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Driving the HD Machine in the African Bush

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Networks of Excellence

Networks of Excellence (NoE) in FP6 will be substantially different from the Thematic Networks in earlier framework programmes—the use of a similar name does not imply the same primary goals or structures. The document at http://ec.europa.eu/intcomm/research/fp6/pdf/neo_070902.pdf clearly sets out the purpose of this new instrument: "Networks of excellence are designed to strengthen scientific and technological excellence on a particular research topic by networking together at European level the critical mass of resources and expertise needed to provide European leadership and to become a world force in that topic."

"Networks of excellence are therefor an instrument designed primarily to address the fragmentation of European research. Their main deliverable consists of a durable structuring and shaping of the way that research in Europe is carried out on particular research topics. Though it is not their primary purpose, networks of excellence will generate knowledge on the topic through the support they provide to enable excellent teams to work together. It is important that these networks do not act as "closed clubs," concentrating only on strengthening the excellence of the partners inside the network. Each network will therefore also be given a mission to spread excellence beyond the boundaries of its partnership. Training will be an essential component of this mission.

"It is expected that larger networks may involve several hundreds of researchers. Others may be of a much more limited size, provided that they pursue ambitious goals and mobilise the critical mass needed for that achievement." The proposed method of funding NoE will be in the form of a one-off grant towards the cost of integration, paid per person joining the network. The key item of a NoE is the Joint Programme of Activities, which goes far beyond current activities like Internet Forums and can even include proposals for exchange of personnel between institutions for extended periods.

Impact of FP6 on Demining Research

The new instruments pose some challenges, as well as offer some real opportunities for HD research and development. Many participants in HD research in Europe are already working on the potential structuring effect and increased co-ordination that could arise from one or more NoE. For example, improved co-ordination of the many test facilities located throughout Europe could be seen as bringing immediate benefits to both in terms of comparing results and also in promoting a co-ordinating body that allows individuals to focus on their specific key areas of competence. Similarly, developing areas of common interest in research could not only reduce duplication of scarce resources but also allow faster progress towards the goal of eliminating mines. Managing the requirements of common-interest collaboration between competing commercial companies remains a major challenge, which has to be addressed in a realistic manner in FP6.

Integrated Projects also offer some challenges, as well as opportunities, to develop key technologies in areas such as airborne area reduction as well as detection equipment and used during individual mine detection and elimination. It is now clear that attempts by individual organisations to work alone and develop new equipment in isolation are no longer an option. European wide collaboration on a large scale is required, the necessity to form groupings or "consortia" has become urgent and this is especially true for SMEs who wish to participate in FP6. Given the proposed scale of activities in IP, it seems likely that the market for humanitarian demining equipment may, by itself, not offer a viable return on investment for companies investing 50 percent of research costs to match the 50 percent paid by the EC. Increasing attention is being given to dual-use and multiple-use technologies to help resolve this issue; for example exploitable vapour detection has potential applications in humanitarian demining, civil security (e.g. airports), range remediation and military purposes. Within a single IP it is envisaged that there will be integration from developing the concept with "principal stakeholder, including users" through to transfer of the finished technology, demonstration and training, and also integration across the applications of dual and multiple-use technologies, see http://ec.europa.eu.int/com/sanat/m/r/pep/fp6/pdf/ip_provisions_070952.pdf.

Overall, the goal of the EU remains to deliver the new tools and equipment that humanitarian deminers urgently need and want."

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Driving the HD Machine in the African Bush

Almost every country in Southern Africa has a mine problem and most of these countries have a tradition of solving their own problems. Because the region is famous for its mine-resistant vehicles, this paper concentrates on innovative mechanical technologies—but it could just as easily have concentrated on PPE or testing facilities where Southern Africa also leads the way.

by Andy Smith, AVS Mine Action Consultants

R&D in Southern Africa

If you measure research and development (R&D) success by the presence of the equipment somewhere in the field, then a lot of useless equipment can be called a "success." This is because those who supported the R&D want us to be able to claim "success" so they "give" equipment to field users. Sometimes this is a direct gift, sometimes it is formally a "loan" or it is tied to further funding. This equipment would often be wholly uneconomic for the users to buy—but in the area it is far too limited to justify the expense. Sometimes it is not even wanted, but "political" concern leads to it being accepted. If you measure R&D success in the terms of the equipment being purchased and used around the world, the number of R&D successes falls dramatically. Moreover, most of the R&D that has achieved this success was "homegrown." It did not originate in the ivory towers and defence research centres of the developed world. Most of it was also very cheap. Often it was the result of inspired lateral thinking that led to improving existing technology and methods.

