD Level 3 class in Quảng Trị Province before the end of 2019. This will be the first IMAS EOD Level 3 training conducted in Vietnam.

The PMC has fully embraced IMAS-based EOD training in Quảng Trị Province. Golden West maintains high standards for all its training and achieving certification is not easy. In addition to three weeks of formal training that incorporates both classroom instruction and practical field exercises, Golden West requires a mentoring period prior to certification. During mentoring, which can last up to one year, experienced technical advisors (TAs) observe students in the field during actual EOD incidents, reinforcing their skills and ensuring application of their IMAS training. During mentoring, TAs provide continuing sustainment training and conduct ad hoc classes on recovered munitions. Golden West also encourages PMC leaders to conduct their own classes, gaining experience conducting training and providing sustainable, formal instruction skills.

Golden West has worked hard to improve the PMC's capacity to conduct high-quality detection operations. In addition to providing the PMC's EOD teams with modern detection equipment, Golden West's Ph.D. geophysicist helped construct a small test and calibration area to ensure those detectors are operating properly. Through these efforts, the Quảng Trị PMC has become highly skilled in the use of detection equipment employed during emergency responses and battle area clearances.

The PMCs needed help improving field medical capabilities for their EOD Teams. With PM/WRA support, Golden West provided all new field medical kits for the medics supporting PMC EOD teams and arranged for training for their field medical personnel, stressing urgent treatment for injuries related to UXO operations. PMC EOD personnel also receive "field medical" classes as part of their regular sustainment training. Golden West attempts to leverage other outside medical experts at every opportunity to enhance the skills of PMC field medics. These include training by the Vietnamese Red Cross and opportunities for training by U.S. military medics as part of the Department of Defense's HMA cooperation with VNMAC.

QTMAC has evolved in coordination with the Provincial People's Committee. Unlike neighboring provinces where the PMCs manage UXO responses without a dedicated mine action center, QTMAC coordinates all emergency responses or requests for EOD support from the Quảng Trị community. The volume of QTMAC tasks for PMC responses has increased dramatically as PMC capabilities improve. Since the start of 2019, PMC EOD teams have responded to over 400 emergency response requests from QTMAC.

Quảng Trị's PMC EOD Program has changed substantially since beginning work with Golden West in 2016. When Golden West first engaged the Quảng Trị PMC, they were organized much like all the other fifty-eight provinces in Vietnam with PMCs.[6] The experienced EOD technicians were scattered among the ten district-level areas, and each was responsible for conducting ERW operations in their assigned areas, often using untrained military personnel borrowed from PMC engineers. Insufficient training, equipment, field medical support, and dedicated transportation limited their value to the QTMAC. Largely due to a lack of confidence in PMC skills and capability to respond, the QTMAC did not often call on them for EOD support.

PMC EOD range at Cam Lo.

M117 bomb incident.

Golden West encouraged the PMC to appeal to Vietnam's 4th Military Region Headquarters in Vinh, requesting a change in how their EOD personnel were organized; this resulted in the creation of a standing, five-person EOD team (four IMAS-qualified EOD operators and one field medic), available for emergency response twenty-four hours a day. Vietnam's 4th Military Region Headquarters approved this change at the end of 2018.

The first test of the new concept occurred over the 2018–2019 Christmas and Tết (Vietnamese New Year) holiday periods, when other INGO teams are unavailable for response. The QTMAC was concerned that there would be no emergency response capability for the province during these periods, but Lieutenant Colonel Hung, Quang Tri's PMC Engineer Commander, and his EOD teams stepped up and provided full-time EOD coverage. Not only was the PMC able to respond to multiple emergency incidents, but they were able to reduce their overall response time to twelve hours from the previous standard of twenty-four hours.

The PMC EOD response team obtained a building on a PMC installation in Đông Hà and, with Golden West help, refurbished it as an EOD team headquarters and operations center. Housing the response team 24/7 during their tour of duty and securing the team's response equipment, this building has telephone utilities and internet service, and is linked to the QTMAC, enabling short notice responses and much improved incident reporting.

A major shortfall preventing effective PMC EOD responses has been a lack of permanently assigned vehicles for use during operations. Late in 2018, Golden West leased a dedicated EOD response vehicle for the PMC, and the teams use it regularly, responding to more than forty emergency responses per month, most of these tasked by the QTMAC. Additionally, PMC leadership provided the PMC EOD organization a five-ton truck. Quảng Trị's DOFA also recently provided another EOD response vehicle to keep the response teams mobile when the leased vehicle is no longer available.

Golden West was concerned that UXO collected by the PMC EOD team was being stored dangerously close to the EOD operations center. Golden West also found that the EOD team's working explosives were stored in an inhabited building on a PMC installation. With Golden West assistance, the PMC obtained improved UXO and explosives storage, increasing safety and reducing the risk of theft or explosive accidents. Risk mitigating storage is also being established at the PMC's new Cam Lộ range. This storage consists of modified shipping containers, properly sited on concrete pads and secured to safely store recovered UXO until it can be destroyed.

This year, the PMC was assigned a permanent 400-acre range located in Cam Lộ District,[7] with part of it dedicated to EOD training and demilitarization. The PMC requested Golden West assistance to help make this range into a training and demilitarization facility. In addition to assisting with basic infrastructure and explosive storage, Golden West is helping to build specialized demolition pits for phosphorus-filled munitions and recommending construction of detection training and test lanes to foster more technical detection expertise.[8]

Golden West's project with Quảng Trị's PMC is designed to make PMC EOD teams self-sufficient and capable of accepting the challenge of long-term ERW risk management. Enhanced PMC skills give provincial officials more confidence in PMC capabilities so they provide better support and equipment to the PMC, making them even more capable. Integration of Golden West's train-the-trainer and mentoring approach provides a means for the PMC to continue developing IMAS-qualified EOD operators long after Golden West's U.S. Department of State-funded project is complete.

As articulated by the GICHD, the important elements of managing residual ERW risk include the development of indigenous capacities and capabilities. The availability of EOD skills, assets, and the scale of that availability are key parts of the MORE context. Some MORE risk controls rely heavily upon the availability of suitably-skilled EOD response assets in sufficient quantities. As the implementers of IMAS-based EOD capacity building programs for the Quảng Trị PMC, Golden West is helping to make MORE a reality in Quảng Trị Province by increasing those EOD capacities and capabilities and assisting the PMC with building a future workforce that will be ready to assume the challenges of mitigating the long-term risks of residual ERW.

Vietnam's long journey to recovery from decades of war must focus on finding a local solution to the long-term residual risks of UXO and other ERW. Our colleagues in Quảng Trị Province recognize that the problems of managing long-term risk are theirs to solve. They know that the international presence, available to respond to individual UXO incidents, cannot be sustained forever. In response, provincial authorities have stepped up their efforts to find meaningful solutions to these challenges. The PMC's EOD forces are an intrinsic component of the province's defense planning. They are a national asset and an important part of the People's Army for national level defense, but they also respond to the provincial government and assist in solving provincial challenges.

This model seems to have value when we look at other nations with comparable ERW challenges. Golden West's training program is not an immediate solution, but does create a path to future capabilities. The difficult technical skills required to safely and effectively respond to a wide range of EOD challenges are not created overnight. The costs to build these skills are substantial, but not when considered in light of the overall costs to maintain a large international effort. Investing in a future capability for self-help and national management of an ERW program seems to make sense when viewed as part of a continuum, with acute, large-scale requirements for urgent clearance of battle areas on one end, and the chronic, regular discovery of residual ERW on the other. It is up to national authorities to determine what mix of civilian, NGO, contractor, and military support works best for their situation. Vietnam has been moving in a positive direction for a number of years and has made great progress in reducing deaths and injuries from ERW. They seem to be poised on the edge of the transition from proactive clearances to reactive responses. Golden West believes the international community would do well to promote this effort to provide Vietnam with professional, highly-qualified EOD forces for future requirements. Quảng Trị Province is showing the rest of Vietnam a way to move ahead and prepare for the future. Whether the rest of Vietnam's provinces will follow their example remains to be seen.

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Allan Vosburgh
Chief Executive Officer
Golden West Humanitarian Foundation

Allan Vosburgh has been the Chief Executive Officer of the Golden West Humanitarian Foundation since 2016. Vosburgh is a retired U.S. Army Colonel and former U.S. Army Master Explosive Ordnance Disposal (EOD) technician with over forty years of experience in munitions stockpile management, explosive safety, EOD, munitions testing, weapons of mass destruction, training, technology assessments, and humanitarian mine action (HMA). Before retiring from the Army in 2005, Vosburgh served in the Office of the Assistant Secretary of Defense (Special Operations and Low-Intensity Conflict) in the Pentagon, where he provided oversight of EOD, HMA technology, and Special Operations Ammunition.

Game-Based Learning:

Figure 1. Screenshot of start page of MRE app.
All images courtesy of CRS.

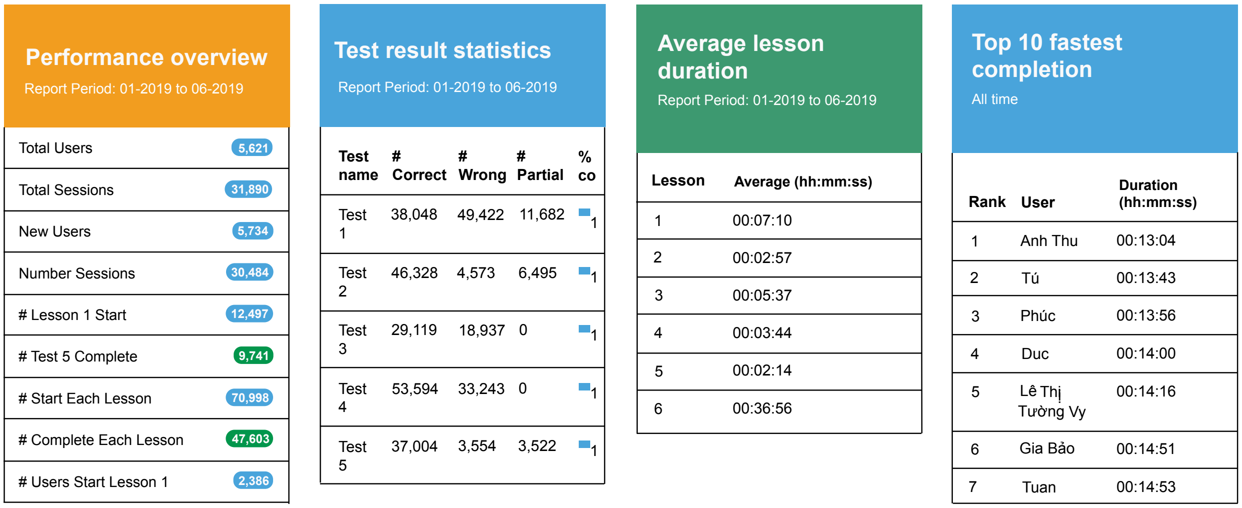
AN INNOVATIVE AND SCALABLE APPROACH TO MINE RISK EDUCATION

by Ta Thi Hai Yen [Catholic Relief Services Vietnam]

More than forty years after the war, Vietnam remains highly contaminated with 800,000 tons[1] of landmines and unexploded ordnance (UXO) such as artillery shells, bombs, missiles, and mortars contaminating 6.1 million hectares of land. According to the *Landmine & Cluster Munition Monitor*, landmines and UXO were the cause of 129 deaths and 241 injuries between 2008 and 2017.[2] Survey findings show that children are one of the most high-risk groups in many provinces in Vietnam, including in heavily-affected provinces such as Quảng Trị, Quảng Bình, Bình Đinh, and Quảng Nam.[3] Since the end of the war, children have been disproportionately affected by mine and UXO-related accidents, of which 38 percent resulted from children playing with mines and UXO—mainly small bombs and M-79 munitions[3] that they did not realize were dangerous. In 2015, a Catholic Relief Services (CRS) survey of 1,836 post-war landmine survivors found that 16 percent experienced accidents between the ages of six and ten (primary-school age) and 18 percent experienced accidents when they were aged eleven to fourteen (secondary-school age).[4] Though the Vietnam government and international organizations have made efforts to reduce the amount of contaminated land, it is likely that several decades-worth of work[5] are necessary to completely clear the land and water during which time children and youth will still be at risk. Although mine risk education (MRE) has been taught in primary schools for years, lessons are not standardized and are often only included as part of other lessons or extracurricular activities. Without frequent and in-depth lessons and discussions on MRE, many students' knowledge of the risks of mines remains dangerously insufficient.

DESIGN STRATEGY

To address these inconsistencies, CRS Vietnam, with funding from the Office of Weapons Removal and Abatement in the U.S. State Department's Bureau for Political-Military Affairs (PM/WRA), developed a digital game-based learning application for children ages eight-to-twelve years old. The application includes thirty minutes of narrated, media-rich gaming that can run on Android, iOS, Windows, and Mac operating systems. The app has features in both Vietnamese and English and can be downloaded for free from Google Play and Apple. It is also designed to be easily shared, and



Performance overview
Report Period: 01-2019 to 06-2019

Total Users	5,621
Total Sessions	31,890
New Users	5,734
Number Sessions	30,484
# Lesson 1 Start	12,497
# Test 5 Complete	9,741
# Start Each Lesson	70,998
# Complete Each Lesson	47,603
# Users Start Lesson 1	2,386

Test result statistics
Report Period: 01-2019 to 06-2019

Test name	# Correct	# Wrong	# Partial	% co
Test 1	38,048	49,422	11,682	1
Test 2	46,328	4,573	6,495	1
Test 3	29,119	18,937	0	1
Test 4	53,594	33,243	0	1
Test 5	37,004	3,554	3,522	1

Average lesson duration
Report Period: 01-2019 to 06-2019

Lesson	Average (hh:mm:ss)
1	00:07:10
2	00:02:57
3	00:05:37
4	00:03:44
5	00:02:14
6	00:36:56

Top 10 fastest completion
All time

Rank	User	Duration (hh:mm:ss)
1	Anh Thu	00:13:04
2	Tú	00:13:43
3	Phúc	00:13:56
4	Duc	00:14:00
5	Lê Thị Tường Vy	00:14:16
6	Gia Bảo	00:14:51
7	Tuan	00:14:53

Figure 2. Information created from data collected through the back-end system.

users are encouraged to share this app via emails and messages by either clicking the sharing icon in the app's main lesson or simply responding to the sharing reminder that pops up while playing. The app has both online and offline functionality and is designed to be user-friendly and age-appropriate for both boys and girls in the Vietnam cultural context.

The five stages of the app are equivalent to lessons. These lessons cover important MRE topics: the characteristics of landmines and UXO, risky behaviors that lead to accidents, ways to prevent accidents, consequences of accidents, and clues to identify contaminated areas. Key messages for each lesson are supported by eye-catching illustrations and lively sounds to keep players excited and interested. Each stage ends with a *challenge*, which is a test to measure players' knowledge when they complete each stage. After completing all five stages, players are given one last challenge to test their overall knowledge.

This app provides a platform to provide children with standardized quality MRE that they can access frequently. By playing this game, children can practice behaviors and thought processes in a simulated environment that have real-life applications. In addition to dynamically engaging young learners, it also facilitates learning for educators and adults as well.

Another key feature of this app is a back-end system to track basic demographic details about users as well as their performance and progress through the five stages. Basic information on users' character name, sex, age, and province is collected at the users' discretion, ensuring that users' full identities are protected. Information

Report Period: 01-2019 to 06-2019	
Total users	5,610
Total sessions	31,717
Average time to complete 5 lessons	00:12:56
Average time to obtain certificate	00:22:19
Completion ratio	78%
Number of certificates issued	2,176

Table 1. Test result statistics.

gathered about users' countries through their internet protocol (IP) address revealed that this game is used outside of Vietnam as well, indicating that the app is not only of interest to children in Vietnam but is also of interest to people in other countries. Figure 2 features a screenshot of visualized information created from data collected through the back-end system. This system plays a critical role in determining areas where children struggle with specific questions, which allows educators to better tailor in-class MRE lessons.

