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Mechanically Assisted Mine Clearance Operations

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Force XX1 Solutions International recently developed a separate organization devoted to global humanitarian operations known as Humanitarian Force. Using mechanically assisted methods, the Humanitarian Force team worked with the Namibia Defense Force (NDF) to clear several hundred mined berms in northern Namibia.

by Greg Caison, *Humanitarian Force*

Introduction

The Company
Force XX1 Solutions International is committed to providing consultation, training and in-country support for humanitarian mine action and humanitarian assistance operations throughout the world. Force XX1's approach to supporting humanitarian efforts is to establish a regional orientation and to stay focused on the needs and requirements of the community, region or country being served. It is a priority, when applicable, to ensure Force XX1's activities are seamlessly integrated into an overall host nation developmental strategy, i.e., agriculture, transportation, health and industry. It is our hope that these activities become mutually reliant and move the effort forward in a positive direction.

A bucket is used by an FEL to deposit soil into the sifter.

Because of Force XX1's successful operations and continued desire for direct involvement in global humanitarian aid efforts, the company has recently developed a separate, yet closely aligned, non-profit organization. The new company, Humanitarian Force, is positioned to seek out global humanitarian aid opportunities and implement related programs with the initiatives and philosophy described above. Just recently (June 2002), Humanitarian Force initiated work in Namibia and Angola to provide reassessments and set priorities based on the needs identified. Several standard mine action programs are available, or custom programs can be developed around specific projects based on the client's needs and requirements. In addition to the projects mentioned, Humanitarian Force is currently working to develop several mechanically assisted tools that can be deployed with minimal support.

Mechanically Assisted Mine Clearance
Mechanically assisted mine clearance operations have proven to be extremely effective in the global effort to remove landmines. Force XX1 believes the use of mechanical clearance techniques, in many instances, is a valuable tool that will enhance any mine action program that uses traditional manual clearance techniques, and it offers a viable alternative to meeting unique, non-traditional nuisance situations encountered in mine action operations. Force XX1 Solutions International has recently finished a three-year effort helping the Namibia Mine Action Program neutralize 401 mined berms using mechanically assisted methods. During this period, Force XX1, working together with the Namibian deminers, successfully cleared the berms and removed approximately 3,904 mines with no injuries or loss of life.

Force XX1 is a firm proponent of establishing sustainable programs that can be maintained by any nation executing mine action operations. Accomplishing this requires dependable equipment that can be repaired and modified in the field. Most often the best approach to meet this requirement is to implement a program using traditional (low-tech) manual techniques. However, our experience in Namibia has led us to also believe that some countries and certain situations can best be served by implementing mechanically assisted mine clearance techniques in concert with manual programs.

Mechanically assisted mine action operations serve three purposes: to enhance safety, to improve the rate of progress, and to meet unique and important environmental challenges. When used in concert with manual techniques, mechanically assisted clearance techniques may be used as a tool for area reduction and vegetation clearance, which are very time consuming and laborious processes for deminers using traditional manual clearance techniques. While more complex than traditional manual mine clearance techniques, this process can be executed at a remarkably low cost in any country that has access to the necessary equipment. Each host nation situation is different; but generally, Force XX1 believes that it is critical to use commonly available commercial equipment not only to stay on the low-tech low-maintenance end of the spectrum, but also to add to the host nation's ability to support other developmental programs. The equipment Force XX1 uses can serve a dual purpose and may be used in many other capacities by the host nation (i.e., agricultural use or any civil engineering-related project). Many of the mechanical devices being developed today cannot be used or sustained by a host nation because they are too specialized, require high maintenance and serve only a single purpose within the scope of humanitarian mine action.

Force XX1 and the NDF have validated this application over a three-year period while working to clear mine-infested berms. The application's success can be characterized as fast, safe and sustainable. In our operations to date, these techniques have proven to be very practical and come closer to the goal of 100 percent clearance than any other system or technique currently used today without compromising safety. This application centers on the use of heavy equipment to effectively and safely manage the environment by clearing topsoil into manageable berms and then applying techniques to process mine-infested soil and debris through large-scale sifters. The soil can be processed through either a mechanical device designed for this purpose or through stand-alone sifters.

Background

In 1990, the territory of Namibia gained independence from South Africa after decades of struggling to end Apartheid. The Southwest African People's Organization (SWAPO), established in 1959, conducted a fully armed insurgency campaign against the South African Defense Forces (SADF). A serious landmine threat was created as a result of the war for independence.