The most famous—and successful—mechanical mine-detection system ever was the Pooki, developed in Zimbabwe (then Rhodesia). Unfortunately it was only good at locating large steel-coated mines recently buried on roads, but that was what it was designed to do and it saved many lives. With its low-weight, "V"-shaped steels wheels and high-frequency VHF detector it was truly revolutionary in the 1970s.

Mechanical Assistance

When looking for more sophisticated mines laid a long time before they are cleared, the use of "off-the-shelf" machines had to change. Old minefields in many parts of the world tend to be overgrown, and the vegetation must be cut to allow thorough mine clearance, which is where most "mechanical assistance" comes to the fore these days.

Steel Wheels and Rollers

Using machines to "deal with" the vegetation begins with MECHEM steel-wheel and rollers in the early 1990s. The wheels and rollers were attached to AV mine-resistant vehicles developed during South Africa's involvement in the Angola and Mozambican wars. The wheels and rollers "crushed" the undergrowth, which tended to spring back up unless the machines were followed up by deminers immediately. Deminers had to follow up because the wheels and rollers left mines and ordnance behind. The system pushed a cushion of vegetation over the mines making it less likely that the wheels would initiate them. In the first half of the 1990s, several deminers were severely injured or killed while following this kind of blanket preparation. (These examples are recorded in the DDMV/ DDA's introduced in another paper in this journal.) Civilians were also injured in areas supposedly cleared by these machines. As a result, the wheel and roller methods were abandoned. Thou Ergo, the Pooki was a single seat mine-resistant mine-detection vehicle.
“Wolf.”

in the back of an armoured mulcher where, in 1993, there was a fatal accident with a roller system mounted on a rank.

were also used in the early days in Angola, on lessons that are used in Mozambique. Rollers were effective at clearing vegetation, but they also miss mines, break mines, heavy ordnance and cost a lot to run and maintain.

NPA claims that ground “clear” with their flails is always covered by a full follow-up with another method (manual or dog).

PAD (formerly UNADF) in Mozambique has had a military flail from Finland for several years. It also spends a lot of time unused while the technicians wait for spare parts.

With full follow-up required, the performance and the cost effectiveness of ground-engaging flails has long been questioned. Safety is another issue.

Ground-engaging flails do not clear the ground and so in humanitarian demining a full follow-up is always required. The total cost of running the flail must then be added to the cost of the manual clearance, which makes their use prohibitively expensive compared to other methods.

Large flails do have the advantage of being able to “chew” through big trees, but they have the disadvantage of disrupting the ground, destroying any mine pattern there may have been and leaving damaging mines and ordnance behind.

MineTech has been using a long-chain flail for vegetation cutting since the mid-1990s when they recognized the value of cutting the vegetation in advance of deminers. They made their machine because the cost of the most resistant flails sold commercially was far too high. The MineTech flail could hit the ground, but it is not deployed in that mode.

Locally made also means that the parts required for service and maintenance are available locally which keeps “down-time” to a minimum. If the user relies on the machines, designers should remember that the mean-time to repair can be far more important than the mean-time between breakdowns.

MgM began to develop a mini-flail in Namibia, and it successfully underwent its first trials at the end of May this year. Contact Scott@mgmorg.

The MgM Mini-Mulcher is much bigger than the machine planned in 1996, but is a major step in the right direction.

Apart from Monster flails, a range of ground processing machinery has been tried in Africa. In Namibia, the ill-used Brems-Processor proved impossible to deploy over rough terrain. In Mozambique, the Krohn system failed to perform as designed. In Zimbabwe, the ground-milling MineBacker was used with controversy and less destructive—but the mine-proof vehicle adds a lot to its cost. Back in 1996 it was recognized that the cutting head could be compact enough to allow its carrier to be very small and lightweight—especially if it were radio-controlled so that lighter armours could be used. I devised such a machine to meet MineTech needs, but the donors were more interested in funding mini-flails that hit the ground.

Firsts for Africa
- Steel wheels
- Vegetation mulchers on mine-proof vehicles
- Locally made Monster-flail
- Tree shears on mine-resistant vehicle
- Mini-mulcher
- Successful ground processing

Monster Flails

The main difference between a mulcher and a ground-engaging flail is in the length of the cutters. Mulchers often have cutting “hammers” binged onto the flail spindle, whereas ground-engaging flails have chains between the spindle and the “hammers.” The power requirements of a ground-engaging flail are very high and the machines are often designed to withstand multiple AT mine detonations, making them suitable for military use. This means that they are large and heavy, so expensive to buy and to operate.

