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Future Developments Trends in Mechanical-demining Technology

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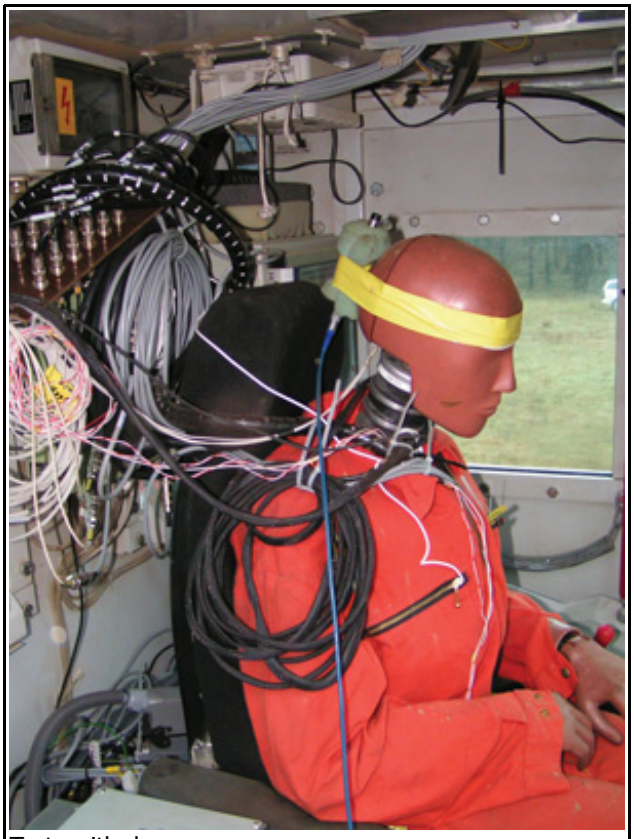
The authors argue that there is a need to turn toward cheaper and more effective mechanical demining. The future of demining technology is very important for countries with landmine-clearance needs.



Tests with dummy.
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In 2005, Richard G. Kidd, then Director of the Office of Weapons Removal and Abatement in the U.S. Department of State's Bureau of Political-Military Affairs, reported in his speech "Perspectives on Global Policies to End the Landmine Crisis": "The most significant factor limiting the future impact of the Ottawa Convention is not one of policy but one of economics. … And while the money will not be there to make the world 'mine free,' the funds, commitment and insight already exist to make it 'mine safe.' We can remove the most pressing impacts of landmines within years, and then redirect those funds to other areas and other causes where they will do more to save lives and promote reconstruction."[1]

The United Nations, the Geneva International Centre for Humanitarian Demining and various international governments and ministries report that the global landmine problem has been considerably reduced and the number of new victims has fallen each year. This success can be attributed in part to the Ottawa Convention, which requires signatories to stop using anti-personnel mines and to mark and remove landmines under their jurisdiction. The United States, though not a signatory to the Convention, was one of the first to enact a landmine export moratorium in 1992; other countries have since followed suit. Consequently, the global trade of AP mines has come to a halt.

Furthermore, the number of demining machines available for clearance has progressively increased throughout the years, and quality assurance to release cleared land has been simplified. Better landmine removal training, more teams conducting explosive ordnance removal and more mine-risk education conducted have also led to a reduction in the number of new landmine victims.

Thus far, donors have supported all of these demining efforts. Unfortunately, with the annual number of landmine incidents steadily decreasing, it is likely that other humanitarian issues, such as food security, HIV, malaria, natural disasters and environmental pollution, will continue to compete for priority in the minds of donors, which could reduce funding for mine action.

Changes Required in Demining Technology


Tests with operator.

We believe a number of changes need to be made to the current spectrum of demining technologies. In particular, with regard to demining machinery, the following topics should be considered.

Variety of mechanical demining machines. There are too many different types of mechanical demining machines currently on the market, with sizes ranging from five to 55 tons. They can be the wheel or crawler type and function with or without an operator. In addition, machines are available with multi-tool applications as shown in the GICHD *Mechanical Demining Equipment Catalogue 2010*.[2] Neither a specific system nor a specific configuration is dominating the market. Rather, despite enormous international, technical and commercial efforts, many machines have never left the prototype status or have not proven to be successful in the market. Testing more than 50 different types of machines, with variations in size, weight, demining technology and operation types (i.e., onboard-driver or remote-control operated), will lead to excessive purchasing and operation costs. This scenario is typical for the research phase if insufficient basic knowledge about the machines and the demining context is available, because there is no standard data set, and funds have to be set aside to test the machines every time, which is a waste of resources.

Optimizing cost-effectiveness of mechanical-demining machines. The international symposium "Humanitarian Demining – Mechanical Demining" in Šibenik, Republic of Croatia (24–27 April 2007), included the demonstration of different types of machines. The program committee summarized the results as follows:

Tillers are preferable for some conditions and threats, but flails are preferable for other conditions.