The original sifter.

Namibia, in partnership with the U.S. government (USG), established a National Mine Action Program in 1995. Through this program, both the Department of State (DOS) and the Department of Defense (DoD) were given the responsibility to assist nations facing a landmine crisis. There were several elements to this program. Through the DoD and the Humanitarian Mine Action Research and Development Program, the Army's Communications and Electronics Command (CECOM), Night Vision and Electronic Sensors Directorate (NVESD) developed a mechanical system that had the potential to assist Namibia with the situation they were facing with the berms. This technology was matched to the specific host nation requirements and brought into action through the efforts of many program managers, including the U.S. (DOS) Country Team, the DoD Theater Command, and the Research and Development (R&D) program. The Berm Processor Assembly (BPA) was originally designed to be used in conjunction with side-casting blades similar to snow plows, a method proven for clearing lanes/roads through a minefield but untested in this new environment.

In 1998, Namibia reported it had cleared all known traditional minefields; however, 401 mined berms remained surrounding the power line pylons in the electrical grid in northern Namibia. Landmine/UXO detonations happen predominantly in northern Namibia, specifically in the province of Kaokoland, an area where heavy fighting occurred. It is important to note that these regions are also the most heavily populated areas in Namibia. The 30m x 30m minefields were employed and recorded by the SADF. Pylons are approximately 400 m apart meaning the 401 power pylons stretch approximately 200 km from north to south in this region.

Initial reports indicated that approximately 25–45 mines (six Valmar J69s and the remainder R2M2s) were placed in these minefields surrounding the pylons. In 1992, the national electric company (SWAK) contracted the removal of these minefields. The contractor cleared the majority of the mines by placing shape charges over the Valmar J69s (jumping fragmentation mine) and by running a roller and tracks of a D-6 bulldozer over the R2M2s (non-metallic blast effect mine). At the completion of this operation, it was determined that some mines still had not been removed. In an effort to finish the job, the contractor prepared a trench next to each power pylon and, using a bulldozer, scraped the surrounding mine-infested topsoil into it. This resulted in a large spillover of topsoil outside the designated trench. The mines were located in this trench and in the surrounding soil outside and beyond the trench. This trenched area was known as the "pylon berms." All generally agreed that the areas in and around the pylon berms were still infested with landmines, and these findings were confirmed during several assessments in 1997 whereby landmines were visually observed in the berms after they had been exposed by erosion.

In 1997, Force XX1 was subcontracted to deploy the BPA, conduct operational tests to determine field performance acceptability and report the results. Force XX1 integrated mechanical clearance operations into the existing NDF mine action organization and evaluated the utility of the BPA to meet this unique requirement. To accomplish this, Force XX1 was required to organize, train and supervise a host nation mine action team in the development of techniques, integration of heavy equipment and technology, and neutralization onsite to conduct these tests. The NDF provided approximately 75 deminers to support this operation. The planning and training focus was to establish an effective operational team capable of integrating heavy equipment operations with traditional mine action skills to achieve fast and safe results. This team required a base of technical mine action, medical, mechanical and communications skills to form a solid foundation from which to build a mechanical clearance capability force. These skills were also essential to create a team capable of executing mine action operations in remote regions of the country. The operation was executed in the following five phases: Phase 1: Pre-deployment Training, Phase 2: Deployment, Phase 3: Link-up, Phase 4: Training and Phase 5: Operations.

Phase 1: Pre-Deployment Training

Before deploying the BPA, on-site training and testing was conducted at Ft. Belvoir, Virginia, during the period of October to December 1997. Additionally, requirements for spare parts and a complete set of tools required to support the BPA were identified and assembled.

Phase 2: Deployment

Transportation was a major factor in deploying the BPA to Namibia. Due to the high cost of air transport, the only cost-effective method to move bulk cargo into this part of the world is by cargo ship.