LAUNCHING THE MRE APP

The MRE app was officially launched in early December 2018 in the coastal province of Quảng Trị in central Vietnam. To an audience of hundreds of students, parents, teachers, government officials, and various mine action groups, CRS and its local government partners announced that the MRE app would be integrated into the informatics lessons of primary schools in the province.[6]

In January 2019, the app was piloted in twenty-six primary schools across three central provinces of Vietnam: Quảng Trị, Quảng Nam, and Da Nang. Forty-seven school managers and information technology teachers were trained on installing and managing the app and given detailed instructions on its contents and structure. Following the training, the app was integrated into each school's informatics lessons so students could play whenever they went to the school computer lab. Provincial-level Department of Education and Training officials (DOETs) aimed for at least one-hundred students per school to play the game during informatics classes.

To encourage students to use the app on their parents' mobile devices, parents were introduced to the app at the end-of-the-year school meetings in May 2019 with the idea that students could continue to play the game throughout the summer break. This provided an opportunity to reinforce students' MRE knowledge and encourage safe behaviors throughout the year.

In its first six months of operation, from January to June 2019, the app had a total of 5,610 downloads, and users played the game 31,717 times. CRS expects that the number of people exposed to the

Students are eager to try the app at the launch.

app's content is much higher than the number of downloads (total users) because students typically play together under one user profile at school, and usually play with their parents or siblings at home.

While the app provides comprehensive MRE information, it was also designed to accommodate a wide range of student abilities and ages. On average, most users complete all five lessons in thirteen minutes and need another ten minutes to conquer the final challenge covering content from all the individual lessons and receive an MRE certificate. As of June 2019, 78 percent of the users were able to complete the whole game.

Already, feedback and results have been extremely positive with students indicating that they really enjoy the game and Vietnamese provincial-level government partners expressing serious commitment to ensuring schools in their jurisdiction use this app. The MRE app, by nature of the platforms on which it is available, is accessible to students throughout Vietnam. Downloads and use have expanded to provinces where CRS is not directly implementing MRE programs. Through the Landmine Working Group of Vietnam, CRS has been able to share key analytics on the usage of the app with other partners and create a platform to discuss critical gaps in MRE knowledge and establish key MRE messages to disseminate across the country.

IMPACT AND SCALABILITY

Delivering key MRE messages in the format of a game helps to keep children interested and to remember the messages longer. Since the deployment of the app, CRS' work exposed 296,230 primary school children to MRE, and in the CRS-supported provinces—Quảng Bình, Quảng Trị, Quảng Nam, and Da Nang—there have been zero casualties.

In the pilot phase, CRS has taken to heart the feedback provided by the government and other key stakeholders. To date, most of it has been positive. A back-end system captures users' performances (lessons they fail, lessons they pass, etc.), indicating gaps in children's knowledge and allowing CRS a means of adjusting the focus/program.

A government partner, Md Nguyen Thi Thuy Thuy, Vice Director of DOET in Quang Tri asserted that "It's critical to provide mine risk education for students to prevent accidents. We appreciate this MRE Play app developed by CRS, as it's a new education tool, which is suitable and appealing to students. It will help them remember information."

Mr. Dinh Bat Chuyen, DOET Representative in Da Nang stated that "This is a good initiative to support MRE at schools. Our teachers and students are very eager with learning new things, especially technologies. This kind of educational game should be introduced to parents as a communication channel to remind students and their family members o[f] MRE messages and prevent UXO accidents in communities."

A fifth-grade student at Cam Lo primary school, Quang Tri Province shared "I like the app very much. It's very interesting to learn MRE through a game."

A teacher who has taught MRE for fifth-grade students for six years at Cam Lộ primary school, Quảng Trị province said that "The app is very useful and highly scalable. I believe that it will be widely used by both students and their parents." All thirty-six students in her class have used the app in the school computer lab.

Globally, CRS is highlighting development of the app and raising visibility around using information communication

Visitors try the MRE app at the CRS booth at the Information and Communication Technology for Development (ICT4D) conference in Uganda.

technology for knowledge sharing. The Vietnam team hosted an internal webinar on 13 December 2018 to educate other CRS stakeholders on the process, cost, intended uses of the app, and the data generated from its use. Furthermore, the app was widely shared through a forty-minute session and at the CRS booth at the Information and Communication Technology for Development (ICT4D) conference[7] in Uganda on 1 May 2019.

The app will strongly complement CRS's class-based MRE but cannot completely replace it in the near future. However, if unable to do class-based MRE when expanding to new project provinces, CRS will use the app as an alternative. As the app is in the form of a game, project staff do not expect major challenges while being played by children in non-project areas. However, CRS will need the acceptance of the local governments of new provinces in order to integrate the app into lessons. Furthermore, as CRS cannot pay to advertise the game in app stores, many people do not know that the app exists. For the future, project staff may consider developing a second version of the game by increasing its complexity to appeal to an expanded range of user ages.

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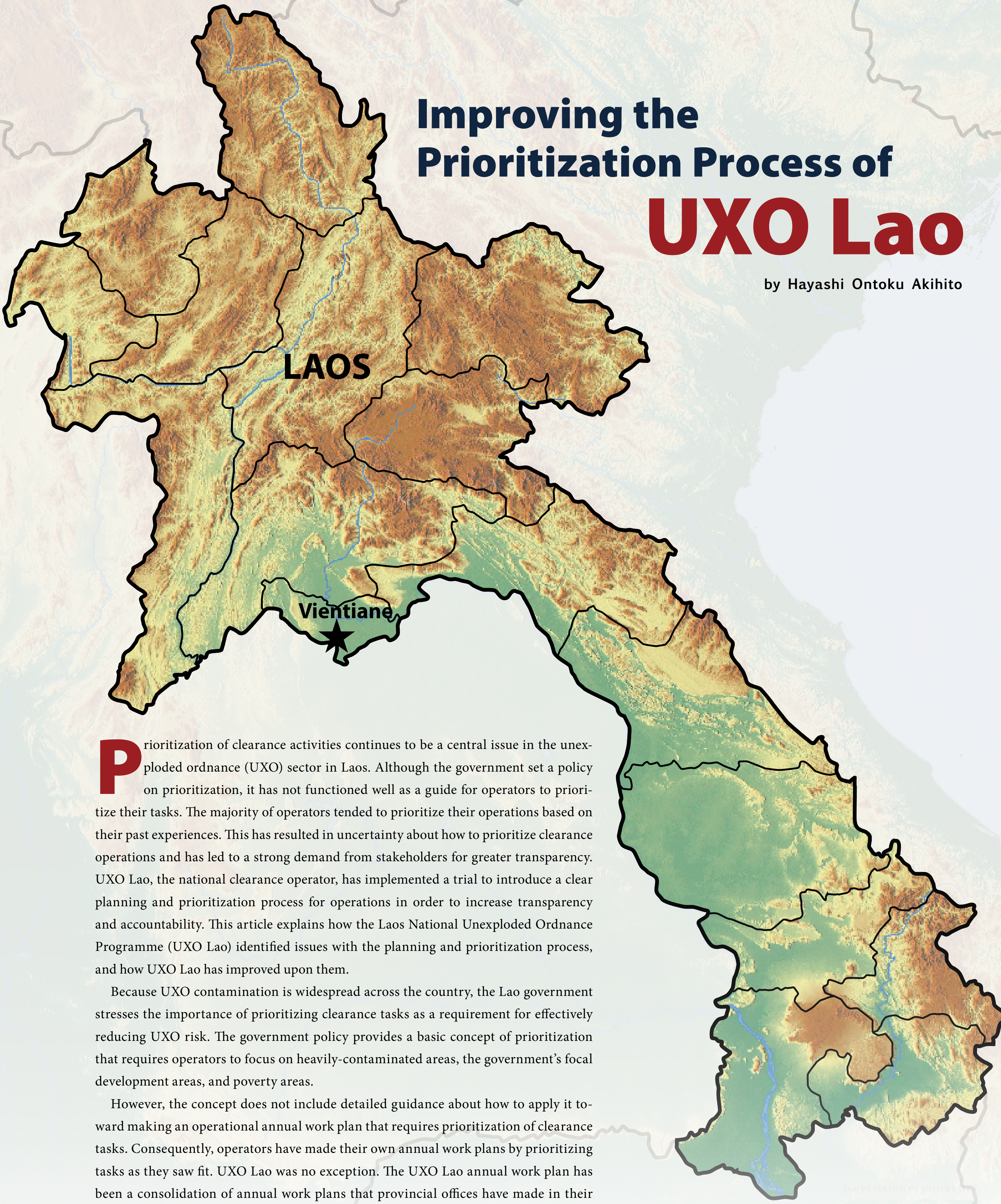
Ta Thi Hai Yen
Program Manager
CRS Vietnam

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

Improving the Prioritization Process of UXO Lao

by Hayashi Ontoku Akihito



Prioritization of clearance activities continues to be a central issue in the unexploded ordnance (UXO) sector in Laos. Although the government set a policy on prioritization, it has not functioned well as a guide for operators to prioritize their tasks. The majority of operators tended to prioritize their operations based on their past experiences. This has resulted in uncertainty about how to prioritize clearance operations and has led to a strong demand from stakeholders for greater transparency. UXO Lao, the national clearance operator, has implemented a trial to introduce a clear planning and prioritization process for operations in order to increase transparency and accountability. This article explains how the Laos National Unexploded Ordnance Programme (UXO Lao) identified issues with the planning and prioritization process, and how UXO Lao has improved upon them.

Because UXO contamination is widespread across the country, the Lao government stresses the importance of prioritizing clearance tasks as a requirement for effectively reducing UXO risk. The government policy provides a basic concept of prioritization that requires operators to focus on heavily-contaminated areas, the government's focal development areas, and poverty areas.

However, the concept does not include detailed guidance about how to apply it toward making an operational annual work plan that requires prioritization of clearance tasks. Consequently, operators have made their own annual work plans by prioritizing tasks as they saw fit. UXO Lao was no exception. The UXO Lao annual work plan has been a consolidation of annual work plans that provincial offices have made in their own ways. Whereas provincial offices obtain approval from UXO Lao headquarters as a formality, headquarters has had little control over the process or the final product of these annual work plans. Additionally—again as a formality—UXO Lao headquarters

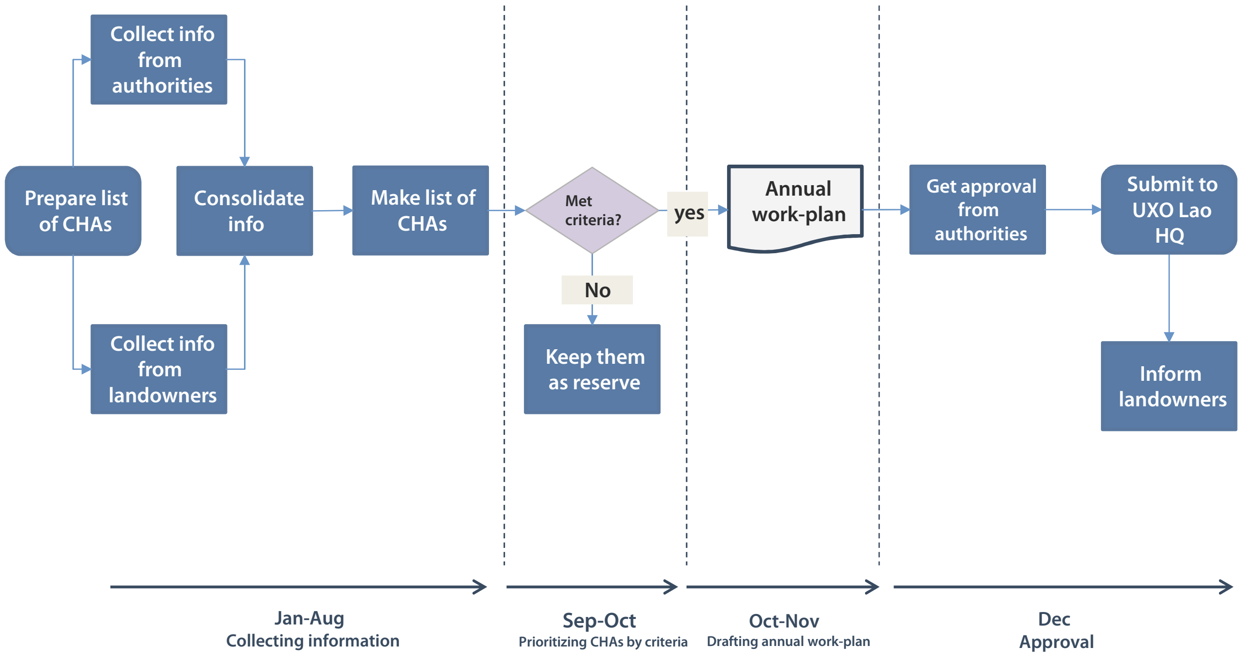


Figure 1. Process of making an annual work plan.
All figures courtesy of the author.

will hold meetings and notify provincial offices when the work-plan making process is to start and when the plan needs to be submitted.

Stakeholders, especially donors, saw this as a problem. There has been no uniform process or method for prioritization across national operators or provincial offices. Transparency and accountability has had limited effect on making annual work plans and prioritizing tasks. Outsiders found the entire process cryptic and would doubt whether planning had been undertaken appropriately.

There has been another driver for UXO Lao to improve the planning process. UXO Lao has been trying to change its operation from a request-based approach to an evidence-based approach. In past operations, UXO Lao cleared land based on requests received from villagers. This became an issue because villagers sometimes requested clearance in plots of land where there was little evidence of UXO. In such cases, UXO Lao found few items of UXO. This approach was frequently taken up as problematic in sector meetings. Subsequently, a new concept of operations, "evidence-based approach," was introduced. This approach focuses only on clearance of confirmed hazardous areas (CHAs) that survey teams have identified as hazardous after completing technical survey. This change required UXO Lao to revisit its planning process to incorporate the prioritization of CHAs as a new step.

UXO Lao recognized the need to make the planning process more transparent and accountable, and to include the new concept of operations. Following this, UXO Lao, with Japan International Cooperation Agency's (JICA's) support, started a project to modify the planning process in 2015. The project aimed at setting up an accountable planning process and defining criteria to prioritize tasks by developing guidelines that all provincial offices could follow.

UXO Lao implemented the three-year project in three southern provinces: Champasack, Salavan, and Xekong. For the first year, project members at UXO Lao headquarters had a series of discussions with the three provincial offices to identify similarities and differences in planning processes among the offices, and from this, outlined a new process that reflected the common elements among the different planning processes. In the second year, the Champasack provincial office tested the new planning process while drafting an annual work plan and reported back to the project members about what worked and what didn't. The project members were able to consolidate these suggestions and revise the draft process. In the third year, all three provincial offices tested the revised planning process. With findings from the trial, the project team developed a final version of the draft planning process at the end of the project.

There are two key features in the newly-established planning process: a well-defined planning cycle (Figure 1) and clarified criteria for prioritizing clearance (Figure 2). Previously, field staff had a limited understanding of the planning cycle, which was not clearly defined. The new planning process clarified the responsibilities of each staff member, types of actions, and timing of actions. As survey teams identify new CHAs and collect CHA-relevant information throughout the year, they also visit field sites and local authorities to update information on existing CHAs that have not been cleared. Meanwhile, managing staff prepare a list that includes information on both existing and new CHAs. Next, staff prioritize these CHAs based on a list of criteria and draft an annual work plan for the provincial office. Once local authorities receive this draft for consultation and approval, the draft goes to UXO Lao headquarters for final approval.

