

HUMANITARIAN DEMINING

PREPARED FOR THE GOVERNMENT OF CANADA



Assessment of the
International Market for
Humanitarian Demining
Equipment and
Technology



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TERMS OF REFERENCE

The Government of Canada undertook the following study as part of its commitment to implementing the Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-personnel Mines and on Their Destruction (the Ottawa Convention). In March 2001, the Government of Canada identified a requirement for a market study of a limited number of Canadian technologies related to humanitarian mine action, including victim assistance and mine clearance. The government identified nine different technologies at varying stages of market penetrations, and which are under consideration for possible government support.

These technologies, referred to herein as Capability Areas, include:

- Aerial Sensor Arrays
- Data Fusion
- Render Safe Mines and UXO
- Personal Protective Equipment
- Prodders and Probes
- Prosthetics
- Shallow Water Detection
- Testing and Evaluation Equipment
- Vegetation Clearance

The Departments of Foreign Affairs, National Defence, CIDA, and Industry Canada are working together under the auspices of the Canadian Centre for Mine Action Technologies (CCMAT) to promote the development, commercialization, and marketing of appropriate technologies that will have an impact on the humanitarian crisis caused by millions of anti-personnel landmines and unexploded ordinance (UXO) worldwide.

GPC International (GPC) was engaged by the CCMAT team to research and conduct a study on the international market for humanitarian demining equipment and technologies, with a specific focus on the nine capability areas above.

This Assessment of the Market for Humanitarian Demining Equipment and Technologies is broken down into five parts:

- **Section 1 – Introduction**
- **Section 2 – Demand for Equipment & Technology**, includes a review of the need for demining, how it takes place, the role of

technology in the process, and an examination of gaps in current technology.

- **Section 3 – Supply of Equipment & Technology**, starts with the characteristics of supply, then an analysis of the types of equipment and technology currently available and being developed, including a discussion of dual-use technology. The section concludes with an analysis of the role of supply in the market, particularly as a form of competition.
- **Section 4 – The Market for Equipment & Technology**, includes the size of the current and future market, an analysis of how it operates, and an outline of some of the factors that affect adoption of certain technologies over others.
- **Section 5 – Conclusions**

It should be noted that GPC did not provide a technical assessment of the capabilities of any of the equipment or technologies referenced herein, nor did we examine the business fundamentals of any companies or specific products to assess their chances of success in the market.

This report includes commentary on the key capability areas, and an assessment of market attitudes toward these areas.

Finally, for a study such as this to be useful requires a certain amount of generalization about market factors and characteristics. In a market as fragmented and scenario-driven as the international humanitarian mine action market, this is a difficult undertaking. Where authors have made general assertions therefore, these are based on the preponderance of information and are not intended to imply that this is infallibly the case.

METHODOLOGY

To initiate the project, GPC representatives met with the CCMAT team to gain an initial understanding of humanitarian demining operations and Canada's role.

This was followed by a literature review, which provided much of the foundation for the rest of the project, including the development of questionnaires for interviews.

GPC conducted interviews with key members of the humanitarian demining community. These included approximately:

- Eight Canadian manufacturers of humanitarian mine action equipment & technology;



- Twelve Canadian government officials engaged in mine action;
- Five non-governmental organizations involved in mine action;
- Six representatives from the UN and other mine action international organizations;
- Seven government officials from Donor countries;
- Five representatives of recipient countries;
- Two commercial demining companies; and
- Three representatives from Mine Action Centres.

Interviews, conducted by phone and in person, form the core element of the research for this study. Anecdotal evidence is used throughout the report to support the analysis.

GPC worked closely with the CCMAT team throughout the project to ensure mutual understanding of the appropriate direction for the study.

KEY DEFINITIONS

The authors of this study have decided for the sake of clarity to use definitions current in the field of humanitarian demining. The Geneva International Centre for Humanitarian Demining (GICHD) has been developing the Mine action equipment: Study of global operational needs, which is soon to be released. This study will be an important contribution to understanding the role of technology in humanitarian demining. Working from a draft version of the study, GPC has adopted their definitions of some key terms, as reproduced below.

