October 2003

Vegetation Clearance Equipment: Huge Potential in Productivity Improvement

Nathan Kunz

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Vegetation Clearance Equipment: Huge Potential in Productivity Improvement

Upon development of its D-1 vegetation clearance vehicle, DIGGER DTR (Demining Technologies) has successfully responded to many of the demands of the demining community. The second generation, the D-2, will feature several new upgrades and is expected to appear on the market by 2005.

by Nathan Kunz, DIGGER DTR

The Company

DIGGER DTR, a Swiss humanitarian non-profit organization with a mine clearance background in Croatia and Cambodia, has been active in the design of demining assistance tools since 1998. Its aim is to assist mine clearance personnel by developing tools to secure and accelerate mine clearance activities.

DIGGER DTR is based in Tavannes, Switzerland, an area known for its expertise in the machinery industry. Two mechanical engineers and three electronic engineers compose the design team. Ten persons with different technical backgrounds handle production, while several more deal with the administrative and organizational tasks. Most of this highly motivated team are volunteer workers, which allows DIGGER DTR to provide cost-effective solutions to the humanitarian demining world.

The development of this organization has been financed by private donors and sponsors. Partnerships with the Swiss Foundation for Mine Action (FSO), the Swiss Army, and two universities of applied science have helped DIGGER DTR during the development of the D-1, its first vegetation clearance vehicle.

The D-1 Concept

Our current product, the D-1, is a lightweight, remote-controlled vegetation clearance vehicle for mine clearance assistance (MCA) work. Deminers in the field stressed the need for this kind of machine. The following extract of a Geneva International Centre for Humanitarian Demining (GICHD) study shows the impact of vegetation clearance in demining: "The view of practitioners in every programme consulted for the purposes of the study reflected the assessment that vegetation clearance is one of the most time-consuming elements of the clearance task. While the time taken to conduct vegetation clearance varies by scenario, it is clear that, overall, improving the speed of vegetation clearance offers a significant increase in overall mine clearance productivity."

DIGGER DTR began with the design of the D-1, based on the following requirements given by the FSO: the vehicle must be:

• Able to cut all kinds of vegetation (up to a 10-cm-diameter trunk).
• Able to withstand the detonation of an AP blast and fragmentation mine, or unexploded shell up to 82 mm in diameter.
• Small and lightweight enough to be transported on a small truck on roads of poor infrastructure.
• Remote-controlled, to guarantee full protection of operating staff.
• Designed and constructed using simple technology, so that repairs are possible with the available means of a developing country.
• Inexpensive to manufacture and run.

According to these requirements, DIGGER DTR began the design of the first prototype, the D-1. One of the biggest challenges for the development team was the use of simple technologies. The use of any high-tech components in the D-1 was banned, which allows the DIGGER DTR vehicles to be easily repaired in the field.

The track design is the best example of this concept. The tracks on the D-1 were developed specifically for this application, because no existing tracks of this dimension offer enough detonation resistance. Moreover, commercial tracks could not be repaired in the field. The tracks that were especially designed for the D-1 offer a good resistance against explosion and can be repaired in the field by simple means.

Another challenge was for the vehicle to maintain a good resistance against fragmentation mines, while limiting the weight. The weight of the machine is a determinant factor for such a vegetation clearance unit. A lightweight vehicle can be carried to almost every minefield, even on poor road infrastructures. A second important factor is that small vehicles do not damage the soil or local environments during the cutting of vegetation. The GICHD study shows that the weight and dimensions of future vegetation clearance equipment will be increasingly important to spare soils: "Some mechanical methods for clearing vegetation can have a detrimental impact on local soil conditions and the wider environment. There is a growing awareness within the mine action community that future demining technologies should take into account not just the clearance requirement itself but the future productive use of contaminated land."

The four tons of the D-1 are less than the weight of an agricultural tractor; therefore, the soil will not be damaged during vegetation clearance. This weight also allows the D-1 to be transported on a small truck, even on poor roads.