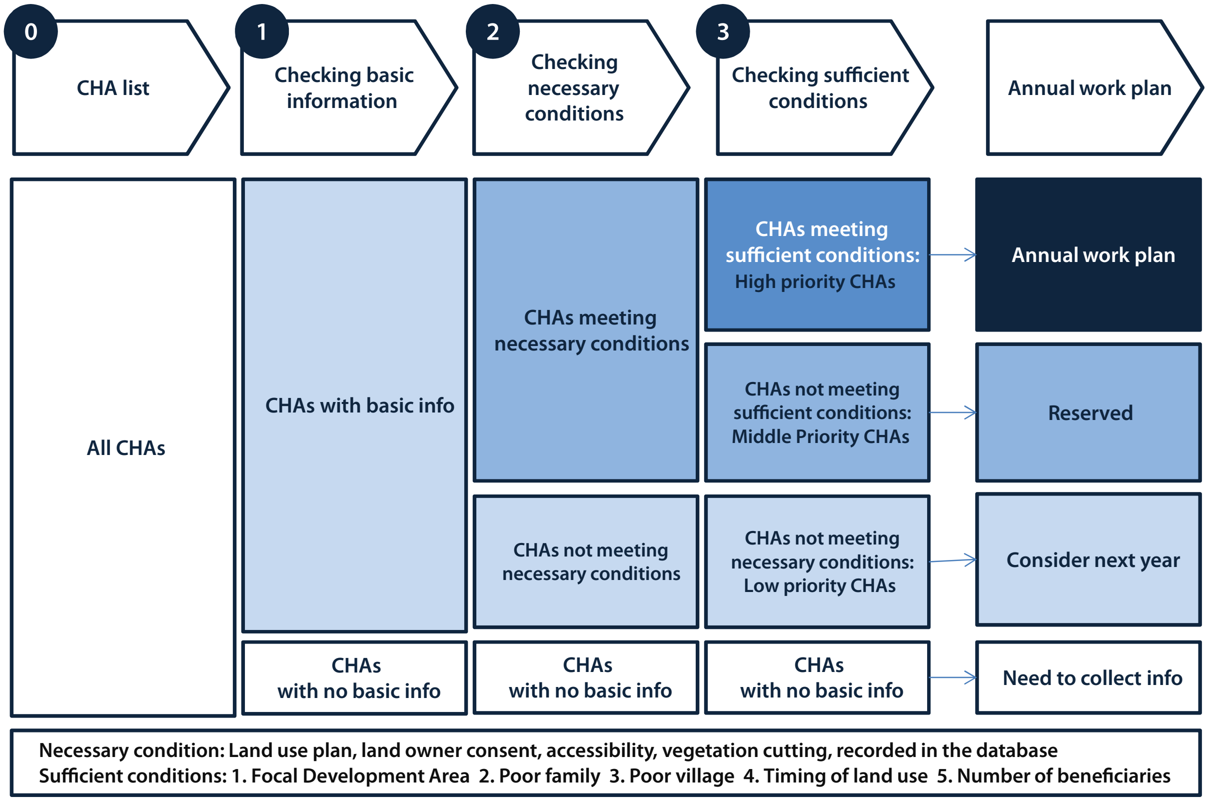


Figure 2. Prioritization of CHAs.

In past operations, the provincial offices prioritized CHA-clearance activities based on their own criteria. In order for all the provincial staff members to follow uniform criteria, the new process clarifies the prioritization mechanism by detailing criteria and setting steps to apply them. The first step is to eliminate CHAs for which basic information such as landowners' names and number of beneficiaries is missing. This arises when field staff members are unable to collect key information from landowners, either because the whereabouts of landowners is unknown or they live far from the site. In such cases, field staff continue to work on collecting the information for the next year's annual work plan.

The second step is to further narrow down the CHA list using *necessary conditions*. If CHAs fail to meet any one of the necessary conditions, staff exclude the CHAs from the list and categorizes them as low priority. Necessary conditions include the existence of a land-use plan, landowners' consent, accessibility, vegetation cutting, and data collection. Staff review the excluded CHAs again the following year with updated information. The third step employs *sufficient conditions* as a screening function to select appropriate CHAs from the list. Sufficient conditions require the UXO Lao staff to check, for example, whether a CHA belongs to a poor village, a poor family, or other criteria. Unlike necessary conditions, sufficient conditions are applied to each CHA one by one. CHAs that meet the first sufficient condition are categorized as high priority and are included in the annual work plan. Subsequently, the remaining CHAs that fail to meet the first condition are reviewed, and CHAs that clear the second condition are put into the plan. This process is repeated until the total area of CHAs reaches the clearance capacity of each provincial office. These conditions permit staff to filter through and prioritize CHAs from the list.

UXO Lao's efforts have resulted in the successful implementation of an improved and more transparent trial planning process for CHA clearance. The new process gives stakeholders confidence that activities are properly managed. However, there is still scope to improve the planning process, and it will be tested in six other provinces where UXO Lao is operational to ensure that the criteria for CHA prioritization can accommodate different environments and practices.

The views expressed in this article are those of the author and do not necessarily reflect those of UXO Lao.

Hayashi Ontoku Akihito

Hayashi Ontoku Akihito is a former JICA Advisor to UXO Lao. He worked with UXO Lao from 2012 to 2018 and was responsible for a project supported by JICA to develop UXO Lao's capacity in planning, monitoring, and information management. Akihito also coordinated a South-South Cooperation approach between UXO Lao and the Cambodian Mine Action Centre. Akihito is currently employed by the Sasaleawa Peace Foundation.

COMMUNITY-BASED INCLUSIVE DEVELOPMENT:

Integrating Survivors into a Broader Victim Assistance System

by Bernard Franck, Donna Koolmees, and Sarah French [USAID Okard, World Education, Inc.]

During the Vietnam War, an estimated 580,000 bombing missions were carried out over Laos, dropping two million tons of ordnance across the country.[1] This contaminated Laos with approximately eighty million items of unexploded ordnance (UXO),[2] including "big bombs," cluster munition and submunition bomblets, grenades, rockets, and other types of ammunition.[3] There also remain an unknown number of landmines across the country, which are further remnants of the war. Today, fifteen out of eighteen provinces and approximately 25 percent of villages are still affected.[4] Between 1964 and 2017, 50,754 people were killed or injured as a result of UXO and/or landmine accidents.[5] While some landmines and UXO have been cleared, the task of demining the entire country will take considerable time and, though decreasing in number, injuries and deaths continue to occur. In response to these challenges, Laos ratified the *Convention on Cluster Munitions* (CCM) in March 2009, and the United Nation's *Convention on the Rights of Persons with Disabilities* (CRPD) in September 2009.[6] Additionally, in 2012 Laos launched a National Strategic Plan for the UXO sector and has committed to reducing the risk of UXO by 2030 through Laos' national Sustainable Development Goal (SDG) 18: Lives Safe from UXO. SDG 18 not only provides targets for clearance activities, but also addresses the ongoing needs of survivors and victims.[7]

The following case study draws from interviews with several UXO and landmine survivors that USAID Okard is working with and illustrates the challenges faced by someone living in an area contaminated with landmines and/or UXO.

Maikorly is a twenty-eight-year-old Hmong woman who is married and has three children. She lives in Kham District, Xieng Khouang Province. One day while she was making a fire in her kitchen, a buried bomb exploded, and shrapnel injured her left leg and burned her neck and face. Her family immediately took her to the provincial hospital, but the accident resulted in the loss of her leg and eyesight.

After two months, she was able to return home, but her life had changed dramatically; she experienced significant difficulty moving around her home and was forced to crawl on the dirt floor. The structure of her house, combined with her limited mobility and visual impairments, restricts her ability to carry out normal household tasks. Before her accident, she would collect firewood, go to the market, cook, clean, and care for her children, but now she depends on her husband to do these tasks. Fortunately, her ongoing medical expenses related to the UXO accident are covered by the War Victims Medical Fund (supported by the U.S. Government). However, due to her injuries, Maikorly can no longer work and her husband's income alone is not enough to cover household expenses, putting her family at greater risk of poverty. In addition to financial strain, the accident negatively impacted the family dynamics. Her husband does not believe household tasks are "men's work," and he has begun to blame and resent Maikorly for not contributing in the way that she once could.

Curiosity from the community about her change in appearance has also become a challenge, and Maikorly has faced negative reactions from some of her neighbors who believe that the accident was a result of her family's transgressions. Maikorly's children have experienced bullying from classmates about their mother's disability, and one of the children has stopped attending school as a result.

Difficulties in functioning, shifting household roles, and stigma from the community have all contributed to Maikorly's feelings of powerlessness, shame, and sadness, which has led her to become withdrawn and, at times, contemplate suicide.

Image 1. Toumkham, a CBID facilitator from the Quality of Life Association, a civil society organization in Xieng Khouang Province, demonstrates how to use a flipbook for community awareness raising. The flipbook explains various health conditions with the goal of reducing stigma and helping villagers engage in disability inclusion within their communities.
All images courtesy of World Education, Inc.

Integrated Victim Assistance within Community-Based Inclusive Development (CBID) Demonstration Model

Across Laos, UXO and landmines hidden in the soil cause about forty accidents per year,[8] often leaving survivors with chronic injuries. There is also an increasing prevalence of non-communicable diseases, road-traffic accidents, and other health conditions that lead to disability and difficulties in functioning. The result is a growing need for increased rehabilitation, psychosocial support, and socioeconomic assistance for the survivors of these accidents and health conditions.

Through the USAID Okard Activity, jointly funded by the U.S. Agency for International Development's (USAID's) Leahy War Victims Fund and Victims of Torture Program, and the Office of Weapons Removal and Abatement in the U.S. Department of State's Bureau of Political-Military Affairs (PM/WRA), World Education, Inc. (WEI) partners with the Lao government and civil-society organizations (CSOs) to develop and implement disability-inclusive policies so that no one is left behind. One of the main features of USAID Okard Activity is the Community-Based Inclusive Development (CBID) Demonstration Model.

In response to the CCM's call "to adequately provide age and gender sensitive assistance including medical care, rehabilitation, psychological support, and support for social and economic inclusion" to survivors of UXO and landmine accidents and their communities,[9] USAID Okard recognizes that in order to provide tangible and sustainable support, an integrated approach through a broader Disability Inclusive Development (DID) framework is essential. The CBID Demonstration Model, developed by USAID Okard, targets any person with a disability regardless of the cause and is inclusive of UXO and landmine survivors. CBID facilitators, employed by CSOs and in interaction with local authorities and communities, provide support that is based on the specific medical, rehabilitative, psychological, and socioeconomic needs of those identified in target communities.

The CBID Demonstration Model is an evidence-based participatory approach that engages the whole community to identify needs and remove barriers to create a more supportive and inclusive environment for persons with disabilities. Guided by the philosophy of DID, the goal of USAID Okard is to improve and sustain the independent living and functional ability of persons with disabilities, including UXO and landmine survivors, regardless of age, sex, gender expression, or ethnicity. The USAID Okard team and its civil society partners who implement the CBID Demonstration Model work closely with the government of Laos at the central level and in two pilot districts, along with communities to implement and test the Lao National Disability Policy and the Lao Rehabilitation Strategy. USAID Okard believes that if the government of Laos and communities are effectively engaged and mobilized toward disability inclusion, and if case management enables increased functioning and participation of persons with disabilities, then these two components will enhance and sustain full participation of persons with disabilities in Laotian society.

After raising awareness on disability inclusion, the CBID facilitators from CSOs engage with stakeholders in practical conversations about how they can contribute to removing barriers that prevent people with disabilities, including those affected by landmine and UXO accidents, from participating in community life. The goal is to improve perceptions and create an enabling environment for disability inclusion within communities. For example, the CBID facilitator might engage village authorities to help monitor and provide support to UXO and landmine accident survivors and their families or hold meetings about disability inclusion with teachers and students at a local school. These activities help to create a common understanding that disability is part of human diversity. Moreover, this process can help demonstrate how long-term development can encompass disability inclusion by reducing barriers for persons with disabilities within communities and encourage stakeholders to examine ways that public spaces can be accessible for all.

In the second component—case management—the project assesses and analyzes the unmet needs of people with disabilities and their households, and then develops a family-centered action plan, provides interventions, and monitors outcomes. When working with families, CBID facilitators use compassionate communication to empower the family; provide psychosocial support; advise on home-based rehabilitation and accessibility accommodations; and provide referrals to medical, rehabilitation, and assistive product providers as well as to more complex mental health and psychosocial support (MHPSS) services. In the case of UXO and landmine survivors, the CBID facilitator also provides them with information about the War Victims Medical Fund and connects them with a district National Regulatory Authority (NRA) official, who can help ensure that they receive reimbursement for their medical costs. CBID livelihood officers support the most vulnerable persons with disabilities to develop income generating activities (IGAs) based on an adapted Ultra-Poor Graduation Approach,[10] originally developed by Building Resources Across Communities (BRAC) in Bangladesh. CBID facilitators also connect persons with disabilities and their families to educational and vocational training and social services while working to strengthen referral networks across these sectors. Each CBID facilitator manages approximately twenty cases like Maikorly and her family, helping them access resources that will optimize their functioning, economic self-sufficiency, and well-being.

The CBID Demonstration Model is implemented by two CSOs: Quality of Life Association (QLA) based in Xieng Khouang Province, and the Association for Rural Mobilisation and Improvement (ARMI) in Savannakhet Province. These two provinces were identified as CBID Demonstration Model pilot areas because they are both predominantly rural and severely contaminated by landmines and UXO.

Developing a Comprehensive Needs Assessment Tool for Case Management

Knowledge about the prevalence, needs, and priorities of UXO and landmine survivors is a common challenge for donor states due to a lack of data on both quantitative impact (whether victims access services and initiatives) and qualitative impact (whether taking into account victims' specific needs leads to improvement in their quality of life). At the same time, globally, there is limited evidence of the effectiveness of CBID on individuals' levels of functioning. The USAID Okard Results Framework incorporates indicators that will provide evidence on access to social services and livelihoods opportunities, which can then be disaggregated by cause of health condition, including UXO and landmine accidents. These indicators include the "number of people receiving health and related rehabilitation services (including medical, rehabilitation, assistive products and MHPSS)," the "number of people gaining new or better employment and accessing technical vocational education training (TVET)" and evidence of the impact of these services on quality of life, and the "number of people with increased function, economic self-sufficiency and well-being." To measure these indicators, WEI and the Nossal Institute of Global Health at the University of Melbourne have developed a CBID *Modular Tool* to accurately measure needs at the individual and household levels. This allows for the collection of rich data while also helping CBID facilitators build a comprehensive understanding of the situations of individual persons with disabilities and their families. The Modular Tool has eight modules that collect data related to household demographics, education, function and use of assistive products, physical health conditions, mental health, access and utilization of health services, economic participation, and well-being. In addition, one of the eight modules focuses on the role of the caregiver and his or her health, well-being, and productivity.

Identifying Needs

Following a community screening (step one in the case management process), the CBID facilitator visits Maikorly at her home to complete the needs assessment using the Modular Tool (case management step two). Initial questions help the CBID facilitator understand Maikorly's family structure, the education levels of the different members of her household, and the family's socioeconomic status. As the CBID facilitator asks more questions, she learns about Maikorly's mobility, the accessibility of her home, and her ability to complete daily activities and participate in community life. By the end of the first home visit, data are collected on Maikorly's health and any barriers that restrict her access to health services.

On the second home visit, the CBID facilitator completes the last four modules of the Modular Tool, exploring Maikorly's psychosocial needs related to possible anxiety, stress, depression, and PTSD. Questions explore the extent to which Maikorly is able to access health, rehabilitation, and MHPSS services, her health-seeking behaviors, and her overall perception of her well-being. This visit will also examine the level of support Maikorly's husband provides to her and her children following the accident and what impact this has had on his productivity as well as physical and mental health. Finally, the CBID facilitator collects data about the current employment status of Maikorly and her family as well as their ability to access financial literacy and skills trainings.