Flailing to detonate mines has been widely tried and abandoned. Nonetheless, Norwegian People’s Aid (NPA) immediately...
over its thoroughness and there were severe incidents while processing the piles of mines and earth. Even when the "host" machine is manufactured elsewhere, the design concepts originated in Southern Africa and the assembly of off-the-shelf parts took place there.

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**Technology's Promises**

Every technology under development makes big promises. Here are five projects that may someday impact the world of mine action.

by JJ Scott, MAIC

**Introduction**

Peruse any brochure or website that promotes a developing technology and there is one word that will come up repeatedly: promise. Every new gadget promises to vastly improve, simplify or otherwise revolutionize some aspect of modern life, and the products aimed at mine action practitioners are no different.

Each promises to make demining quicker, easier, safer or cheaper, and each breakthrough promises to be more earth shattering than the last. I looked into a variety of devices that promise to have an impact on some aspect of mine action, from new mine-detecting sensors to new types of landmines—even a potential landmine substitute. These projects vary widely in their goals, budgets and feasibility, but all share one common bond: if fed enough money, each promises to forever alter the practice of mine action.

**Fido**

Dogs are superb at detecting landmines. Their noses are some of the most sensitive detection devices ever created. That is, until they get tired. Or sick. Or it gets too hot outside. All cause dogs' effectiveness to drop rapidly. Dogs also tend to lose interest in demining as the day wears on, which is an inevitable though particularly dangerous consequence of their assigned task. How might one retain the mine-sniffing abilities of dogs while negating their shortcomings?

Nomadics, Inc., with funding from the U.S. Army, is developing a vapor-detecting sensor they call "Fido" that promises to detect an mine without as effectively as a dog but will never get tired, never get sick, never get bored and never get fleas. I quoted Mr. John Sikes of Nomadics about his company's aptly named device, its developmental process and its promises for the future of landmine detection.

I can't explain exactly how Fido works, for doing so would require me to accurately use words like "collimator," "borescopic," and "pentaprism," which I am not prepared to do. However, thanks to Mr. Sikes, I am able to explain what Fido does now and what it might do someday. It turns out that Fido doesn't specifically detect landmines at all. As a vapor detector, it alerts its user to the presence of trace amounts of chemicals such as TNT—which happens to be the most common explosive used in landmines. Fido is by far the most sensitive detector yet tested, capable of discerning units of femtogram (that's $10^{-15}$, or 0.000000000000001 grams) of TNT vapor in a milliliter of air. According to the company's website, that is equivalent to one drop of fluid in 25 Exxon Valdes-sized tankers.

Mr. Sikes said that at this level, "on the best days under the best conditions we're up there with dogs." This is quite an achievement, but Nomadics hopes to push Fido even harder, until the device can detect one attogram (10^-18 grams) of material. At that point, dogs might be able to go back to fetching sticks and lying in the sun all day, leaving the mine detection to sensors and the deminers that use them.

Looking ahead to this inevitable day, I asked Mr. Sikes about the miniaturization prospects for Fido. After all, who wants to carry around a sensor device that is heavier or more awkward than it needs to be? Mr. Sikes believes his company "can get the basic technology down to about a cigarette pack size, roughly a pound or so." Technical problems are not holding them back, he explained, adding, "We probably wouldn't even need to do any custom electronics, just more of a concentrated effort, but we don't really have the funding for that right now...." As Mr. Sikes put it, "The problem is that the people who need our technologies the most are going to be able to afford it the least." Obtaining funds is an all too common problem among inventors and developers, leaving projects to lie fallow until a bit of seed money allows their promises to bloom.

But let us return from this digression to the task at hand: identifying promising technologies. Fido looks like it will be a useful addition to deminers' toolboxes someday, as the basic technology is sound and operable. Mr. Sikes foresees an area-reduction role for Fido, declaring, "That's the great thing about this system: it can tell you where the mines are not, so farmers can get back to work...." and other redevelopment projects can get started. Further development (as permitted by funding) will lead to smaller, harder and more sensitive rendition of the device. Nomadics is currently designing standard handheld detectors using their technology, but that's not all they are planning. Fido happens to be just the kind of sensor device needed by two other developing technologies: remote explosive detection and robotic