Phase 3: Link-up

The focus of this phase was for Force XX1 to deploy and quickly set up training areas, classrooms and logistical support for extended humanitarian mine action operations prior to the arrival of the BPA. For three weeks, Force XX1 was afforded the opportunity to coordinate with an Army Special Operations Forces (ARSOF) support team and liaison officer (LNO) to facilitate the transition from traditional manual clearance operations to mechanical clearance operations. It is essential to integrate mechanical clearance operations into existing in-country programs while staying focused on the end user's (i.e., the host nation's) requirements and capabilities. A critical element to the success of this mission was Force XX1's ability to integrate into and overlap with the USG "Train-the-Trainer" indigenous mine action training program executed by ARSOF. Since 1995, U.S. personnel have worked with Namibia on the establishment of a national program to remove mines that includes mine awareness threat education, mine detection and clearance. In this situation, Force XX1 was able to build upon this effort and expand on it in the implementation of mechanical clearance operations. Force XX1's background in Special Operations proved invaluable in working with the programs established by the military theater command's Special Forces, Civil Affairs and Psychological Operations (PSYOP) soldiers.

Phase 4: Training

Force XX1 initiated a 12-week training period that focused on developing individual skills and progressing to the development of collective team skills. Teams received training on all aspects of operating the BPA. Training also included driver skills, maintenance, logistics and repair operations for the BPA and its supporting equipment, including front-end loaders (FELs), bulldozers and Wolfe/Casper vehicles. This training was essential to ensure the NDF had the capability to sustain mechanical clearance operations. Maintenance and repair training required the most attention during this phase of the operation. All the mechanical theories behind the operation of the BPA and its supporting equipment (including the internal combustion engine, electrical and hydraulic systems and basic preventive maintenance procedures) had to be addressed. This area of training required a significantly longer time than any other phase of training. Standard operating procedures were rehearsed for all the techniques used in removing the berms. It is important that deminers working mechanical clearance operations are trained and skilled in standard manual mine action techniques and procedures. Refresher training on standard mine action techniques was conducted as necessary. In this situation, the ARSOF teams had previously established a trained and skilled cadre from which to obtain a solid foundation. Applicable techniques in TC 31-34 (ARSOF Humanitarian Mine Action Handbook) and standards/procedures previously established by ARSOF Mine Action Training Teams were utilized in conjunction with berm-processor operations. Force XX1 designed training that was constantly focused on the target audience and operational environment.

Phase 5: Operations/BPA Methodology

The BPA's methods of employment and design were modified over the course of this operation. During the initial stages of the training phase, it was determined that the BPA needed modifications because of problems associated with using the angled blade.


The latest sifter.

A significant weakness of blades and plows is that they leave mine-contaminated windrows on one or both sides of the clearing vehicle. For mine clearing blades and plows to be acceptable humanitarian demining tools, a method to clear these windrows was required. The BPA was created for this reason. The system could be towed behind the clearing vehicle to remove mines from an earthen windrow. The mechanism deposits AP landmines behind the BPA by picking up the dirt and applying a mechanical filtering process to isolate AP mines. The BPA returns the processed soil back to the ground with the AP mines in plain view behind the path of the berm processor. It was thought that the mined berms could be reduced into smaller windrows using this process enabling them to be cleared much faster and safer than conventional clearance methods.

While the concept of using an angle blade to push out windrows on relatively flat, hard soil is technically sound, consistent results using the blade to create the appropriate windrows could not be achieved when applying this technique to mounded sand berms infested with thick vegetation and rock. Using the angle blade also presented a concern with recontamination. As they were, all the mines were essentially contained in the berm area. Attempting to break the berms down into windrows required that these contained areas be spread out over a considerable distance to enable the BPA to process them as originally planned, potentially causing cleared areas to be recontaminated with landmines. It was determined that it was safer and more practical to switch the BPA from being a towed vehicle system to a stationary system whereby the BPA would be reconfigured to act as a "sifter" rather than scooping up soil while being towed. After the soil is sifted, the BPA still applies a mechanical filtering process to isolate AP mines and deposit them behind the BPA for subsequent neutralization.

Stand-Alone Sifters


BPA with modifications.

The basic sifter concept was tested before making any modifications to the BPA. A series of prototypes was built from locally acquired materials. The first model, built from wood, demonstrated that the concept was sound, and this led to the construction of a number of sifters fabricated from heavier-strength metal components. The first of these used diamond (chain-link) fencing and U-shaped pickets. The pickets formed the legs and frame from which the fence was stretched and to which it was secured. A FEL would excavate a bucket-load of soil from the berm and deposit it into the sifter. Because some of the aggregate material in the soil would not pass through the screening material, the FEL would have to lift and shake the sifter to get all the soil to pass through. This process left any large debris and mines on top of the fence for removal. The sifters were routinely damaged because of this type of interaction with the FELs; however, the concept had proven to be successful.