The Modular Tool was developed by a team of technical experts and involved the review, selection, and refinement of questions from the Washington Group on Disability Statistics[11] and other psychometrically tested surveys[12] to construct the eight modules, which, as a whole, form a cohesive, practical instrument. Response categories serve as triggers for unmet needs, and decision-making algorithms raise red flags to inform CBID facilitators of where it could be beneficial to target interventions. Specific questions comprise scaled scores to measure function and well-being. The tool has been digitized using the open-source software platform Kobo Toolbox, allowing CBID facilitators to collect data through the Kobo Collect application on a tablet. After data are uploaded to a central database, the program generates an automated summary of results for the CBID facilitator to discuss with Maikorly and her family as they collaboratively develop an action plan. This process utilizes a family-centered approach, underpinned by the principle that Maikorly and her family understand their needs and are in the best position to inform the CBID facilitator of the priority interventions connected to their unique family situation. This also helps build a supportive family environment so Maikorly can achieve optimal functioning and participation. The CBID facilitator then returns to Maikorly's home to discuss the results from the Modular Tool. During this session, the facilitator suggests interventions that could address Maikorly's unmet needs and, with her family, she develops an action plan.

Interventions Could Include the Following:

Health and rehabilitation services assess her functional mobility and provide appropriate assistive products, such as a prosthesis, wheelchair, commode chair, and other devices to help Maikorly complete daily activities. The costs of accommodation and transportation to access these services are covered when needed. At the same time, the CBID facilitator can assess the home environment to see what adaptations can be made to improve accessibility, for example, widening a doorway or installing a ramp. The CBID facilitator may also follow up on the home-based exercise program provided to Maikorly by rehabilitation professionals. These interventions would contribute to optimized functioning and increase Maikorly's participation in daily activities and community life.

Psychosocial support by a health specialist provides counselling related to her feelings of sadness, suicidal thoughts, or changes to her self-image as a result of her injuries.

Peer-to-peer support with another UXO/landmine survivor or person with disabilities builds confidence in dealing with the changes in her life following the UXO accident. This can help create a space where Maikorly feels comfortable seeking out advice related to her daily functioning and receiving support when she encounters challenges or stigmatization.

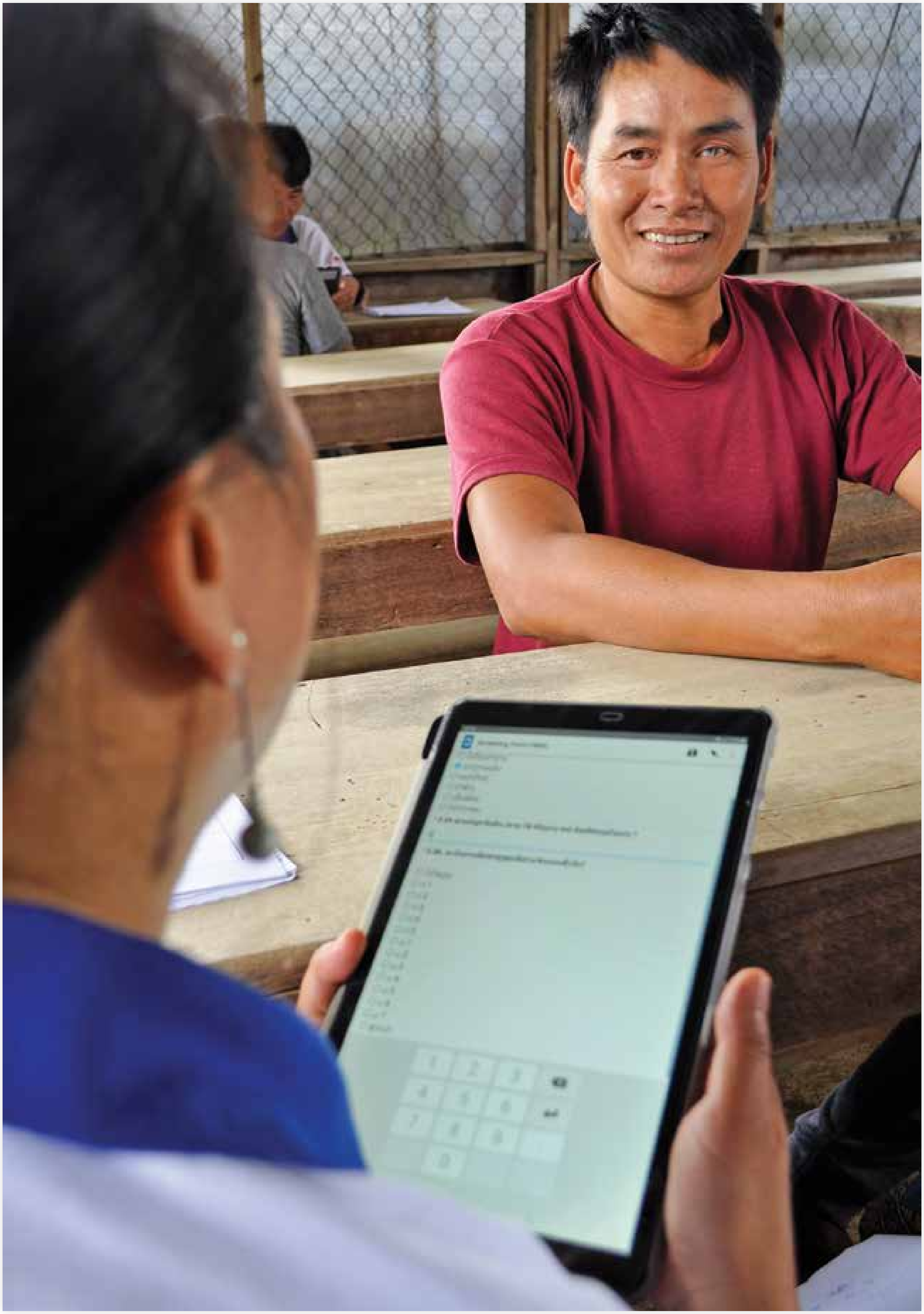
Image 2. Teuy (left), and Peter (right), both UXO survivors, participate in a peer-to-peer support session. These sessions allow UXO and landmine survivors to connect, share personal experiences, and provide support to others who have been in similar situations.

Support to access an income generating activity (IGA), which might involve providing Maikorly and her family with new assets to start a small business, supporting her family to expand or diversify their existing assets, such as land and livestock. To help build her capacity for economic self-sufficiency, Maikorly might also access enterprise coaching, financial literacy training, and, if needed, vocational skills training.

Support to her husband via caregiver training better equips him to assist Maikorly. Trainings include discussions about the distribution of household tasks related to traditional roles and gender stereotyping.

Monitoring the Impact of CBID Case Management on Functioning and Well-Being

The CBID facilitator continues to visit Maikorly and her family to provide coaching and continuous monitoring of the action plan implementation, ensuring that referrals to services are followed up on and completed. After approximatively six months, once specific actions and objectives related to each intervention have been achieved, the CBID facilitator repeats the CBID Modular Tool to measure what has changed and how. Key questions include: To what extent has Maikorly's functioning and well-being improved? In what ways has her husband's approach to caregiving changed? And to what extent has the family's socioeconomic status and capacity for economic self-sufficiency changed as a result of participating in the program? By comparing initial needs assessment data with data at the end of intervention, the case management process captures the quantitative and qualitative changes that indicate the impact of CBID interventions on quality of life, based on the number and type of services and support Maikorly has received.



Looking Forward

While contributing to the implementation of the UXO/Mine Action Victim Assistance Strategy 2014–2020 of the government of Laos, USAID Okard advocates for a broader disability inclusive model. By integrating UXO/mine action victim assistance in a broader CBID Demonstration Model, USAID Okard also helps to implement and test the new National Disability Law and Policy and the National Rehabilitation Strategy, creating stronger systems to assist all victims of injury regardless of the cause of the accident. To ensure the long-term sustainability of DID, while also applying a person-centered approach through the CBID case-management process, USAID Okard works closely with the government of Laos to build ownership of inclusive policies that enhance equal access to social services for all persons with disabilities, including UXO and landmine survivors.

The CBID facilitators from two national CSOs (QLA and ARMI) work collaboratively with provincial and district focal points from the Ministry of Labor and Social Welfare and the Ministry of Health. Through the CBID Modular Tool, the case-management process generates quantitative and qualitative data that demonstrate what types of support and services have been provided to persons with disabilities, including UXO and landmine survivors, and how this has impacted their functional ability and quality of life. This information is used at the central level to inform policy makers on progress, successes, and challenges directly related to the government of Laos strategy and its commitments to the CRPD.

USAID Okard also provides QLA and ARMI with the opportunity to access other donor funding and supports them to build their governance and managerial capacity to sustain their organizations. This way, they will be able to expand CBID to other districts beyond the present geographic reach of USAID Okard so that persons like Maikorly and her family can continue to benefit from the assistance they need in the aftermath of UXO/landmine accidents. The CBID Demonstration Model aims to develop inclusive, resilient, and equitable communities where UXO/landmine survivors and persons with disabilities are empowered, and to prove that effective inclusive development can happen at the community level.

See endnotes page 59

A special thanks to editors and contributors Chansamone Chasuakao (Gender and Inclusion Officer), Somphet Keovongxay (CBID Coordinator), Sathaphon Phoumarinno (SBCC Coordinator), Souliya Ounavong (Communication and Liaison Officer), Samantha Pike (Project Manager), Meredith Lunsford (Program Officer), and Charlotte Grant (Former Program Officer).

Image 3. Bouaphone (left), a CBID Facilitator from the Quality of Life Association, uses a tablet implementing the CBID Modular Tool. Using the short set of questions developed by the Washington Group on Disability Statistics and other psychometrically tested surveys, the Modular Tool will help identify persons with disabilities within communities and will help to assess an individual's needs.

For further information on the USAID Okard Activity and CBID Demonstration Model, contact Bernard Franck (Chief of Party) at bernard_franck@la.worlded.org. This article was produced by World Education, Inc., through USAID Okard, a five-year cooperative agreement funded by the U.S. Agency for International Development under Agreement No. AID-486-A-17-0004 and is made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of World Education, Inc. and do not necessarily reflect the views of USAID or the United States Government.

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Explosive Ordnance in the BALTIC SEA

NEW TOOLS FOR DECISION MAKERS

by Torsten Frey [Leipzig University], Jacek Bełdowski, Ph.D. [Polish Academy of Sciences], and Edmund Maser, Ph.D. [Kiel University]

The global ocean economy is predicted to grow by more than 100 percent between 2010 and 2030. By then, more than 40 million people are going to be employed by the maritime industry.[1] Recognizing this potential, the European Union (EU) devised a "Blue Growth" strategy that seeks to reap the anticipated economic benefits.[2] While technological advancements allow for an increased utilization of marine resources, the newly gained access to untapped opportunities forces coastal nations to simultaneously face the challenge of explosive remnants of war (ERW) and chemical warfare agents (CWAs) in the sea.

Image 1. A corroded German KC-250 mustard bomb, found at the Bornholm dumpsite was first recognized on a sonogram, then investigated by an ROV, while final identification was done by classifying the bursting charge with the help of the munitions database.
Image courtesy of DAIMON project.

FACING EXPLOSIVE REMNANTS OF WAR IN THE BALTIC SEA

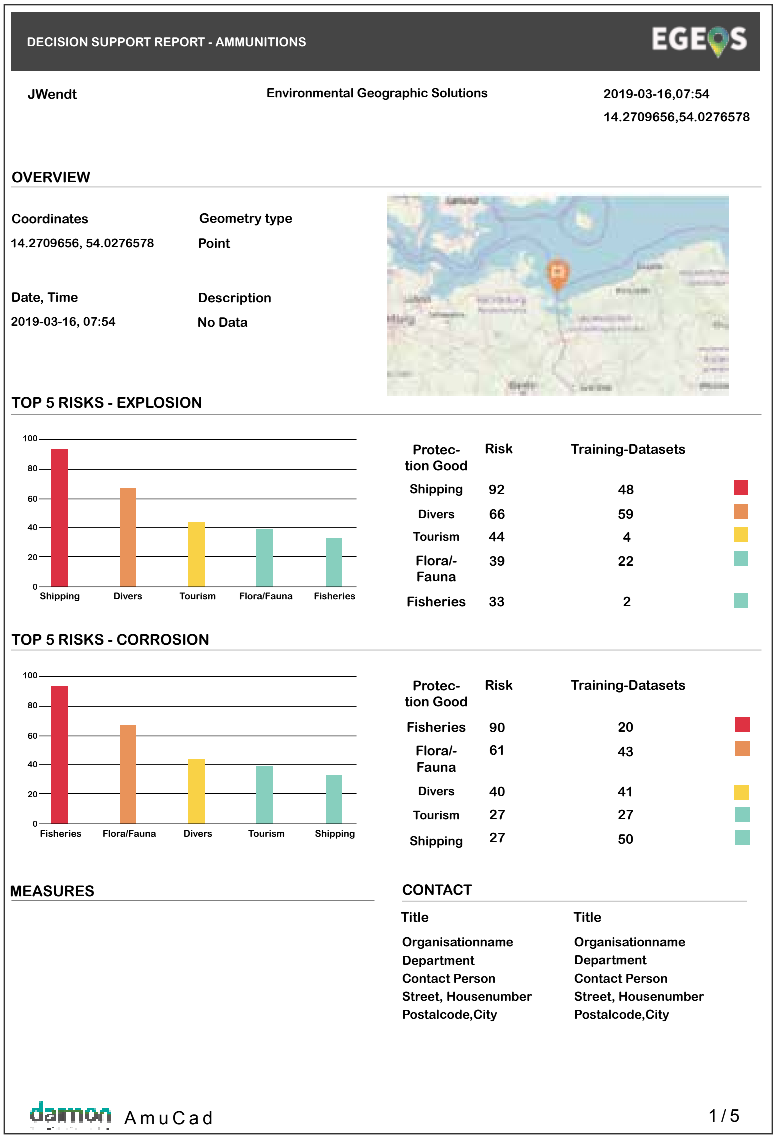
Like all European seas, the Baltic Sea is still heavily affected by ERW and CWAs from the world wars. One estimate suggests that around 300,000 metric tons (t) of conventional munitions are still present in German Baltic waters alone.[3] Here, explosive ordnance was in part introduced due to naval and air battles and mine laying activities. During both world wars, between 100,000 and 150,000 naval mines were laid in the Baltic.[4] An additional mode of entry of ERW and CWAs into the Baltic Sea were post-war dumping activities. Up to 65,000 t of chemical ordnance were dumped in the Baltic Sea.[3]

Against this backdrop, the EU seeks to organize the efficient, safe, and sustainable use of its waters. A framework for maritime spatial planning has been established to take advantage of the economic potential of the European seas and to increase transboundary cooperation while simultaneously protecting the environment.[5] The main goal of the EU's Marine Strategy Framework Directive is to "achieve a good environmental status of European seas by 2020.[6]" The presence of ERW and CWAs impedes ambitions to make use of the Baltic's economic potential as well as with the aim of doing so in a sustainable and ecosystem-friendly fashion.

In recent years, research groups in Europe have focused on the development of new tools that provide guidance on how to treat submerged ERW and CWAs. Some of these tools are discussed in this article, which is the first publication wherein their potential integration is described. The DAIMON (Decision Aid for Marine Munitions) decision-support system (DSS) suggests management options for ERW and CWAs at different geographic locations at a strategic level. One of these management options is site-specific monitoring, which may be performed with the help of a new biomonitoring approach. Another management option is the execution of an explosive ordnance disposal (EOD) campaign. For the implementation of this option, a comprehensive quality guideline was published.