Technical Description

The D-1 consists of an armoured, V-shaped hull, which gives it a very good resistance against anti-personnel blasts (APBs) and fragmentation mines. The vegetation cutter fixed to the front (mulcher or flail) allows it to cut trunks up to 10 cm in diameter. The mulcher unit operates at approximately 500 rpm, using 44 adjustable chisels to remove thick vegetation and trees. The minimal cutting height is two cm above ground.

To increase cutting depth, a flail unit has been developed after the first tests in Albania. The rotor operates at 500 rpm, using 62 chains. A hardened steel hammer is attached at the end of each 50-cm-long chain. The cutting depth is mutually adjustable from plus five cm to minus five cm from ground. By cutting the vegetation, the flail removes tripwires and reduces risks for deminers by neutralizing mines.

The hydrostatic transmission is powered by a 2,709-cubed cm Kubota diesel engine (46 kW/62 hp). The vehicle is remote-controlled from behind a protection shield from a distance of 50 m to over 300 m. The average working speed in light vegetation is 2,000 sq m per hour; in dense vegetation and heavy soil, the speed is 600 sq m per hour.

DIGGER D-1 working on the Albania-Kosovo border.
The Swiss army carried out tests of the system's chassis and cutter unit's resistance to explosive blast. Six detonations of 730 g of TNT with fragmentation between 0.84 m and 1.0 m were carried out against the cutter unit. Five detonations of 208 g of TNT were fired beneath the vehicle tracks. No serious damage was reported in any of the cases.

During the summer of 2002, DIGGER DTR tested the prototypes for two months in Albania and Kosovo on real minefields, in partnership with the FSD. The information collected during these tests was used for the D-1 redesign. PM1-1 explosions under the vehicle's tracks caused no damage to the system. The protection shield was tested against fragmentation with a PMA 2A fired at six m. No serious damage was observed.

### Second Generation: The D-2

In 2004, the development team will design the D-2, the second generation of this vegetation clearance vehicle. In order to answer deminers' needs, the use of this machine will be extended to a multi-tool ground preparation vehicle for mine clearance assistance. Its main activity will continue to be vegetation clearance, but it will also manage tasks such as area reduction or spoiling debris with a shovel. Some new specific tools will be designed for the D-2.

The D-2 will be equipped with a more powerful engine (3.500 cubic cm, 51 kW/69 hp), more improvements will be made in the assembling techniques in order to reduce production time and costs.

### Logistics and Infrastructure

International transportation can be really accomplished in a 26-h container, which can also be optionally equipped as a field workshop. In small dimensions and weight, the D-2 can be carried by a small track or a trailer. DIGGER DTR can provide the specific recovery equipment necessary to pull the D-2 out of a minefield in case of serious damage.

### Selling Strategy

The D-2 will be available for sale in 2005. As a humanitarian and non-profit organization, DIGGER DTR's goal is to make the D-2 affordable to as many demining organizations as possible, so that the safety of the deminers can be improved and global mine clearance productivity can be increased. Due to the D-2 selling price being fixed as the costs, as well as the significant voluntary development work involved, DIGGER DTR is able to sell this vehicle at a very attractive price (165,000 CHF).

Table 1: D-2 Technical Data.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length without attachment</td>
<td>3.500 mm</td>
</tr>
<tr>
<td>Vehicle width</td>
<td>1.360 mm</td>
</tr>
<tr>
<td>Width with attachment</td>
<td>1.600 mm</td>
</tr>
<tr>
<td>Working width</td>
<td>1.600 mm</td>
</tr>
<tr>
<td>Overall height</td>
<td>1.640 mm</td>
</tr>
<tr>
<td>Max weight with attachment</td>
<td>3.500 kg</td>
</tr>
<tr>
<td>Speed range</td>
<td>0–10 km/h</td>
</tr>
<tr>
<td>Engine</td>
<td>3.300 cubic cm (Kubota diesel (67 hp net))</td>
</tr>
</tbody>
</table>

The Information Management System for Mine Action (IMSMAM) V3.0 was released June 2003, and early experience with the system has been positive. Salient features are summarized, including geographic information system (GIS) capabilities based on ArcView GIS.