From this experience, a second sturdier prototype was developed using 16-mm round bars spaced 40mm apart with angle iron legs and footings. The sifters were 3.5m long by 2m wide and 1m high. This particular sifter was constructed using 16-mm round bars spaced 50mm apart and heavier 4in x 2in channel iron for the legs and frame. It was made sturdier with the use of heavier metal components, and full metal arms replaced the chain used to move and control the sifter. A solid steel bar was connected at both ends of the sifter to enable the FEL to pick up the sifter and shake it to clear the debris or to move it to a new location improving safety and its operational effectiveness.


Protective Blast Shield.

As an increase in the number and siz of rocks and debris made the terrain more difficult to process, the sifters had to become more durable. Force XX1 currently uses a seventh generation version of the sifter. As mentioned earlier, these stand-alone sifters have proven to be so effective that they were incorporated into the operational concept. Four stand-alone sifters were used in conjunction with the modified BPA to clear the berms.

BPA Modifications

To convert the BPA to the new sifting application, a processing chute, capable of sifting soil to remove landmines, was built onto the front of the BPA, enabling it to operate in this manner. This processing chute was the first BPA modification. It included a top grate and an angled grate built into the chute to allow the soil and sand to pass through while catching larger debris and mines. The top grates are spaced 200mm apart and prevent larger material from entering the BPA, while the angled grates, which are spaced 40mm apart, catch and feed the remaining debris or mines into the BPA for processing.

A conveyor belt rotates at the bottom of the processing chute, capturing the rocks, mines and other smaller debris that are filtered through the grates. These items are fed to the rear of the BPA, where mines are deposited, making it safer to neutralize them. The latest

BPA modification enlarged the processing chute and extended this conveyer belt an additional 3m from the front of the BPA.

In this configuration, the BPA is capable of processing larger amounts of soil. Hardened FELs scoop up quantities of soil from the berms and transfer it to the BPA where the mechanical filtering process isolates the AP mines for easy disposal.

Equipment

The heavy equipment used by Force XX1 consisted of standard commercial FELs and a bulldozer. This type of operation did not require any significant modifications to the original machine.

During the operations, three FELs, three Wolfe personnel vehicles, and one bulldozer supported NDF operations. The FELs and bulldozer were outfitted with special cabs that protect operators from accidental landmine blasts. Detonations of R2M2 or J69 mines in the FEL buckets can cause damage to the buckets. For this reason, the buckets were armored to prevent damage and extend the life cycle on these items. The Wolfe vehicles were designed and manufactured to provide a high level of personal protection.

Sifter operations.

As operations progressed into the more difficult regions located in the north, it was necessary to develop new tools, concepts and procedures to meet the changing situations faced by the NDF. A berm rake was developed, along with blast mats, to assist the NDF in dealing with large rocks and boulders found in this area. The berm rake is an attachment used on the FELs to lift large rocks or debris and dump them onto the blast mats. This is done to minimize damage to the sifters and sifter bucket. The blast mat is very similar to a stand-alone sifter, but without the legs. The large rocks and debris were dumped onto the mats to ensure that any mines encrusted in these items are contained and there is no accidental recontamination of the area.

Safety

Safety is the number one priority. In addition to blast-proofing the heavy equipment, other protective measures were developed for deminers in the operational area, and they were quite effective. Protective blast shields were built and positioned at designated locations on the site to protect other deminers while the heavy equipment is operating. These shields address the threat posed to deminers from the J69 landmine.

While providing protection to deminers is their primary purpose, the shields have also increased the speed of on-site operations by reducing the distance deminers have to walk to reach a safe area. The blast shields also provide seating and shade for deminers. Additionally, Force XX1 purchased and modified commercial grippers designed to safely extend a person’s reach when manual landmine removal is required. The redesigned gripper is 1m long with a deflector located at the end of the shaft and an upper safety shield at the top. The grippers were used to pick up and control mines that had been exposed by the BPA or sifters and move them to a safe area for neutralization. By using this device with the deflector and the safety shield, deminers were able to utilize maximum safety at times when manual mine clearance was required. A prototype of the gripper was provided to a representative of the USG DoD Humanitarian Mine Action Program in July of 1999 for further development.