THE NEW DECISION SUPPORT SYSTEM

The presence of ERW and CWAs at any given location constitutes an inherent risk. The DSS bases its decision-making process on the categorization of this risk, which is a function of a multitude of


DECISION SUPPORT REPORT - AMMUNITIONS

EGEOS

JWendt | Environmental Geographic Solutions | 2019-03-16,07:54 14.2709656,54.0276578

OVERVIEW

Coordinates	Geometry type
14.2709656, 54.0276578	Point
Date, Time	Description
2019-03-16, 07:54	No Data

TOP 5 RISKS - EXPLOSION

Protection Good	Risk	Training-Datasets
Shipping	92	48
Divers	66	59
Tourism	44	4
Flora/-Fauna	39	22
Fisheries	33	2

TOP 5 RISKS - CORROSION

Protection Good	Risk	Training-Datasets
Fisheries	90	20
Flora/-Fauna	61	43
Divers	40	41
Tourism	27	27
Shipping	27	50

MEASURES

CONTACT

Title	Title
Organisationname	Organisationname
Department	Department
Contact Person	Contact Person
Street, Housenumber	Street, Housenumber
Postalcode,City	Postalcode,City

daimon AmuCad 1 / 5

Figure 1. An example report of an ERW site located at the border between German and Polish territorial waters. The report was generated with the Decision Support System in the web-based software AMUCAD.org.
Figure courtesy of EGEOS GmbH, 2019.

aspects. Some ERW items may be buried under sediment, or their munitions compounds (MCs) may have already leached into the environment. Such circumstances limit the imminent threat these items pose for the ecosystem. On the other hand, some ERW emit toxic effluents to nearby sediments or constitute a hazard for fishing vessels and workers employed in the offshore industry.[7] In order to support decision makers with the management of ERW and CWA sites, it is required to assess their risk level. The DAIMON project responded to this requirement by creating a user-friendly web-based tool.[8] This system is able to evaluate available local and regional data and to suggest management options to decision makers in Baltic Sea states. It utilizes data on object properties, site-specific environmental conditions, and impact on biota.

Object properties include the type and current state of ERW and CWAs. Information on the object type is derived from technical surveys and object recognition with the help of hydroacoustic imaging, visual inspection, and an online munitions database (Image 1).[9] Corrosion assessment for present condition and corrosion modelling for future condition provide information on object integrity. Environmental properties that are processed by the DSS include oceanographic data (which are integrated from public HELCOM and SEDNET databases), modelled spread of contamination by bottom currents by a high-resolution hydrodynamic model,[10] and concentration measurements of degradation products from MCs in nearby sediments. The impact on biota is included in a dedicated database, containing biomarker data of ca. 20,000 fish specimens, which were collected in munitions dumpsite areas.

All of this information is processed by neural networks, which were trained on data from the dumpsites and contain weighting factors for each parameter. Experts used all of the parameters entered into the DSS for risk assessment calculations during case studies, and calibrated neural nets to produce comparable outputs. The data interpretation is based on toxicity thresholds obtained during the DAIMON project, and a full list of references is available in the DSS documentation.[9] It furthermore uses specialized algorithms, which involve, inter alia, the number of ERW items in close proximity to one another and health stressors for marine biota. The result is subsequently judged by another neural network, which considers the potentially-affected subjects of protection such as fishery, shipping, offshore structures, and tourists.

The DSS presents users with a comprehensive risk-assessment report, which includes color-scale coding for both the risk level and the confidence level, allowing them to decide either how to manage the site or to collect additional relevant data to aspire for more informed decision making (Figure 1). If not considered a threat, the DSS may advise the decision maker to omit action for some ERW and CWA items. For other items it may propose a number of management options. These include monitoring, if the system is warning for delayed consequences; establishing restrictions for maritime sectors, in case the items present a latent safety hazard or could become more dangerous if disturbed; or EOD, if items present an immediate threat for a given subject of protection.

The DSS is currently under development. It is exclusively concerned with the Baltic Sea but could be extrapolated to other geographic areas. It uses data that were collected during research projects and by maritime protection agencies in a comprehensive way, thereby allowing for informed decision making.

BIOMONITORING OF SUBMERGED ERW

The informed decision to necessitate site monitoring requires a plan on how to perform the monitoring. A holistic, environmental monitoring program for conventional ERW in the sea has thus been developed as part of the joint scientific project UDEMM (environmental monitoring for the delaboration of munitions on the seabed) by partners GEOMAR Helmholtz-Centre for Ocean Research Kiel, Institute of Toxicology and Pharmacology of the Christian-Albrechts-University in Kiel, and Leibnitz Institute for Baltic Sea Research Warnemünde. The concept includes the use of hydroacoustic and optical means such as towed cameras, autonomous underwater vehicles (AUVs), and divers, as well as sediment and water sampling, with subsequent chemical analyses of munition contaminants. It also integrates biomonitoring, which is a long-term possibility to classify ERW.[11]

Monitoring is a collective term for all types of systematic recordings, measurements, or observations of an operation or process by means of technical aids or other observation systems. The term biomonitoring is used, inter alia, in ecology and describes the periodic measuring of the stock and state of health of plants and animals as well as their communities with the aim of determining the quality of environmental conditions. Modern analytical methods enable experts to record many pollutants in very low, environmentally-relevant concentrations. The goal of biomonitoring is the protection of the ecosphere and of human health.

A main hazard of ERW in the marine environment is the chronic contamination of the marine ecosystem and marine organisms with toxic explosives continuously leaching from corroding ERW. In the worst cases, this may lead to toxic substances entering into marine and human food chains, so that seafood consumers may be heavily exposed. It is universally accepted that explosive MCs pose a threat to marine organisms and the marine ecosphere. In addition, health risks for humans that are exposed to trinitrotoluene (TNT) have been determined. Notable toxic manifestations have included aplastic anemia, toxic hepatitis, cataracts, hepatomegaly, and liver cancer.

For a number of reasons, mussels (bivalves) are particularly suitable for the detection and recording of explosive compounds that leach from corroding ERW in the marine environment.[12] They are widespread representatives of the marine fauna and are benthic and sedentary organisms—meaning that they live a mostly stationary life on the seabed—and constitute a main source of food for fish, birds, crustaceans, and starfish. In addition, their filter feeding lifestyle and slower metabolic rate favor the absorption and bioaccumulation of explosives. Further, they are a resistant species which can thrive in unfavorable conditions. Finally, bivalves are an important seafood species and can be used as indicators for the entry of toxic substances into the marine food chain, even at low concentrations.[13] While conditions in the sea that change in the short-term (temperature, salinity, and currents) make it difficult to continuously assess the ecological hazards of ERW by other means, biomonitoring with mussels offers the opportunity for long-term studies to predict potential risks for the ecosphere and for seafood consumers.

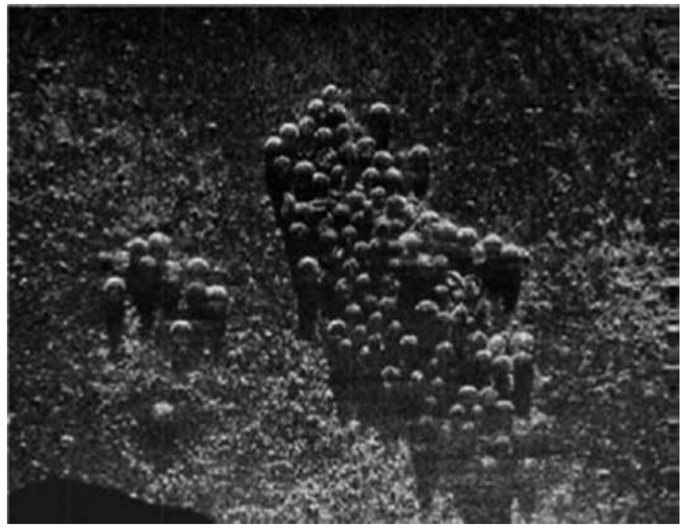


Image 2. A synthetic aperture sonar image of around seventy moored mines at Kolberger Heide in German territorial waters. The location's distance to the closest German beach is 2 km.
Image courtesy of German Navy, 2012.

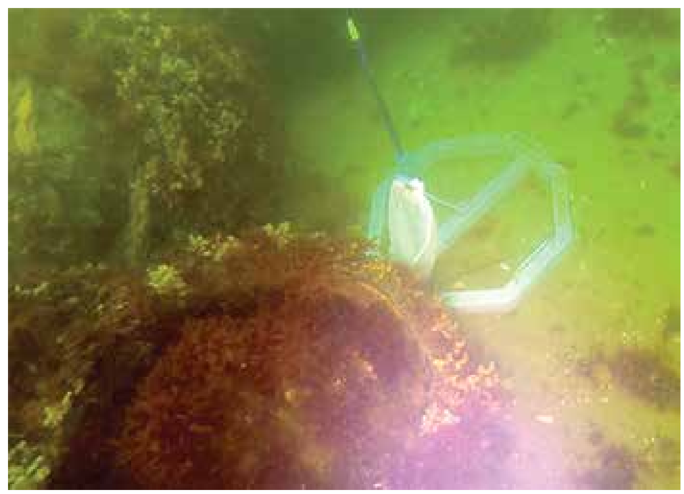
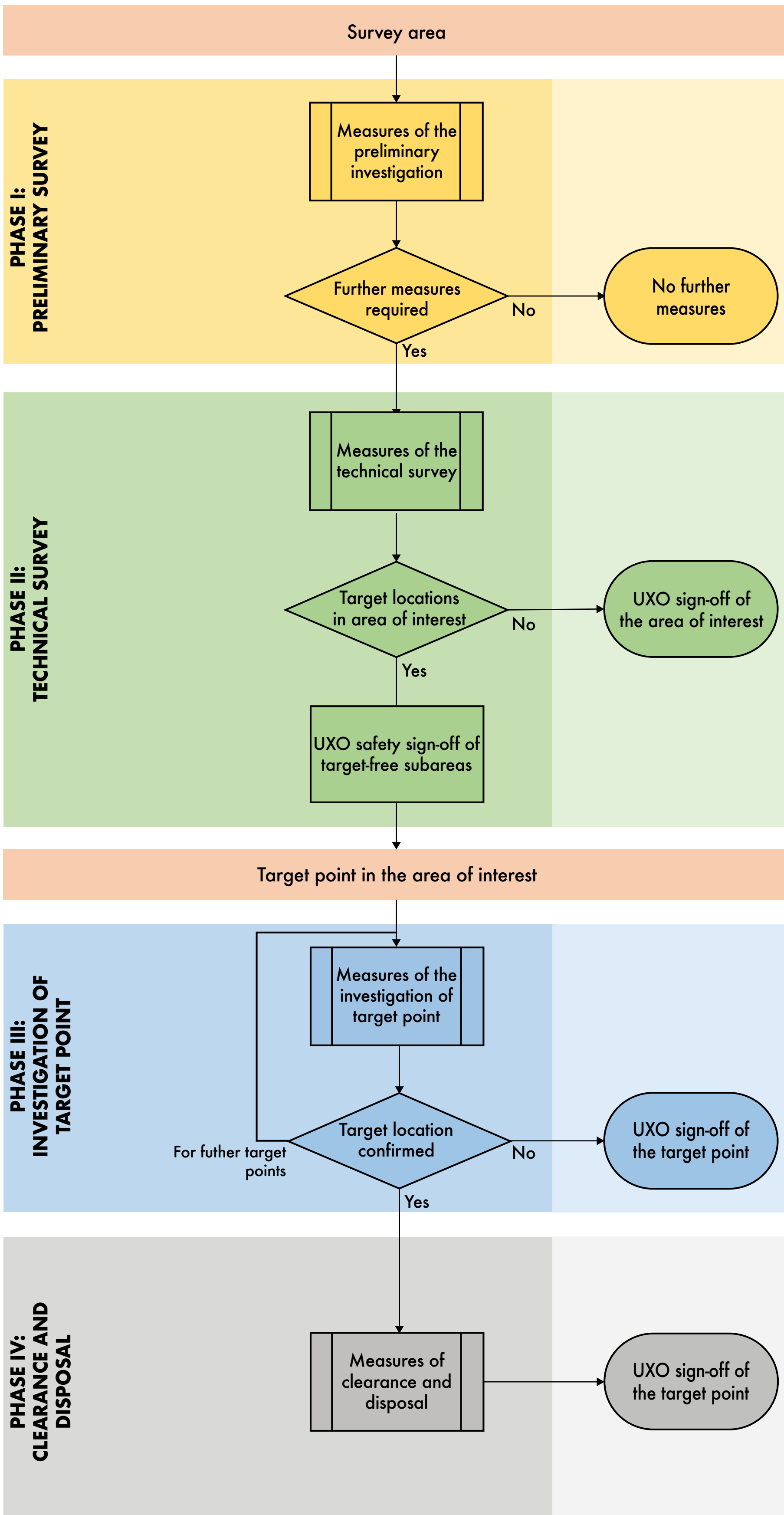


Image 3. A mooring with a net containing mussels that was placed adjacent to a corroding moored mine.
Image courtesy of Diving Center of Kiel University.

Mussel monitoring was used in the German dumpsite of Kolberger Heide (Image 2). The area served as a test site to develop new methods and workflows for detection, monitoring, and assessment of ERW in the marine environment.[12] Divers placed moorings with mussel bags (Image 3) at various positions near a pile of about seventy moored mines distributed over an area of approximately 70 × 30 sq m. After recovery, the bioconcentration levels of 2,4,6-TNT and its main metabolites 2-amino-4,6-dinitrotoluene (2ADNT), and 4-amino-2,6-dinitrotoluene (4ADNT) were measured in mussel tissue by means of two gas chromatography-mass spectrometry/mass spectrometry (GC-MS/MS) analytical methods.[14] The result of such mussel monitoring may then be entered into the DSS, which will increase the system's capacity to suggest management options for a specific area.



One of the most important results was that comparatively higher total concentrations of the different TNT metabolites were usually detected in mussels placed directly on a free-lying piece of hexanite,[15] a widely used military explosive that was used by the German Navy during both world wars. Lower concentrations were found in mussels placed in the immediate vicinity of dumped mines in different states of corrosion.[16] This unexpected result is a strong case against the common practice of blasting dumped munitions for clearing purposes. As a consequence of low-order deflagrations, large areas might be contaminated with unexploded materials, such as hexanite, thereby increasing the availability of the chemicals to the surrounding biota.

GUIDANCE ON PERFORMING OFFSHORE EOD

If an ERW item or a dumpsite presents an immediate hazard to human life or offshore assets, an EOD campaign is imperative. Every offshore construction and exploration project in the Baltic renders the execution of at least the survey phases of an EOD campaign essential. However, numerous challenges in connection with offshore EOD exist, and the process is often performed in the absence of universally-accepted standards. There was no recognized industry-wide method of assessing the suitability of organizational procedures, deployed personnel, devices used, and the handling of these devices during EOD. This situation was mainly owed to the fact that a

Figure 2. Flow chart illustrating the phases of offshore explosive ordnance disposal representing the top layer of organization in the quality guideline.
Figure courtesy of Leipzig University, IIRM, 2019.

framework for formal recognition of any of these aspects was absent. In response, Leipzig University's Institute for Infrastructure and Resources Management (IIRM) developed a "Quality Guideline for Offshore Explosive Ordnance Disposal."[17] This effort was part of the RoBEMM project (Robotic Underwater Salvage and Disposal Process with the Technology to Remove Explosive Ordnance in the Sea, in Particular in Coastal and Shallow Waters).