- Machine operators exhibit a large influence on the performance of machines.
- Change in management thinking and planning is required in order to avoid the purchase of machines that are not necessary.
- The management and costs required to transport big machines nationally and internationally contrast with the efficient and cheap transport of smaller machines, which require a separate guiding vehicle.[3]


Open tiller design

Size of demining machine with operator. Analytical examination of global activities with different types of mechanical demining machines and results from the test centers at the Croatian Mine Action Centre, International Test and Evaluation Program for Humanitarian Demining, Swedish Explosive Ordnance Disposal and Demining Centre, and the Swiss, British and German Armies have resulted in an optimum specification for demining machines.

Tests with and without dummies, with and without flail and tiller equipment and a very detailed measurement of actual loads on the human body lead to a machine with a total weight of 15 to 20 tons (13,607 to 18,143 kilograms).[4] Experience gained by deminers in field deployment with flail and tiller operation in different soil and vegetation conditions leads to an engine power of 250 to 400 horsepower. In addition, tests with anti-tank mines demonstrated that a distance between the AT detonation and the driver cabin has to be at least four meters (13 feet).

Machines should not only meet optimum specifications but be fitted with a range of mine-clearing tools as well. The

"toolbox concept" outlines the idea that machines could be fitted with a number of different attachments so they are able to deal with a wider variety of mine threats. The benefit of this type of machine is that it would be equipped to perform development and/or livelihood operations after demining ceases. These operations include farming, forestry, the building industry and a number of other possibilities.

In summarizing the different key requirements, we came to the following specifications that will lead to dramatic cost reductions in the machine's operation, maintenance, repair and transport. Proposed specifications for both tracked and wheeled vehicles using the toolbox system include:

- Total weight of vehicle with tiller or flail: 15–20 tons
- Engine power: 200–300 kilowatts (250–400 HP)
- Safety distance between detonation (flail/tiller) and cabin: four meters (4.4 yards)
- Direct-driver operated
- Includes both flail and tiller options
- Open tiller design
- Container transport


Wheeled tractor model

Tracked or a wheeled-type vehicle? Our knowledge base of 10 years in demining technology informs the summary found in Table 1, and takes into account 10 key points including safety, cost and comparisons of the medium crawler, medium tractor, and the light crawler with remote control, as found in the GICHD catalogue.[2]

As demonstrated, the crawler machine is the best in terms of demining performance and effectiveness, but the tractor-based demining machine with flail and tiller unit is by far the most cost-effective arrangement. Tractors with operators do not require a logistical support vehicle and/or a system for remote-control operation.

Powerful tractors up to 400 HP (e.g., John Deere, New Holland, Claas, Valtra, Case, Fendt, Belarus), are available globally. Such tractors could be modified into demining tractors locally, wherever expert support is available. Modifications of off-the-shelf tractors have already been demonstrated by Pearson, Armtrac and the U.S. Department of Defense's Humanitarian Demining Research and Development Night Vision and Electronic Sensors Directorate's Rapid Area Preparation Tool. Protected tractors are currently the standard equipment for most nongovernmental demining organizations such as the HALO Trust and MAG (Mines Advisory Group).

All modifications in line with our proposed specifications have been used during extensive test programs on existing machines as noted above and in other test situations, including the open tiller technology, protected cabin and protection of the basic machine. The proposed changes are modifications to existing machines and do not require additional costly tests.

Multi-function system. A multi-function tractor-based system is more cost-effective, less complicated, and easier to handle and maintain than a special machine. In addition international tractor companies offer a globally available supply of spare parts with fast shipping. This system can be used for:

- Mine clearance
- Survey, reconnaissance
- Quality assurance
- Transportation
- Cultivation, farming, vegetation cutting
- Reconstruction and development
- Obstacle removal
- Airfield clearance, bomblets
- Pioneer vehicle for military use
- Vehicle for multi-sensor technology

Conclusion

We propose that a driver-operated, tractor-based toolbox-system containing both the flail and tiller is more cost-

effective than purchasing and using multiple pieces of equipment to effect the same results. Investment and operational costs might be reduced by at least 50 percent. Operating more cost-effective machines helps to ensure that demining activities can and will continue. These machines are also versatile and allow for multiple uses, which will greatly benefit many developing mine-affected countries by first reducing the landmine threat and later providing countries with a means of development following clearance completion. The future of mechanical-demining technology is very promising since the machines will be more cost-effective and efficient, which will allow demining efforts to continue without diverting funding from other important issues.

Biographies

Heinz Rath is the owner of STS Safety Technology Systems, inventor of the MineWolf Toolbox concept and founder of MineWolf Systems AG. In 1997, Rath retired as International Director for Research and Quality at Lucas Automotive. He is the former Chairman of the supervisory board of MineWolf Systems and now serves as Engineering and Consultant Manager for MineWolf Systems. Rath is also the recipient of the *Bundesverdienstkreuz*, the highest award from the Federal Republic of Germany.

Dieter Schröder, Chief Engineer at STS Safety Technology Systems, was formerly Engineering Manager at TRW Automotive Holding Corporation, having supported Heinz Rath in all aspects of engineering and quality. Schröder retired from TRW in 1995.

Raymond Alain Twiesselmann studied political science at the University of Cologne, graduating in 2007 with an emphasis in the influence of Islam on the politics of Islamic countries. Later, he worked for a newspaper and in the *Staatskanzlei* of Rhineland-Palatine. He is responsible for public relations at STS Safety Technology Systems, an engineering and consulting firm.

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