Site Operations

The berm serves as the focal point for establishing a new operational site. Prior to setting up the site, a D7 bulldozer with a grid roller attached cleared an area approximately 40m x 40m around the power pylon and a 25m area immediately surrounding the berm.

Clearing around the pylon with the roller flattened the grass, vegetation and brush to establish obstruction-free areas, which allowed deminers using metal detectors to operate safely and effectively.

Clearing around the berms had the same effect but allowed the FEL to gain immediate access to the berm. In both instances, the roller often detonated any mines that were in these immediate areas and posed a threat. Once this was accomplished, all the equipment was moved into a safe area and the site was set up using the berm and the clock reference system. The BPA and four stand-alone sifters were positioned in a circle around the berm at a distance of 50–75m. The BPA was set up at approximately the nine o’clock position. The four stand-alone sifters were placed at the 12, two, four and six o’clock positions. Protective blast shields were employed. One FEL cycled between the BPA and the sifter located at the 12 o’clock position as its primary task. A second FEL cycled between the two sifters at the four o’clock and six o’clock positions as its primary task. The remaining sifter at the two o’clock position was designated as a backup in case any of the others became damaged or inoperable for any reason.

(Top to Bottom) Mine in BPA. Mine in sifter.

The FELs loaded their buckets with soil from the berm and deposited it in either of their primary positions, the BPA, or a sifter. In either case, soil was deposited and screened until the processed soil piled up under the sifter and reached the bottom of the screen or the bottom of the conveyor belt on the BPA. At that time, the BPA, towed by a Wolfe vehicle, was pulled forward and positioned to repeat the process. The sifter was then picked up and moved a short distance to repeat the process. After every load was deposited, the BPA operator checked for mines and debris behind and in the BPA to ensure the assembly was clear of obstructions before receiving the next load. This process was also followed for the sifters. When the sifters got clogged, the FEL had to shake them until they were cleared.

Once the berm had been cleared to a depth of approximately 1–2m or bedrock was reached, the bulldozer was used to refill the excavated hole with the processed dirt where the berm had been. The final step was to proof the berm area using traditional manual techniques and metal detectors. On average, 10–15 berms were cleared monthly using this methodology.

Quality Assurance
Quality assurance was an important factor in gaining the trust of the local tribesman. In addition to using traditional manual proofing techniques, Mine Detection Dogs (MDD) were also incorporated into the process. Over 1,477,500 sq m were cleared and approximately 3,904 mines were found and destroyed using mechanically assisted techniques. On average, Force XX1 and the NDF cleared 9.7 mines per berm with a 100 percent clearance rate. No leftover mines were found during the quality assurance testing and there have been no incidents reported from local villagers using the reclaimed land. Not everyone’s efforts resulted in the same levels of success. In a similar operation where a DoD contractor tested equipment, one mine was found after clearing only two berms.

Sustainability
A highly deliberate effort was required to keep heavy equipment operating in these remote environments. The berms were located approximately 400–500mi from the capital of Namibia, resulting in an eight to 12 hour drive one way to obtain direct support. Mechanically assisted operations required a focus on all aspects of maintenance, repair and logistical support. While supporting remote field operations can be a challenge, Force XX1 was able to minimize the impact of operating in remote areas by establishing operational support bases located near the berm area being cleared. Using the remotely located support bases both enhanced and streamlined the logistical and maintenance aspects of this operation. By hiring local mechanics and support personnel to work out of

the base camp, equipment servicing and specialized repairs were very manageable. Only the most difficult repairs had to be outsourced to local shops. Where possible, all logistical support was procured from local sources. The main advantages of having the equipment supplied and supported from local sources in country included low cost of employment, continued availability of personnel and supply, and better accessibility for maintenance or repair. It was also a critical factor in developing rapport, which is a key ingredient for the success of any operation in a foreign country. The remote base camps increased the operating efficiency of the team and significantly minimized the logistical expense of remote operations. It also provided continuity of effort by eliminating the time-consuming and costly daily transportation requirements of traveling to the remotely located berms.

Terrain
Operations started at the southern-most end of the pylon berms and continued to move north along the power grid into Ruacana. This area was selected for two key reasons. First, this region is predominately made up of sand and loose dirt that is ideal for the berm processor and heavy equipment operations. Second, this region presented an opportunity for Force XX1 and the NDF to gain confidence and experience in removing the berms prior to operating in the more difficult rocky terrain in the north. The berms in this region were fairly ideal for mechanically assisted mine action operations.