The development of the quality guideline was initiated with a comprehensive literature review, with the aim of identifying the basic actors and processes of offshore EOD. The International Mine Action Standard (IMAS) for Underwater Survey and Clearance of Explosive Ordnance (EO)[18], served as an input of this initial step. Of great importance for the future recognition of the quality guideline was the involvement of representatives of all those stakeholders who would ultimately be affected by the finished document. Accordingly, stakeholder workshops were organized during which the findings of the literature review were verified, clarified, and expanded upon. Next, a preliminary version of the quality guideline was drafted and experts were given the opportunity to annotate. As these comments were processed, it became apparent that some expert opinions were conflicting, and thus expert groups were held to moderate these differing views and prepare the final document.

The resulting quality guideline covers the entire procedure of offshore EOD. A general section at the beginning of the document includes a glossary and a register of relevant normative and legal documents. It contains sections that define the overall competence requirements and mandatory qualification verification of the actors and their personnel. The subsequent chapters each describe one of the four phases, which have been divided as follows (Figure 2):

- Phase I: Preliminary Survey (five processes)
- Phase II: Technical Survey (eight processes)
- Phase III: Investigation of Target Points (nine processes)
- Phase IV: Clearance and Disposal (eight processes)

The document outlines these phases and subsequently subdivides them into their processes. For each process it provides a general description as well as potential deviations from the standard procedure. Furthermore, it details the functions and responsibilities of actors relevant to the process. Where necessary, it describes suitable technologies and their way of application. Finally, it supplements processes requiring documentation and reporting with lists of necessary content items. The ultimate section of the quality guideline is a reference section for technical and environmental quality drivers, which influence the quality of offshore EOD work. The quality drivers are defined, their interrelations are identified, and where possible, threshold values for minimum operational requirements are suggested.

The "Quality Guideline for Offshore Explosive Treatment" is available in German and English, and focuses on the execution of EOD in German waters. The principles and practices it suggests, however, can be applied to any location in the Baltic Sea.

THE TOOLS ARE READY FOR APPLICATION

The tools described in this article demonstrate the eagerness of the European scientific community to actively contribute to the development of approaches, which are meant to respond to the challenge of offshore ERW and CWAs. While all of the presented instruments and concepts are beneficial on their own, their benefits further increase when combined. They may be picked up by national and state authorities, militaries, offshore construction companies, and EOD specialists to tackle the ERW and CWA challenge in the field.

As economic and ecologic pressure on the Baltic Sea increase, ERW and CWAs constitute one of a myriad of challenges that need to be addressed. The DSS, the monitoring concept, and the quality guideline are aids that will help fulfill the vision of maritime spatial planning, thereby achieving sustainable and cooperative Blue Growth. The tools are ready for application.

See endnotes page 60

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The Development of a Humanitarian IED CLEARANCE CAPACITY in AFGHANISTAN

by Alexander Tan [The HALO Trust]

Image 1. The first abandoned improvised mine (AIM) uncovered by HALO clearance teams in Helmand Province, southern Afghanistan. *All images courtesy of The HALO Trust.*

Improvised explosive devices (IEDs) have been widely used in Afghanistan since the mid-2000s, presenting a significant and life-threatening hazard to the civilian population. As areas become free from conflict and permissible for humanitarian clearance, an effective response is required to protect civilians. With the support of the Netherlands Ministry of Foreign Affairs and the German Federal Foreign Office, and in coordination with the Directorate of Mine Action Coordination (DMAC; the Afghan national mine action authority) and other stakeholders, The HALO Trust (HALO) has developed and implemented a successful *proof of concept* for manual clearance of victim operated IEDs (VOIEDs). While VOIEDs are cleared in other countries and have previously been cleared in Afghanistan, this project, delivered in Helmand province, has provided the opportunity to develop and test safer and more efficient methods for the targeted humanitarian clearance of abandoned improvised mines (AIM) in the current Afghan context. This article explains the path HALO has taken to deliver the proof of concept, some of the results so far, and future plans for supporting the sector.

THE AFGHAN CONTEXT

IEDs as Part of the Afghan Conflict. After the coalition of international military forces removed the government of the Islamic Emirate of Afghanistan in 2001, the regular and increasing presence of international military forces in the country encouraged armed opposition groups (AOGs) to adopt increasingly asymmetric tactics. The use of IEDs increased as conventional munitions became less available and effective against the technologically-advanced international military forces. Since this time, IEDs in Afghanistan have resulted in the death of thousands of civilians, of which a large proportion were inflicted by VOIEDs.

Terminology. In Afghanistan, the mine action sector has agreed that VOIEDs that function like conventional mines shall be known as improvised mines. They adhere to the definition found in the *Anti-Personnel Mine Ban Convention* (APMBC): "a mine designed to be exploded by the presence, proximity or contact of a person that will incapacitate, injure or kill one or more persons." In Afghanistan, the term AIM is used when improvised mines are no longer part of the active conflict.[1]

Engaging with Improvised Mines. In late 2016, the Afghan government, understanding the impact that improvised mines were having on the civilian population, requested the assistance of the

Image 2. A HALO training device shown in a distributed configuration, with the pressure plate, main charge, and battery pack separated from each other and connected with linking wire.

Images 3 and 4. Examples of carbon rod pressure and bare pressure plates splayed, showing the reduced metal electrical contacts inside the pressure plate.

Afghan humanitarian mine action sector (the Mine Action Programme for Afghanistan (MAPA)) to develop a response to the crisis. An initial assessment of affected districts identified large amounts of AIM contamination that were causing fatal or life-threatening accidents and posed a direct threat to the civilian population.

In early 2017, community representatives from several districts in central Helmand Province approached HALO with requests for the clearance of improvised mines from their villages. This prompted HALO to begin two strands of work: the first to determine the rationale for MAPA to engage with improvised mines; the second to develop a technical response to mitigate the threat posed by improvised mines.

The rationale for engagement was an important precursor to the development of the technical response and to the proof of concept. The work was carried out by consultant Dr. Rebecca Roberts and funded by the United Kingdom's Conflict, Stability, and Security Fund (CSSF). It explored the suitability of humanitarian clearance of improvised mines by MAPA under existing international and Afghan legal frameworks, and under existing MAPA strategies and policies. The views of a wide range of stakeholders including DMAC, other Afghan ministries, donors, and mine action operators were all considered.

Dr. Roberts' report found that there is a robust legal framework for humanitarian clearance of improvised mines under Afghan and international law where it is intended to protect civilians and their human rights. To conduct clearance, the report found that MAPA would need to maintain its status of neutrality in order to operate according to humanitarian principles of "do no harm," distance itself from ongoing conflicts, and deal with devices not considered part of the active conflict.

DEVELOPING THE TECHNICAL RESPONSE

To develop the technical response to mitigate the threat of improvised mines, HALO began expanding its understanding of the problem and preparing its in-country capacity. HALO assessed the physical environment where the clearance teams would be working, as well as the threats likely to be found in central Helmand Province and across Afghanistan.

In developing new techniques and procedures, HALO's approach was to extend existing humanitarian mine clearance practices by adapting and incorporating the relevant parts of military search and disposal techniques. This was to ensure that the knowledge, lessons learned, and experience from previous military operations could be assessed and incorporated into humanitarian practice where beneficial. This task was undertaken in early 2018 by bringing former-military IED disposal (IEDD) operators and humanitarian mine clearance operators together to devise, trial, and practice standard operating procedures (SOPs) tailored for the Afghan context.

HALO Afghanistan's program was able to draw on 30 years of in-country experience of clearing explosive hazards. This helped to ensure the development of capability and the operational response were contextually appropriate. Similarly, the project was sensitive to local politics, local security dynamics, and considerate of cultural and social norms.[2] With the support of HALO global experts, HALO Afghanistan developed SOPs and a training model that was then vetted externally by a third party providing an additional level of assurance. For this, HALO used the services of Artios Ltd. given their military, commercial, and NGO IEDD experience as well as their close involvement in the development of IMAS. Additionally, the SOPs and training were accredited by DMAC and reviewed by the United Nations Mine Action Service (UNMAS).

As part of the design of this project, HALO identified lessons and challenges experienced during the implementation phase in order to assist MAPA and inform the development of a wider AIM mine action capacity in Afghanistan.

Humanitarian Clearance, Consent, and Access. In Afghanistan, humanitarian clearance will only be conducted in permissible areas where active hostilities have ceased. AIMs in Afghanistan are almost always in areas that have experienced

Image 5. Local community members and survivors show the crater caused by a VOIED.

significant conflict. To keep clearance teams safe, HALO liaises extensively with key stakeholders to ensure that those with an interest understand our intent, and provide their consent for us to access areas to conduct clearance. HALO also conducts liaison with a variety of actors at a regional level to ensure that other actors are informed and aware of our activities and to address any concerns that may be raised. If required, clearance can be stopped and teams relocated until those concerns have been satisfied. In Helmand, HALO has had the full support of the local community and has been able to work uninterrupted. Looking ahead, obtaining and maintaining consent will likely be a key challenge requiring careful liaison and relationship building as AIM operations expand.

UNDERSTANDING IED DESIGN IN AFGHANISTAN

In building the technical response, it has been necessary for HALO to understand the design of IEDs in Afghanistan. IEDs in Afghanistan have evolved to defeat many modern detection methods and are usually intended to target the activities and tactics of specific military units working in an area. Two design elements of IEDs that are most relevant to this are the layout of the device and the material the switch is manufactured from. The use of a variety of detection technology by military forces may be one of the biggest driving factors for the evolution of these design features. In addition, IEDs in Afghanistan are known to include anti-handling elements, as either secondary components or secondary devices.

Device Layout. Almost all improvised mines in Afghanistan are electrically initiated and contain electrical circuits. These IEDs have batteries as a power source; batteries are easily found with a metal detector because of their high-metal content. However, the electrical wire linking the battery, the switch (often a pressure plate), and the main charge (with electric detonator) can be distributed around the emplacement location (see Image 3). This allows the emplacement of components to be more varied than a conventional pressure-activated mine and can make them more difficult to detect. For example, a pressure plate and a main charge with either a low-or no-metal content may be placed in the same location on a path, while the battery pack is placed several meters away from the path. This then places the easily detectable battery pack outside the natural search area, and makes the device more complex to detect.

The location of components can be configured to achieve different effects. For example, a main charge is easily placed away from a pressure plate targeting a vehicle, so that while the switch is activated by a vehicle tire, the main charge will function under the center of the vehicle where it is likely to inflict significantly greater damage.

Switch (Pressure Plate) Material. While there have been a number of switch types used in improvised mines in Afghanistan, including tripwires and pressure-release switches, it is anticipated that the vast majority of devices that humanitarian operators will clear will have pressure-plate switches. These are currently found in three main material types: high-metal-content pressure plates, which have large metal contacts; carbon-rod pressure plates made from a nonmetallic but electrically-conducive materials (commonly found in household batteries); and bare-wire pressure plates that use stripped wire as the electrical contacts. These switch types have different levels of detectability.

Device Design. Due to the nature of improvised mines found in Afghanistan, AIM clearance in Afghanistan is significantly different from that of conventional mine clearance. Specific clearance methods, search tools, and explosive ordnance disposal (EOD) techniques are required.

Many AIMs in Afghanistan are assessed to have been emplaced with a separation of high-metal signal batteries and low-or no-metal signal pressure plates, which present challenges for clearance using standard techniques. The use of materials such as carbon rods can significantly reduce the detectability of the device and requires specialist IED detectors to be used. Specialized detectors are needed to be able to detect the location of the switch in an AIM, as this is likely to be the hardest component to locate while remaining the most sensitive part of the device.

Search Patterns. By understanding the layout of the device, clearance teams are able to adjust their search and clearance procedures to find more detectable and less sensitive components of a device before finding the harder-to-detect components. An example of this would be the deployment of deminers parallel to a path where batteries were assessed to be offset. The larger footprint of most AIMs has also encouraged the adoption of "2 m breaching" and "linear clearance" techniques. These are search patterns that allow a greater surface area to be searched prior to the deminer moving forward. This increases the chance that multiple components are initially located and reduces the chance that AIM components may be located in the uncleared area to the side of the deminer while remaining linked to components within the deminer's lane. This makes it easier and safer for the deminers and EOD operators to work after locating a potential device.

Device Employment. AIMs in Afghanistan are typically emplaced in smaller numbers than conventional minefields or the IED belts used in parts of Iraq. In addition, the AIM contamination encountered is typically in rural or semi-rural areas usually in small fields, compounds, or lengths of road or tracks. This requires survey teams and clearance team supervisors to be trained to recognize different contamination, potentially laid over different periods of time. For example, improvised mines in one area may use high-metal-content pressure plates and be laid in the middle of roads to target vehicles in the first contamination period, while the improvised mines may have carbon-rod pressure plates and be laid to the side of the roads targeting foot soldiers in the second contamination period. By understanding how IEDs are used, clearance methods can be adapted to ensure the safest and most effective clearance.

Team Management. The use of new techniques and procedures against a more complex threat requires a significantly higher level of supervision than that required by traditional mine clearance teams. HALO AIM clearance teams currently consist of four deminers with one team leader, who is also trained as an AIM EOD operator for this project. This high management ratio allows for strong supervision of clearance in and around compounds and allows the experienced team leaders more time to assess possible contamination and device patterns on their tasks. While the ratio of deminers to team leaders may change as HALO becomes more confident with AIM clearance, and while the role of AIM EOD operators may be separated from the role of team leader, the ratio of deminers to supervising staff is expected to remain significantly lower than traditional mine clearance teams.

IMPLEMENTATION

With the proof of concept receiving joint funding from the Netherlands Ministry of Foreign Affairs and the German Federal Foreign Office in June 2018, HALO was able to proceed with the recruitment and training of an AIM non-technical survey team (NTS) and two manual AIM clearance teams. The AIM NTS team

Images 6 (left) and 7 (right). An example of the standard Afghanistan "one man, one lane" (OMOL) technique with a searched area of 1.4 m x 0.3 m, compared to the HALO AIM 2 m breaching technique with a searched area of 2.4 m x 70 cm.

Image 8. A HALO AIM deminer conducts clearance in central Helmand.

Image 9. A HALO AIM deminer excavating signals in a 2 m breach lane.

was deployed operationally in Helmand in July 2018. The two manual AIM clearance teams were deployed to the same area in October 2018, with AIM clearance operations beginning in November 2018 following the receipt of accreditation from DMAC.

During this project, the HALO manual AIM clearance teams worked a total of 148 days and cleared 10,902 sq m across two AIM confirmed hazardous areas (CHAs). This equates to an average clearance rate of 73.7 sq m per day, or 9.5 sq m per deminer per day. During this time, the teams located and destroyed six emplaced AIMs, assisted in the safe disposal of an AIM uncovered near a task by a local farmer, and destroyed a main charge handed to the teams by the community. In addition, the survey team surveyed seventy-nine AIM CHAs with an average of 13,097 sq m per CHA and seven AIM suspected hazardous areas (SHAs) with an average of 37,295 sq m per SHA. The AIM survey team also investigated fifty-two EO accidents around central Helmand Province, almost all of which are assessed to have been caused by AIM contamination.

This project provided HALO the opportunity to assess its initial clearance procedures and with minor adjustments, proved that the procedures would continue to be successful against the target devices in central Helmand Province. In addition, HALO has also been able to conduct field-testing of several specialist IED detectors. These specialist detectors include ground penetrating radar (GPR) detectors optimized for the detection of short buried wires (like those found in the majority of AIM components). The benefit to AIM clearance is the ability to ignore many of the irrelevant metal signals that would require excavation and significantly slow the rate of clearance in the semi-rural areas.

NEXT STEPS

HALO's first AIM clearance project ended in June 2019, following nearly eight months of clearance by two manual AIM clearance teams and the release of two AIM contaminated areas. Having proved that AIM clearance is possible in Afghanistan, there are several challenges to address next. One challenge is to improve the speed and versatility of the current AIM clearance procedures in order to reduce the risk of accidents within the civilian population, releasing land for safe use and development more quickly. The second major challenge is how to scale up AIM clearance within the country.