### Introduction

Information technology (IT) is a support function within the bigger world of humanitarian mine action. IT managers strive to turn data into information and information into knowledge so we can find better mine action solutions. This expedites the following:

- Safe demining
- Impact, technical, and completion surveys
- Quality control and assurance
- Mine risk education (MRE)
- Reliable, secure communications
- Training

Mine action is always evolving, which the terms reflect. Humanitarian demining fees focused on the physical removal of mines worldwide, good programs are now in place doing this. As managers shift attention to education and efficiency, information system people have a bigger job to do. The first job of a management information system (MIS) is to support Operations (Ops)—not create "data processing" capability, resulting in the well-known problem of "a lot of data but no information." The IT team should also support headquarters administration, donor reports and interagency liaison as well as give 24/7 support to decision makers through timely and accurate information and analysis. So they need a good information system.

Information systems for mine action must be simple, economic, secure and stable. The system must be locally maintainable while following international IT standards and focus on the "shovel edge"—not the "blinding edge"—of technology. GIS and data export-import capabilities are essential. The system should support local languages and share information in UN languages, with full acceptance by the international mine action diaspora. Moreover, software should be easy to use and able to run on standard computers.†

The system meeting these criteria is IMSMA. Developed at the Swiss Federal Institute of Technology in Zurich (ETHZ) with leadership by the Geneva International Center for Humanitarian Demining (GICHD), No mine action center (MAC) should operate without IMSMA.

### IMSMA Background

The Swiss Ministry of Defense, through the Center for Security Studies and Conflict Research at ETHZ, sponsored the development of IMSMA as part of Switzerland's commitment to humanitarian demining. The software development team engineered IMSMA as a highly-customized Microsoft Access database; any group using small-office PCs could use the system. In 1999, the UN Mine Action Service (UNMAS) declared IMSMA its standard mine information database. The GICHD, founded in 1998, began training and implementation as a partner with ETHZ. Using ArcView software, ETHZ developed IMSMA GIS, a custom version of ArcView optimized for mine action. GIS allowed presentation and analysis of mine action information (vector data) on maps and imagery (raster data). UNMAS and the U.S. government began encouraging use of IMSMA. IMSMA V2, developed and distributed from 2000 to 2002, added a tank tool and improved the GIS engine. ETHZ's development team was recognized by the Environmental Systems Research Institute (ESRI) for innovations in GIS work.

Use of IMSMA by MACs accelerated. The U.S. Department of State and Department of Defense accepted it as their reference standard for training the extensive Demining Support System (DSS). ESRI worked with the GICHD to provide ArcView 3.2a to mine action programs, giving many less-developed countries their first GIS. Nicaragua and Afghanistan pioneered IMSMA use.\(^2\) During 2002 and 2003, with at least 26 mine action programs running the IMSMA GIS, the GICHD assumed responsibility for training and implementation support. ETHZ developers began work on the IMSMA GIS and the "bleeding edge"—of markup language (XML) technology. This will be an exciting and positive development.

### ArcView and IMSMA GIS

ArcView, developed by ESRI in Redlands, California, is a well-known desktop GIS tool worldwide by planning agencies, universities, corporations and anyone needing accurate geographic data. It has powerful tools for querying spatial data.

ArcView GIS does not require specific skills for basic use, although it does take training to become proficient. People experienced with graphics software (e.g.,

<table>
<thead>
<tr>
<th><strong>IMSMAM V3.0: Experiences From the &quot;IMSMAM Diaspora&quot;</strong></th>
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