Improving Productivity in Manual Demining by Magnetic Clutter Reduction?

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Observations on humanitarian demining

• Manual demining is in many cases the preferred method (reliability; for donors: building of local capacity; creating jobs)

• Even with mechanical demining: manual demining used as check (heavy mechanical equipment: challenges in deployment, maintenance, etc)

• The metal detector is (and will stay) the primary detection tool in manual demining

• Use of metal detectors slows the operation due to huge numbers of “false alarms”
  Typically in HD-operations: FA-ratio of 1:100 to 1:1000

• Study of GICHD: reduction of FA-ratio with 50%: yields 21% to 47% efficiency improvement of operation (in 10 out of 12 demining scenarios)
False alarm reduction

• Combining Ground Penetrating Radar with MD will reduce FA-ratio.

• Demonstrated in field trials of 2 dual-sensor detectors. (more independent test results from test in Croatia Oct ’07?)
• Disadvantages of MD: price, weight, power/battery consumption, training and experience of the operators, modification of SOP, maintenance, …. acceptance
False alarm reduction: an alternative way

• Ferromagnetic clutter can be removed with a magnet (on the soil surface and flush-buried)

• A number of demining organizations have tested magnet(-tool)s and use them in demining. However, hardly any results or experiences are reported.

• Aim of project ‘Magnetic clutter reduction efficiency’: To quantify the efficiency increase obtained by the use of hand-held magnets or ‘magnet-tools’ in manual demining.

• Data-acquisition in real demining operations (not in a simulated test environment)

• Results will depend on the scenario (amount and type of clutter, etc.)
ITEP (www.itep.ws)

- Project in the ITEP Work Program
- ITEP: International Test and Evaluation Program for Humanitarian Demining
- UNMAS and GICHD observers in ITEP are the link with the “field”
- ITEP’s aim is to increase efforts within global demining through generating, collecting, and distributing objective, independent, scientifically based test and evaluation data on humanitarian demining materials, systems, and methods
- No transfer of money
Project phases

• Selection of magnets / ‘magnet-tools’
  Making use of high-grade Neodymium (NdFeB) permanent magnets

• Set-up training and data-acquisition procedure
  Should fit in SOP of demining organisation

• Data-acquisition in SE Asia:
  Cambodia, partner is Cambodian Mine Action Centre (CMAC), fall 2006

• Data-acquisition in Africa:
  Angola, partner is Norwegian People’s Aid (NPA), spring 2007

• Extended: fall ‘07

• Reporting
Selection of magnets / ‘magnet-tools’

Criteria for magnets / ‘magnet-tools’ (addressed in questionnaire):
- hand-held, weight
- size, force distribution
- soil manipulation
- visibility and removal of clutter
- price, availability
- robustness, maintenance, on-site or in-country reparability
- etc.
Data-acquisition in demining operation

1. Check area visually on metal, removal of vegetation (remove metal)
2. Scan with metal detector
3. If MD alarm: scan that location with the magnet/magnet-tool
4. Record (on sheet) that an MD alarm is found.
   If the magnet finds piece of metal → remove metal
5. Scan the location again with MD;
   record the (non)-occurrence of the MD alarm
6. Proceed according to the SOP:
   (a) *No MD-alarm*: step forward and scan new area with MD
       → proceed (step 1)
   (b) *MD-alarm*: prodding, excavation, etc → remove metal
       (during excavation the magnet/magnet-tool can be used)
Data acquisition

- Deminers record for each metal piece found: time, how it was found (visual; scan with magnet(-tool); excavation), type of metal object (nail, bullet, cartridge, etc)
- All metal found is collected, sorted by the way it was found
- Measurement of cleared m² each day per deminer/magnet(-tool) by supervisor
Data acquisition phase in Cambodia

- Partner: CMAC (contacted by NPA)
- Location: Koh Ker, 130 km NE of Siem Reap
- 8 deminer pairs (2 men – 1 lane procedure); 5 weeks
- 4 tools: CMAC-magnet (reference); ring; HSM; rake
  (2 deminer pairs per tool)
Results from the trial in Cambodia

- In area with CMAC-magnet:
  1 metal piece per 40 m² (0.025 clutter/m²)
- In area with ring magnet:
  1 per 14.7 m² (0.068 clutter/m²)
Data acquisition phase in Cambodia

Diversity in scenario:
  slopes of bank: with and without thick vegetation;
  on top of bank: flat area with dirt road, trees and thin vegetation
Feedback from the CMAC deminers

From interviews

• General:
  - use of magnets/magnet-tools increases demining speed
  - easy to get used to the magnets/magnet-tools
  - fit in SOP

• Ring:
  - preferred, mainly because of its strength

• Hand-held Sweep Magnet (HSM):
  - too fragile and magnet not strong enough

• Magnet-rake:
  - too heavy
  - not used as rake (tines up)
Metal collected in Cambodia with magnets
Data acquisition phase in Angola

- NPA as partner
- Set-up similar to Cambodia trial
  but only 2 tools: ring magnets and flex magnet-rake
  (plus reference group: no magnet-tools)

- 15 deminers (3 groups of 5), 1 man – 1 lane; 13 days
- Minefield in Kwanza Sul province, village of Cachoeiras
Data acquisition phase in Angola (2)

- Flat and hill slope grassland
- Flat part prepared with Aardvark half year before
Results of data acquisition phase in Angola

- Data in graphs corrected for missing sheets, illness of deminers, etc

- Reference group (no magnet tool):
  1 metal piece per 2.236 m²

- Ring magnet:
  1 metal piece per 1.656 m²
  (35% more than reference)

- Magnet rake:
  1 metal piece per 2.095 m²
Feedback from the NPA deminers

• General:
  - use of ring magnet and magnet-rake increases demining speed
  - easy to get used to the ring magnets and magnet-rake
  - fits in SOP
  - no danger of detonating mines

• Ring:
  - preferred, because of its strength
  - handle is needed

• Magnet-rake:
  - magnets are too weak (compared to the ring magnet)
On the Angola results

• Data show no productivity improvement *despite* the feedback from the deminers

• Area where ring magnet was used
  - was prepared with Aardvark (half year earlier, before rain season)
  - has 35% more clutter than reference area

• Ring magnet needs modifications (handle; better cleaning possibility)

• Data acquisition procedure may affect the results (too much time used for reporting by the deminers in the field)

• NPA proposes to conduct a 2-month trial *prior to implementation*. No data acquisition by the deminers (only cleared m² per day per deminer)
3 criteria for success met

Up till now:

• Tools and procedure used in live minefield by local deminers (fits in SOP; instruction and training are easy)

• Impression of a positive result on manual demining (productivity and/or work pleasure) (but quantification based on the data is not possible)

• End-users (CMAC and NPA) requested instruction on tools and procedure in other minefields (other scenarios)

Near future (Fall 2007):

• 2-month trial in Angola with modified ring-magnet (prior to implementation)
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GICHD Guidebook on Detection Technologies and Systems for Humanitarian Demining