HALO is assessing a number of methods of improving the speed and versatility of AIM clearance processes in Afghanistan. In July and August 2019, HALO conducted initial trials of mechanical AIM clearance methods, drawing from the lessons learned from HALO Iraq, and building upon the extensive mechanical clearance experience already held by HALO Afghanistan. These trials were further reinforced by additional trials in September and early October 2019, before two mechanical AIM clearance teams were deployed to the field in mid-October 2019. To improve clearance speed, HALO will also continue trials with a number of specialist IED detectors and search techniques. In September 2019, all HALO AIM deminers were trained in building and compound clearance techniques, enableing them to clear AIM contamination in the enclosed spaces that are accessed to be present on a high proportion of AIM clearance tasks in Afghanistan.

In order to scale up AIM clearance, MAPA is working with donors to raise awareness of the humanitarian need for AIM clearance. To assist, HALO is sharing the lessons identified during the proof of concept project through MAPA's AIM Technical Working Group. HALO will also continue conducting capacity development of others, such as the recent partnering and training of another operator to deliver AIM NTS for UNMAS. HALO will continue to develop its humanitarian AIM clearance capacity and to share lessons with partners, enabling the mine aciton sector to meet this urgent humanitarian need as soon as possible.

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A Real-Time VIDEO-STREAMING SYSTEM for Monitoring Demining

by Mohammed Al-Husseini, Ph.D., Masoud Alipour, Ph.D., Hassan Ghaziri, Ph.D., [Beirut Research and Innovation Center, Lebanese Center for Studies and Research,] and Ali El-Hajj, Ph.D. [Electrical and Computer Engineering Department, American University of Beirut]

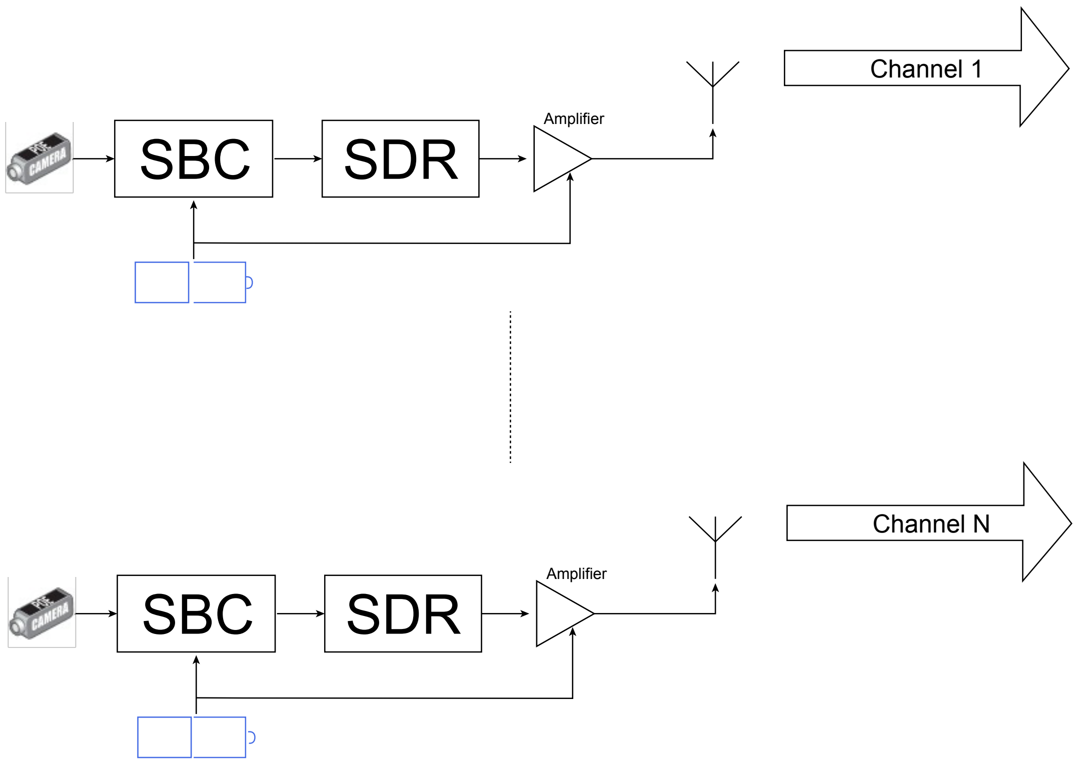

Figure 1. Diagram showing the components of the video-streaming subsystem. Each deminer using the system will be equipped with one of these subsystems.
All graphics courtesy of the authors.

The most deployed detection technology for landmine clearance is the metal detector (MD).[1] Other detection technologies exist, such as ground penetrating radar,[2] chemical sensors,[3] biological sensors,[4] and infrared imaging,[5] to name a few. However, despite their widespread use, MDs suffer from high false-alarm (FA) rates since they cannot differentiate between the metal components in a landmine and harmless metal clutter. Deminers using MDs usually rely on their personal experience to differentiate between the sounds emitted by the MD when scanning a landmine or an item of clutter. Usually, they continue to excavate on a large number of occasions and end up finding a harmless piece of metal. For each found landmine, it is estimated that a hundred to a thousand false positives are encountered.[6] The high FA rate substantially slows the demining process and increases costs. This delays the recovery of contaminated land and the resumption of everyday activities around the affected areas.

Despite the training and the protocols that are put into place to make the demining process safe, accidents do happen during clearance operations.[7] Preventing or at least minimizing the number of accidents is essential. When an accident happens, it is necessary to know exactly what happened and why it happened. This helps determine responsibility and prevent similar accidents in the future.

In this article, the authors present a real-time video transmission system—the Demining Monitoring System (DMS)—that can be used to closely monitor the activities of deminers during humanitarian landmine clearance. This system comprises a high-resolution video camera and a wireless transmitter that can be placed on the deminer's helmet, chest, or shoulder as well as wireless receivers and a digital

Image 1. Photo of the SDR chip inside a USB 3.0-to-VGA adapter.

video recorder (DVR) at a base station. This enables supervisors to remotely view what the deminers are doing in real time, while also recording the video streams from all deminers. These can be used to help determine the cause of accidents, as well as train deminers under normal circumstances. This work is done in collaboration with the Lebanon Mine Action Center (LMAC), which assisted by providing the logistics to test the DMS in the field.[8]

DEMINING MONITORING SYSTEM DESCRIPTION

The DMS was conceived after several accidents involving deminers occurred over a short period of time during clearance operations. The causes of the incidents were hard to determine, which delayed further clearance work and complicated the work of the insurance companies expected to pay compensations to the injured deminers. The monitoring system comprises two main subsystems: the video-streaming subsystem and the base station. Each deminer is equipped with a video-streaming subsystem. The base station receives and records the video streams from all deminers, and has the ability to forward the video to remote locations such as the headquarters of the demining group.

Image 2. A camera is attached to the side of the visor.

VIDEO-STREAMING SUBSYSTEM

The video-streaming subsystems consist of high-quality digital cameras connected to single-board computers (SBCs). Also connected to each SBC is a software-defined radio (SDR), which is a radio-communication system. The components of this system are implemented on a general-purpose embedded system using software, instead of being implemented as special-purpose hardware.[9] Examples of such components include mixers, filters, modulators, and demodulators to name a few. The main advantage of the SDR is that some of its functions can be changed or upgraded during operation via software, without the need to change the hardware. In our video-streaming subsystems, SDR output is connected to a power amplifier interfaced to a transmitting antenna. A lightweight battery directly powers the SBC and the power amplifier, whereas the SDR is powered by the SBC. A diagram of the video-streaming subsystem is shown in Figure 1.

The SBC receives the digital-data stream from the camera and runs Python, a programming language that controls the function of the SDR. With the help of Python, the SDR takes the camera's video stream and transforms it into a Digital Video Broadcast-Terrestrial (DVB-T) transmission, which is fed to the input of the power amplifier. DVB-T is the European Standard for the transmission of digital terrestrial television, which has proven to be a successful and reliable digital video transmission standard. The amplifier augments the power of the transmission, allowing it to reach longer distances, beyond the safety distance set between deminers and supervisors. The antenna at the output of the amplifier transmits the signal into the air.

The SDR not only enables the selection of the transmission standard (DVB-T in this case) via software but also allows the operator to set the transmission frequency using this software. The ability to

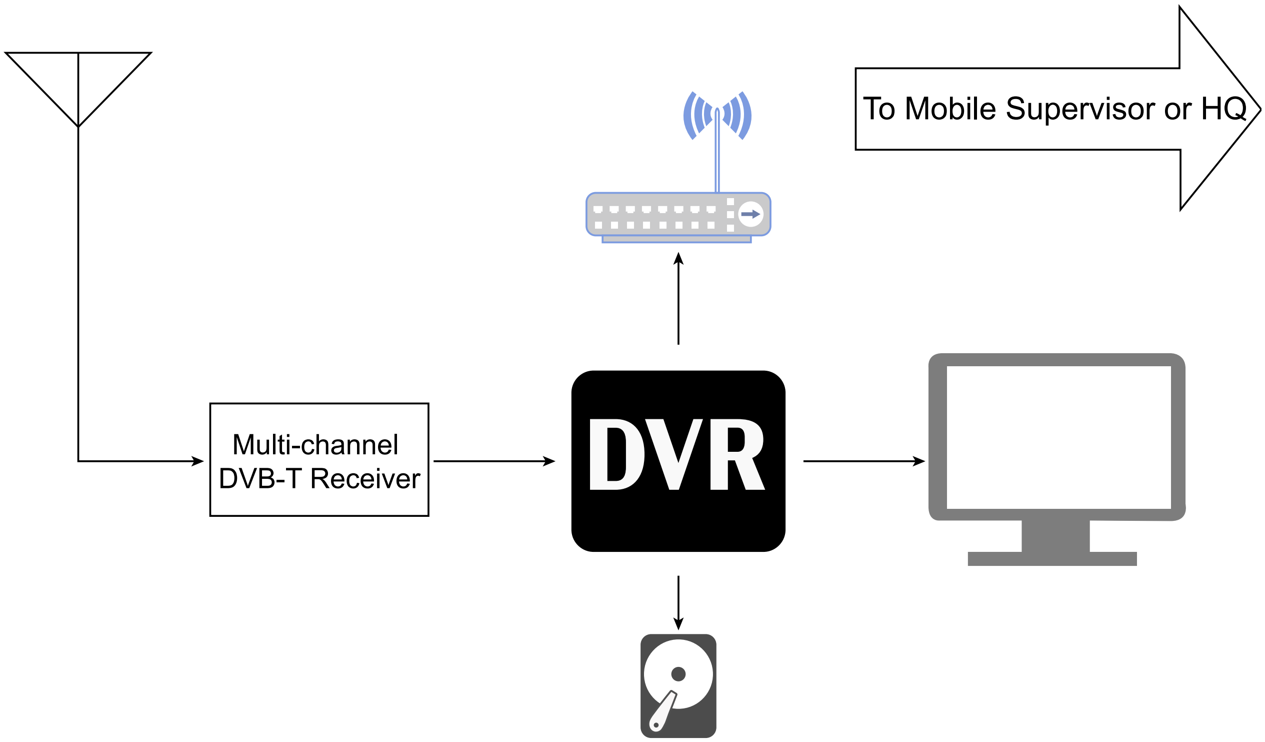

Figure 2. Diagram showing the components of the base station.

select the transmission frequency is essential to distinguishing the channels of the different deminers' video streams, thus limiting interference and also allowing the operator to choose the frequency band for the whole system operation. DVB-T offers improved picture quality and spectral efficiency, which is essential for the demining application when there are transmissions from several deminers at the same time in a small geographical area. DVB-T is also power-efficient, which is a plus for our application, since the transmitter is equipped with only a lightweight battery.

SBCs are ubiquitous and inexpensive. For example, a Raspberry Pi Zero costs only a few dollars. Moreover, SDRs are becoming less expensive and widespread. An inexpensive SDR chip is available in a USB 3.0-to-VGA adapter and is used in the video-streaming subsystem. A photo of the SDR chip inside a USB 3.0 to VGA adapter is shown in Image 1. The selection of these components also helps to keep the overall cost of the system below an acceptable threshold.

The camera can be attached to the visor, on the shoulder of the deminer, or on their chest. The other components (SBC, SDR, and amplifier) are all housed in a small box, which can be mounted on the back of the deminer's vest. A cable runs from the camera to the components box. The antenna can be a simple monopole directly connected to this box or can be a specially-designed wearable-patch antenna made on the back of the vest. Image 2 shows a photo of a camera connected to the side of a visor. A positioning feature (using GPS or similar services) can also be added to this subsystem to pinpoint the locations of each deminer at the time of recording.

BASE STATION SUBSYSTEM

The base station comprises a multi-channel DVB-T receiver connected to a DVR. The DVR has a hard disk installed inside it, which is where the different streams are recorded. A second output of the DVB-T is connected to a monitor to view the different streams in a grid, with the ability to select the number of viewed streams or view only one of them maximized on the monitor. An antenna is attached at the input of the DVB-T receiver. Since the received signals have very low powers, a high-gain antenna should be used as a receiver, and should be capable of picking up signals from wide-azimuth angles. A high-gain monopole antenna can be used, but for better performance, a single-module slotted-waveguide antenna,[10] or its lighter and printed counterpart, the substrate-integrated waveguide antenna,[11] can be employed instead. The estimated time delay between the camera taking the video and viewing the video on the base-station monitor is about 300 milliseconds (0.3 seconds), which gives the feel of real-time viewing. The base station also has the ability to forward the received streams via WiFi or a 4G network to either a mobile supervisor with a laptop or tablet, or to a remote location such as the headquarters of the demining group. Figure 2 shows the components of the base-station subsystem.

DESIGN CHALLENGES

Several cameras with video-streaming capabilities already exist in the market. However, these devices are not suitable for mine action. The main reason is that most of these devices use the WiFi standard for their transmissions, which limits their coverage distance to below the safety distance imposed in demining. The devices that operate in the ultra-high frequency (UHF) band are mostly analog, which makes them prone to external noise. Moreover, the picture quality degrades due to obstacles like hills and vegetation. The second issue with UHF streaming is the limited band, which does not allow several transmissions from different deminers in separate channels.

A solution is to use SDRs to program each camera subsystem to transmit at different frequencies, and to select the band in which the whole system (base station plus all transmitters) operates. This is useful for the operators to select the frequency band that they are allowed to use. Employing DVB-T, which is a digital system, gives users all the advantages of DVB-T including spectral and power efficiency, in addition to noise resistance and operational functionality in rough terrain and thick vegetation. Furthermore, in devising this solution, the authors sought to keep the system cost low, which translated into the selection of inexpensive albeit quality components.

CONCLUSION

A first prototype of the system has already been assembled but is still ongoing lab testing and fine-tuning. An additional field test, with the help of LMAC, is scheduled for the first quarter of 2020. A ruggedized industrial-grade prototype will be fabricated afterward and will also be field tested. Different demining agencies will inspect this new prototype to poll their opinions on the functioning of the system, areas in which it could be improved, additional features to be added, and more importantly, the practicality of the system in real-life demining contexts.