The second region was located approximately 50km (north) from the southern end of the pylons. The berms in this region transitioned from sandy topsoil to areas of loose gravel and rock to a hard-packed clay environment. Mechanically assisted mine action operations became essential under these conditions and required a more concentrated effort.

The third region was located approximately 150km north of the southern end of the pylons. The terrain in this northern portion of the power line was more problematic and required the most contractor support. This area transitioned from loose gravel/rock and hard-packed clay to a predominately mountainous environment with much steeper terrain to negotiate. Large boulders had to be cleared before the sifters could be used. Several of the berms in this area had large pieces of steel that were used to construct the pylon imbedded into them.

Another unique situation was posed by several berms located on ridges that were extremely overgrown with heavy vegetation. The final region consisted of approximately 12 pylons in the northern sector, five of which presented significant challenges to deminers because of very steep mountainous conditions. The remainder were previously uncleared because of other obstructions and fencing. This area required an intense adjustment in the standard operating procedures to overcome these factors.

Communications and medical support were primary considerations because of the remote location of the operations. Force XX1 relied on convenient, portable hand held FM radios for internal communications onsite and between bases. A repeater tower significantly extended the range of this system. External communications were achieved using satellite telephone technology and high frequency (HF) networks operated by the NDF. Ambulances and NDF medics trained in emergency medical care were present onsite during all operations.

Redeployment
Upon completion of the R&D operational tests and several modifications to the operational concepts/procedures, the U.S. Country Team and local authorities insisted that the NDF continue the successful effort to assist the host nation in eliminating this imminent threat. The DOS then began managing the program and contracted Force XX1 to continue this effort. In 2000, the DOS, in an effort to enhance and broaden its capabilities, contracted RONCO under the Integrated Mine Action Support (IMAS) contract to provide logistical resource management and support for DOS operations worldwide. Force XX1 completed this effort under contract through RONCO.

Humanitarian Assistance

Force XX1 not only provides mine action support but also continues to provide a wide array of services strongly focusing on humanitarian assistance. Force XX1 strongly supported all facets of the mine awareness effort and conducted mine awareness classes for over 13,000 local villagers. This has become so popular with the local authorities that Force XX1 returned in October 2001 and again in January 2002 to provide and sponsor additional mine awareness education programs. Force XX1 provided English language training to NDF deminers, assisted several communities with the repair and installation of water wells, sponsored local sporting events and provided support for several other general construction/engineering projects during the three-year period that Force XX1 implemented mechanical clearance operations. The sporting events have become widely anticipated annual events in some regions.

Conclusion

Mine Awareness Training.

Force XX1 provided a wide range of critical support to the NDF throughout this deployment in order to enable NDF deminers to safely and expeditiously neutralize, clear, process and proof the power pylon berms. This support ranged from providing oversight and on-site advisory assistance for training programs and operational planning to facilitating in-country logistical and administrative support, emergency maintenance, repairs and sustainment for the BPA as well as any other heavy equipment necessary for successful field-site operations. In the final analysis, the ability of Force XX1 and the NDF to develop innovative, precise clearance techniques and nonstandard methods for neutralizing berms was critical to the ultimate success of this effort. Each of the berms encountered was proven to be a unique situation and presented a challenge that required an individual solution to meet its needs.

The mechanical clearance techniques developed in Namibia have direct applicability throughout mine-infested Third World nations. Force XX1 believes in using a "tool box" approach, which focuses on taking ideas and concepts for seemingly complex problems and turning them into workable solutions using a variety of "tools," depending on what the situation dictates. This is a strength Force XX1 maximized during this deployment, enabling us to meet a continuously changing requirement. The secret of Force XX1's success continues to be to fill its toolbox with all the available tools, to match the right technology or technique to the right situation and to have a support mechanism in place to quickly and effectively mobilize these resources.

Basketball court construction.

It is unrealistic to assume that technology will provide a "silver bullet" that is going to get the job done in every possible landmine situation. However, a wider acceptance and strategy for integrating mechanically assisted clearance must be adopted by program managers and planners to effectively develop, deploy and sustain cost-effective mechanical mine clearance initiatives in support of the global mine action effort.

**All photos courtesy of the author.*

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