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Developing New Technology for Humanitarian Demining

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Tempest cutting vegetation in a live area in Bosnia
Photo c/o Russell Gasser

Developing New Technology for Humanitarian Demining

by Russell Gasser and Terry Thomas

Despite the spending of hundreds of millions of dollars on high-tech research over the last few years, local humanitarian deminers still use traditional prodders and metal detectors. The biggest recent technical innovation has been mechanical vegetation clearance which was mostly developed in the field and bypassed the research route.

An understanding of technology choice makes it clear why this has happened and can help us avoid following too many dead-ends in the future. Research should generate viable new options, and technology choice then helps select which one to use. However, the critical word is *viable*. Innovations that are very expensive, risky, hard to fit into existing work practices or that do not address high priority problems are not viable. If the innovation process is not *driven* by potential users but is instead controlled by distant outsiders it will usually be fruitless. An experienced field practitioner always has as much to offer as the expert in the laboratory; it is the combination that is most productive. In humanitarian demining research such a combination is rarely found.

The Development Technology Unit (DTU) in the School of Engineering at Warwick University has a methodological approach to humanitarian demining research. After 12 years of active research in appropriate and sustainable technology with project partners in 10 developing countries, new work is based on what has been learned about the types of technology that really promote development and are suitable for use in these countries In all its humanitarian demining research, contact with organizations in the field and visits to mined areas are used to keep the end user as an important partner in the whole process of engineering R&D. This keeps the focus on types of technology that actually work in the field and that deminers really want, though of course it does not mean that every idea is successful. As part of a university noted for its excellence in high-technology research and engineering, the DTU takes full advantage of access to information and expertise in a wide range of technical disciplines.

To date, much of the DTU humanitarian demining program has focused on the development of equipment that can be *produced* in heavily mined countries. An independent British charity, the Development Technology Workshop (DTW) has been established to undertake much of the technology transfer work; one notable success has been helping local people establish the Cambodian Demining Workshop (CDW) in Phnom Penh. The CDW is a Cambodian small business that now employs 23 local people, 60 percent of them with disabilities and half of them women. The CDW products are prodders, visors, protective clothing and other demining equipment. Similar small-scale production can easily be established in other heavily mined countries where there is demand, the technologies used are all transferable. The CDW and DTW between them also manufacture (in Britain and Cambodia) the "Tempest" vegetation mini-flails—these radio-controlled machines weigh two tons and three are currently working with demining NGOs in Bosnia and Cambodia.

Technology choice often involves comparing high-tech, imported equipment to traditional locally made alternatives that are not as fast, but are much cheaper. In humanitarian demining the choice has to be between different speeds and costs and not just different levels of safety. Using less safe equipment just because it is cheaper has effectively been ruled out as there is an over-riding requirement to protect professional deminers. Risk assessment methods clearly show that rapid clearance of as few as 80 percent of the mines in an area could halve the casualties over the next 20 years compared with the current near-perfect but very slow method [http://www.hdic.jmu.edu/hdic/journal/3.1/features/risk_brown/risk_brown.htm]. The large decrease in civilian casualties would be accompanied by a small increase in deminer casualties and that simply is not acceptable.

In contrast to most trades, deminers must be able to use all their tools and equipment effectively from the first day they work in a live area. A humanitarian deminer cannot start as an apprentice with a few limited tools and skills and gradually increase both. Working alongside and watching an experienced deminer is also dangerous and unacceptable. It places a heavy demand on the designers of tools and equipment to avoid any operating methods that depend too heavily on detailed experience or having gradually learned a subtle feel or complex instructions.

There are similar problems in the innovation process itself. Testing prototype demining equipment is nearly impossible. Prototype safety equipment, and demining tools that are not quite good enough yet, or maybe have hidden faults, cannot be tested thoroughly in live areas. This is becoming even more important as microprocessors start to be used in almost all metal detectors. The computer software that the microprocessors use cannot be exhaustively tested to prevent against all eventualities. Limited testing with surrogate mines is the best that can be done, but tests on a small number of items cannot guarantee adequate performance under all circumstances. This is a strong argument in favor of improving existing tools that work well and abandoning work on very complex new equipment no matter how good it may promise to be.

Much of what has been written on "appropriate technology" deals with technologies for production. Humanitarian demining produces land that is free from mines. This view of demining as "producing" usable land can be helpful in looking at which technologies are likely to succeed. If a technology looks completely unsuitable for use in a production environment in a factory in a particular mined country then it will probably not be suitable for use in the field. Improved productivity (increase in area cleared per dollar) is a very important measure of demining equipment and has often been overlooked in research programs that choose instead increased sophistication.

Technologies that function well in a laboratory may not be suitable for local deminers familiar with simpler methods such as manual prodding. If operating the equipment is confusing and complex, there is every reason for a deminer to fail to trust his or her own memory of how to use it. Local humanitarian deminers may choose to ignore advanced demining tools and continue to use trusted methods. Failure to remember the correct operating instructions could result in injury or death.

Some of the effects of making demining technology choices are a lot less obvious. For example, many mine field vegetation clearance machines can only work where there is good road access and where the site is reasonably level. In many countries the flatter and more productive land, especially where there is good road access, is already owned by the richest families or the local war-lords. If mechanically assisted methods could be used to clear mines and UXO from only two-thirds of the agricultural land in a particular village a demining agency could well decide that the other third is "uneconomical" to clear.