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ENDNOTES

HMA in the Gray Zone by Kadlec [from page 5]

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A Twenty-Minute Walk Through Fallujah: Using Virtual Reality to Raise Awareness about IEDs in Iraq by Bialystok [from page 10]

1. "VR for Good: Creators Lab Returns for 2017," *Oculus Blog*, 8 May 2017, https://ocul.us/2lPbs6d.
2. Chris Milk, "How virtual reality can create the ultimate empathy machine," Ted Talk, 22 April 2015. https://bit.ly/1EvtDA9
3. "Clouds over Sidra" was released in January 2015 and filmed at the Za'atari Refugee Camp in Jordan. It tells the story "a 12-year-old girl who has lived there since the summer of 2013. The film follows her to school, to her makeshift tent and even to the football pitch." It was the first virtual reality experience created by the UN and was first used to the support the Secretary General's MDG Advocacy Group's work. https://bit.ly/2kOwly6
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Long-Term Risk Management Tools and Protocols For Residual Explosive Ordnance Mitigation: A Pretest In Vietnam by Stauffer and Mestre [from page 18]

1. IMAS 07.14 "Risk Management in Mine Action." First Edition, February 2019. https://bit.ly/2kGBAjv. Accessed 12 September 2019.
2. "United Nations Inter-Agency Coordination Group on Mine Action," Eighth Conference of High Contracting Parties to Protocol V on Explosive Remnants of War to the Convention on Certain Conventional Weapons, 10 November 2014.
3. If signatory to APMBC or CCM 'tolerable' risk is determined as 'every effort' or 'all reasonable effort' to remove all known landmines/cluster munitions.
4. The detail of the research framework and methodology used for the LTRM framework can be found in: Geneva International Centre for Humanitarian Demining (GICHD), Long-Term Risk Management Tools and Protocols for Residual Explosive Ordnance Mitigation, Vietnam, GICHD, Geneva, 2019.
5. It may be that risks posed by the remaining contamination increase above a tolerable level again in a few years, due to changes in the context. This implies that the thresholds used for the evaluation of the tolerable level of risk and the evaluation itself have to be reconsidered and reviewed on a regular basis (e.g. every five years).
6. Indicator 1 was subdivided to test four options (A, B, C1 and C2): *"The residual state (tolerable level of risk) is achieved, if the percentage*

of EO victims (injuries and fatalities)/per population/per year in a district over the last 10 years [(A) does not exceed the lowest percentage of EO victims in the whole province over the last 10; (B) does not exceed the average percentage of EO victims in the whole province over the last 10 years; (C) has not been one of the top 10 {C1} or top 20 {C2} causes of death in Vietnam in the last 10 years] more than [threshold (th.) 1: 0 time / th. 2: 3 times / th. 3: 5 times]."

7. Stakeholders had some reservations on the use of indicator 5 on cost-benefit analysis, arguing that in the context of Quảng Trị, land prices are very volatile and would not provide a solid basis for analysis. Indicator 5 was therefore not used in the pretest.
8. For the purpose of the article, only findings of Cam Lộ's pretest are presented.

Cluster Munition Remnant Survey in Southeast Asia by McCosker, Stoa, and Harrison [from page 22]

1. The full publication is available at https://bit.ly/2OIgNIt.

Providing IMAS Training to Local Military Forces and Mitigating Long-Term ERW Risks in Vietnam by Vosburgh [from page 27]

1. "Management of Residual Explosive Remnants of War. GICHD," Geneva International Centre for Humanitarian Demining, 2015, https://bit.ly/2kSrhbz, accessed 10 September 2019.
2. Hoang Nam, (Speech, Quang Tri PPC, Hue, Vietnam, 19 April 2019).
3. "Vietnam Aging Study Management of Explosive Remnants of War (MORE), Geneva International Centre for Humanitarian Demining, July 2019, https://bit.ly/2kf2YVG, accessed 10 September 2019.
4. CEN International Mine Action Standards (IMAS).
5. Vietnam People's Army 4th Military Region Headquarters in Vinh performs military command and control of PMCs in six Provinces: Thanh Hóa, Nghệ An, Hà Tĩnh, Quảng Bình, Quảng Trị, and Thừa Thiên–Huế Province.
6. There are also five Level One Cities that qualify as provinces: Hanoi, Hai Phong, Da Nang, Ho Chi Minh City, and Can Tho, but these don't have separate PMCs.
7. The PMC Range is located in Cam Nghia Commune, Cam Lo District, Quảng Trị Province, Vietnam. Coordinates: Latitude: 16.743326/ Longitude: 106.909428
8. This project has not yet been approved.

Game-Based Learning: An Innovative and Scalable Approach to Mine Risk Education by Yen [from page 31]

1. https://bit.ly/1ur8Tnz
2. Landmine casualties from 2008 to 2017 taken from the *Landmine Monitor*; Excel file of casualty data available upon request.
3. "Báo cáo hiện trạng tồn lưu, ô nhiễm bom mìn vật nổ sau chiến tranh ở việt nam trên cơ sở thực hiện dự án điều tra, lập bản đồ ô nhiễm bom mìn, vật nổ trên phạm VI toàn quốc- giai đoạn I," Vietnam Mine Action Centre, accessed 20 November 2019, https://bit.ly/2QD0Bto.
4. "Data tabulation by province_11.04.16," CRS Microsoft Excel file, available upon request.
5. "Khắc phục hậu quả bom mìn sau chiến tranh: Cần nỗ lực hơn nữa," Nhân Dân, 2 April 2019, https://bit.ly/348ro5i.
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Community Based Inclusive Development: Integrating Survivors into a Broader Victim Assistance System by Franck, Koolmees, and French [from page 38]

1. "UXO Problem," National Regulatory Authority for UXO/Mine Action Sector in Lao PDR, accessed 10 October 2019, https://bit.ly/2olCB1H.
2. Ibid.
3. "UXO Types," National Regulatory Authority for UXO/Mine Action Sector in Lao PDR, accessed 27 November 2019, http://www.nra.gov.la/uxo.html
4. "Unexploded Ordnance Sector Annual Report 2018," National Regulatory Authority for UXO/Mine Action in Lao PDR, accessed 1 October 2019, http://www.nra.gov.la/resources/Annual%20Reports/Annual%20Report%20English/UXO%20Sector%20Annual%20Report%202018_English.pdf.
5. "Lao PDR: Casualties," *Landmine & Cluster Munition Monitor*, accessed 27 Nove 2019, http://www.the-monitor.org/en-gb/reports/2019/lao-pdr/casualties.aspx
6. "UXO/Mine Victim Assistance Strategy 2014–2020," National Regulatory Authority for UXO/ Mine Action Sector in Lao PDR, 2014.
7. "SDG18: Remove the UXO obstacle to national development," United Nations Laos PDR, accessed 3 December 2019: http://www.la.one.un.org/images/sdgs/SDG-18-06Sep2016-English-Final-smallchange29Aug17.pdf

8. The approximate average number of accidents per year between 2014–2018, from the National Regulatory Authority (NRA) IMSMA database.
9. "Article 5 Victim Assistance," *Convention on Cluster Munitions*, (2008), accessed 1 October 2019, https://bit.ly/2mGMHKb.
10. BRAC's Ultra-Poor Graduation Approach is a comprehensive, time-bound, integrated and sequential set of interventions that aim to enable the poorest households to achieve key milestones towards sustainable livelihoods and socio-economic resilience in order to progress along a pathway out of extreme poverty. The approach holistically provides both short-term support and long-term investments in areas such as financial literacy and savings and enterprise development. For more information, please see: http://www.brac.net/program/ultra-poor-graduation/
11. The Washington Group for Disability Statistics (WG) was established in 2001 by the United Nations Statistical Commission to address the need for improved statistical methodologies and measures related to disability that are comparable across countries. Since its inception, the WG has developed survey tools and worked to strengthen international cooperation.
12. USAID Okard referenced the following psychometrically tested surveys to develop the Modular Tool: Washington Group Extended Set (WG-ES), WHO Disability Assessment Schedule 2.0 (WHODAS 2.0), Model Disability Survey (MDS), Rapid Assessment on Disability (RAD), WHO Quality of Life (WHO QoL BREF), Short Form Health Survey (SF-36), WHO Assistive Products Tool (WHO AP Tool), Adult Caregiver Quality of Life (AC-QoL), Patient Health Questionnaire (PHQ-9), Primary Care PTSD Screen (PC-PTSD), Satisfaction with Life Scale (SWLS).

Explosive Ordnance in the Baltic Sea: New Tools for Decision Makers by Frey, Beldowski, and Maser [from page 44]

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The Development of a Humanitarian IED Clearance Capacity in Afghanistan by Tan [from page 49]

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2. HALO Afghanistan employs over 3,300 national staff and is Afghan led and managed. HALO works closely with the DMAC and the MAPA, as well as local and international development partners to protect and improve the lives of beneficiaries across the country. HALO conducts mine clearance, battle area clearance, weapons and ammunition disposal, non-technical survey, technical survey, explosive ordnance risk education, physical stockpile and security management, and most recently, AIM clearance.

A Real-Time Video Streaming System for Monitoring Demining by Al-Husseini, Alipour, Ghaziri, and El-Hajj [from page 54]

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Landmine clearance in Bosnia and Herzegovina
Photo courtesy of ITF.

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Editorial: Empowering Local Capacity in Mine Action

With explosive hazards contamination persisting in spite of dwindling funding opportunities, sustainable solutions are becoming increasingly more important. Similarly, creating mine action programs and centers that can be relied upon to pick up the reigns after foreign clearance organizations and contractors have left is of paramount importance. What lessons learned can the community share in regards to building national capacity and employing locals to continue operations after projects have concluded?

Balkans

Organizations working in Bosnia and Herzegovina, Croatia, Serbia, Kosovo, and Montenegro are encouraged to submit on their current programs, challenges, and successes.

Environmental Concerns of Explosives

War and conflict have obvious negative effects on the human communities in which they occur, but the effects that ammunition and explosives can have on the environment are less evident. How does explosive contamination affect the environment, how do explosive detonations affect the physical and chemical properties of ground soils, and what measures can MA operators take to reduce these effects?

HMA and CWD in the Context of IDPs and Migration

How can HMA/CWD programs better adapt to the return of IDPs, and how are countries/organizations addressing migration as it occurs across mined borders and contaminated areas?

Demining in Dense Terrain

Freedom of movement remains restricted in some forest and jungle areas of the Balkans, Ukraine, and Colombia, endangering human life, damaging the ecosystem, and increasing the risk of fires. The Journal seeks submissions from organizations operating in these areas.

Management Information Systems and/or On-Site Analytical Tools

Management information systems differ from information management systems in that they are used for decision making as opposed to information storage. How are organizations using decision-assisting technologies to analyze and interpret data and efficiently allocating resources to the field?

Research and Development

The Journal of Conventional Weapons Destruction seeks research and development (R&D) articles. All technical articles on **current equipment, technology, trends, and developments** in the field of mine action and CWD will be considered. Commercial companies, NGO's, and researchers are encouraged to submit. R&D articles are submitted to three experts for anonymous peer review and two of the three reviewers must approve the article for publication. Reviewers approve articles for publication, suggest revisions, or reject articles for publication.

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Men wait to be fitted for new prosthetics in Vietnam.
Photo courtesy of CISR.

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Battle Area Clearance/Urban Clearance/Urban Survey

Organizations conducting recent battle area clearance/urban clearance are encouraged to submit. Discussion of surface search, threat assessments, security, mitigating risks, reporting, quality management, and technology within unique, complex environments is encouraged.

Accidents and Investigations

IMAS 10.60 requires that "an accident in which a mine, ERW or explosives harms a demining employee, visitor, or member of the local population" shall be investigated and the report made available. In mine action, all reasonable effort should be made to reduce the risk to the deminer. When accidents and incidents occur, how does your organization identify and investigate the cause? How can requirements for reporting be improved? How does data obtained from A&I reports provide insight into trends that can help promote good practice in the field?

Prosthetics

Academics, organizations, and individuals working with prosthetics in humanitarian mine action are encouraged to submit articles on the use of prosthetics in HMA. Topics may include the latest technological advances, prosthetics within the context of mine action legislation, effects of decreased funding for victim assistance, integration of disability support services in HMA.

Mobile and/or Efficient Data Collection Methods

Collecting data via mobile technology such as iPads and other tablets has increasingly become the standard; moreover, thoughtfully created data collection forms drastically improves the efficiency and efficacy of data recording.

Caucasus

Organizations are encouraged to submit on their programs operating in Armenia, Azerbaijan, and Georgia.

Developing Partnerships and Sustainable National Capacity

The 2030 Agenda for Sustainable Development and the Sustainable Development Goals provide framework for integration of mine action in national development plans. How can organizations working in HMA gain trust in local communities and sustainably build programs that will not be mismanaged but held accountable for future work?

Commercial Off-the-Shelf Tools for Mine Action

Commercial off-the-shelf (COTS) products require minimum adaption and save on development costs. Submissions on COTS products used in HMA are encouraged.

Research and Development

The Journal of Conventional Weapons Destruction seeks research and development (R&D) articles. All technical articles on **current equipment, technology, trends, and developments** in the field of mine action and CWD will be considered. Commercial companies, NGO's, and researchers are encouraged to submit. R&D articles are submitted to three experts for anonymous peer review and two of the three reviewers must approve the article for publication. Reviewers approve articles for publication, suggest revisions, or reject articles for publication.

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Excess munitions are prepared for destruction in Rwanda.
Photo courtesy of RECSA.

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Editorial: The Oslo Review Conference - The Fourth Review Conference of the *Anti-Personnel Mine Ban Convention* commemorates the APMBC's 20th anniversary since entering into force. Held in Oslo, Norway, in November 2019, the Fourth Review Conference presents the HMA sector with an opportunity to consider the scope of work that remains in order to realize the tenets first negotiated in 1997—to save lives, promote sustainable development in affected areas, and to assist survivors. Since the APMBC went into effect in 1999, how has the HMA community changed to meet the needs of an ever-changing sector? Does the HMA sector currently possess the capacity to help States Parties adequately and efficiently achieve the terms outlined in the APMBC? Submissions discussing what progress has been made, as well as the challenges that remain are encouraged.

Mine Action in the Public Eye - In 1997, Princess Diana advocated for those suffering from landmines in Angola and Bosnia, raising awareness of the humanitarian issue surrounding landmine contamination. Similarly, retracing his mother's footsteps, Prince Harry's September 2019 visit to Angola drew global media attention to the ongoing humanitarian crisis of landmines and other explosive remnants of war. But what happens after the media spotlight dims? How can HMA organizations leverage stories at the country level to help advocate for resources that will advance the sector's goals and its beneficiaries? Raising attention of the people most affected by landmine contamination through human impact stories and advancing the HMA narrative by showing how explosive hazards clearance affects individual communities can raise support and leverage assets. Every organization involved in HMA has hundreds of stories at the country level to share with the global community—tell us yours.

Africa - *The Journal* seeks submissions on organizations' programs in Democratic Republic of the Congo, Mozambique, Libya, Somalia, South Sudan, Senegal, and Zimbabwe. Of particular interest are articles operating specifically in Angola, focusing on demining efforts, survey, physical security and stockpile management, information management, and victim assistance.

Robotics and Remote Sensing - Used to assist in identifying potential contamination, as well as in planning and monitoring and evaluation of clearance operations, *The Journal* encourages submissions on the latest technological advances.

Victim Assistance and Disability Rights Integration in HMA, Legal Frameworks, and Capacity Building - What issues around VA need to be addressed within the current context of HMA? How can VA be integrated into broader disability and development frameworks? Building on the foundation from the Maputo Action Plan, what challenges, opportunities, and expectations does the Oslo Action Plan set forth?

Physical Security and Stockpile Management - Topics of interest include: mentoring and evaluation, developing national capacities, ammunition management training, monitoring, database systems, successes, challenges, etc. Articles focusing on ammunition management/storage are encouraged.

Low-Order EOD Techniques/Sustainable Methods of Destruction Many programs face issues finding in-country explosives as high explosives are increasingly not permitted for disposal operations and alternatives are becoming expensive. Programs operating with low-order EOD techniques are encouraged to submit.

Humanitarian Mine Action Training Centers/Sites: Best Practices and Standards - Organizations are encouraged to submit on their training centers as well as on-site training grounds for in-country personnel.