Khmer staff wearing personal protective equipment made at the CDW in Phnom Penh, Cambodia.
Photo c/o Russell Gasser

As is well known, humanitarian demining is not one single activity, nor is it done in the same way in different countries. Far too much high technology research has focussed on finding a single universal mine detector that will have a single operating procedure—this is a military requirement more than a humanitarian demining requirement. Military mine field breaching and humanitarian land clearance by local people working for a demining organization are so different that equipment suitable for one is generally not useful for the other. Unless the results of commercial demining research are useful to the large

and lucrative military market it is difficult to justify funding to pay for it. Humanitarian demining has been expected to benefit from spin-off from military research but this has been very limited. The cost and complexity of military equipment and the military breaching requirement for rapid detection even if small mines are occasionally overlooked are not compatible with humanitarian land clearance. Crucial decisions about humanitarian research program are taken by expert advisers who have a background in military engineering or explosive ordnance disposal. Inevitably, the equipment that is most familiar in presentation and function seems more attractive, at least initially. Hence there is a built-in bias in high-tech research towards equipment suitable for military use. Instead of humanitarian demining equipment benefiting from spending on military research the reverse has happened and the main beneficiaries of most humanitarian high-tech demining research have been military deminers, in both their combat and peacekeeping roles.

Manufacturing Tempest vegetation clearance machines. Hulls being made in Cambodia. Final assembly in Britain.

Photo c/o Russell Gasser

The need for emergency demining programs will continue, but humanitarian demining is already moving toward a different role, that of being a partner in long term development. Donor funding for humanitarian demining is starting to shrink, in the future more will have to be done with less funding and the cost-effective developmental approach will become more important. In emergency aid, the needs are acute so supplies, experts and technologies are parachuted in as fast as possible. In development, hard lessons have convinced most people that the only way to get the right answers is a sound collaboration between local people—the insiders who really understand the local problems—and outsiders who have specific expertise. There is a wealth of experience in managing this change from emergency response to development work in such areas as health care, water supply, low-cost housing and agriculture. Humanitarian demining organizations can benefit from the hindsight of other agencies and avoid repeating some of the painful mistakes that have been made in the last 20 years. Some aspects of developmental work are already familiar to many demining organizations, for example:

- Prioritizing needs.
- Working within available funds even when they are insufficient.
- Building on existing knowledge and technologies instead of starting from scratch every time.
- Including all the people who will benefit right from the beginning so that resources are not misused.

Demining is in a leading position as many other development activities cannot start until the land is cleared, however it has similar requirements to any development work in needing the right tools and equipment. These must be:

- Functional and reliable.
- Affordable and good value.
- What the user wants and can understand.
- Suitable for local use exactly where they are needed.
- Easy to maintain and repair.

The need to develop new tools and techniques, not just select from a range of existing alternatives, imposes further restrictions. Engineering research can only be done effectively where there is access to funding, trained personnel, information, technical data, supplies of parts for building prototypes, workshops and test facilities. This inevitably means that Europe and North America dominate; the participation of professional researchers in mined countries is often underrated or ignored.

Specialized research in the richest countries has led to remarkable advances such as computers and mobile phones, but it has also narrowed the thinking of many researchers to the point where the only way forward is increased complexity. In marketing terms, more features give the user more choice. By contrast, "Advanced Simplicity," the harnessing of the latest technology and thinking to make equipment simpler has generally been ignored. In demining research, finding out what deminers in the field really want has all too often become a token exercise; a good understanding of field conditions can only be gained from visiting mined areas at every opportunity. For example, the many ideas for equipment that use a color-display computer screen to warn the operator of mines are doomed to fail in some countries. Not only are these screens unreadable in bright tropical sunlight, they currently have a limited temperature range, are expensive and fragile, and mean that the deminers must focus their visual attention away from the ground and vegetation that they are clearing. Yet in the lab they seem such a good idea. What is lacking is the exchange of ideas between engineers, deminers and people who have experience of the problems of development.

Some minimum standards for any new demining tool or equipment, in addition to the more general criteria above, are that it:

- Works in the lab to humanitarian demining specifications and continues to work when taken into the field.
- Takes into account the realities of humanitarian demining SOPs and the local deminers' knowledge.
- Provides something that deminers somewhere really need and actually want to use.
- Enhances the demining process by making it faster, safer or cheaper.

There are three well-tried ways of producing more effective tools:

1) Design all-new tools.
2) Upgrade traditional or existing tools, such as improving metal detectors.
3) Scale down or adapt equipment from allied fields, like agricultural vegetation cutters.

Research institutes and universities in Europe have generally concentrated on the first route at great cost and with little to show. Commercial companies and NGOs have sometimes followed the second route and made good progress. Some demining organizations and specialist NGOs have taken the third route and achieved some remarkable successes.

It has become common to think that technological solutions to demining problems are difficult to achieve and require a lot of time and money. In fact the opposite is true. The record of individuals and organizations with few resources and tiny budgets making major improvements is quite outstanding. Successful vegetation clearance and building-rubble-clearance equipment has been built by demining organizations for their own use from commercial off-the-shelf components; visors and protective clothing are now made in several countries by local workshops and metal detectors are now better than a few years ago. In parallel, improved management and refined SOPs have led to a large increase in deminer efficiency and a reduction in accident rates.

If we persist in spending vast sums of money tackling the wrong problems (e.g. detecting buried mines in level lawns), if we look only to technical experts with very narrow specializations and if we ignore any development issues, then we can expect another few years of fruitless effort and wasted money. The choice is clear. ■

Field testing a force-feedback prodder designed as a training aid. The prodder indicates when excess force is used during prodding/excavation.

Photo c/o Russell Gasser

**Opinions expressed are personal and not necessarily the views of the DTU of the University of Warwick.*

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