“The terms ‘mine action’ and ‘humanitarian demining’ are both used in this report. The distinction is important.

- **Humanitarian demining** refers to those functions, activities and tasks, which, together, result in the survey, marking and clearance of contaminated land, and the return of safe land to communities.
- **Mine action** describes all those capabilities including humanitarian demining, stockpile destruction, mine awareness, victim assistance and advocacy which, together, aim to reduce the wider socio-economic impact of landmine contamination.

The study defines the terms ‘equipment’ and ‘technology’ as follows:

- **Equipment** refers to assemblies and sub-assemblies that have been fully developed and evaluated, and are available off-the-shelf without significant modification or changes.
- **Technologies** require further development or demonstration before it is ready for production.”



2. THE DEMAND FOR EQUIPMENT & TECHNOLOGY

This section focuses on assessing the demand for humanitarian demining equipment and technology. This involves:

- Establishing the need for humanitarian demining;
- Outlining how demining takes place; and
- Assessing the role of technology in this process, including issues and concerns about its use.

This leads to a discussion of gaps in existing equipment and technology as well as conclusions about the demand for existing equipment, incremental improvements, and radical advances in technology.

THE NEED FOR DEMINING

DISTRIBUTION OF MINES

“Some 60 countries, especially in the developing world, are currently affected to a greater or lesser degree by landmines and other explosive remnants of war”

[A Study of Socio-Economic Approaches to Mine Action](#)
UNDP, 2001

An assessment of the number and nature of mines currently in the ground is necessarily driven by best guesses on the part of those concerned, such as demining NGOs and the United Nations Mine Action Service, as surveys of all mine-affected countries have not yet been conducted.

The lack of completed surveys in all mine-affected countries has not prevented people from attempting to quantify the problem. Estimates range from 110 million mines in the ground (International Campaign to Ban Landmines) to 60 million (U.S. State Department), which may or may not include anti-tank mines. Estimates are further complicated by the question of unexploded ordnance (UXO). Some organizations include UXO as part of the clearance problem, while others concentrate on landmines alone.

“UXO is much more important than landmines – sometimes ten times the size of a problem.”

Dr. Vernon Joynt, Mechem

The quantity of UXO can greatly magnify a clearance problem. It is estimated that the failure rate among conventional munitions is generally around ten per cent. In some parts of the world, the Balkans for example, this can mean that UXO can outrank landmines as a threat to civilians. UXO such as sub-munitions from cluster bombs and artillery can be extremely sensitive to pressure, and cause similar problems as mines.

IMPACT OF MINE CONTAMINATION

Much has been written about the need for humanitarian demining. For the purposes of this study, we take it as read that there is indeed a current problem caused by the presence of anti-personnel mines and unexploded ordnance that is afflicting millions of people around the world. There are differing opinions regarding the number of countries affected by landmines. The International Campaign to Ban Landmines (ICBL), for

“The cost to a nation is a good part of its future. Previously healthy human beings are now permanently maimed and unable to lead productive lives. They must resort to charity to survive and represent a permanent drain on the future wealth of the country. Further, land now infested with mines lays fallow instead of being available for production by resettled or displaced persons wishing to return and start their lives again in their homeland.”

Sustainable Humanitarian demining: trends techniques and technologies. George Focsaneau,

example, estimates that there are eighty-eight mine-affected states in the world, while the UN Development Project suggests that 60 countries are affected. Either way, it is well documented that these mines affect people directly by killing and maiming civilians, and indirectly by removing infrastructure and agricultural land from productive use, crippling socio-economic recovery. For instance, in Iraqi Kurdistan, the presence of landmines has cut in half the viable agricultural land.

As highlighted in the recently released UNDP Study of Socio-Economic Approaches to Mine Action, “The widespread use of landmines and / or the presence of unexploded ordinance (UXO) typically results in prolonged and acute social, economic and environmental harm extending far beyond the localized human suffering commonly inflicted by other conventional weapons.”

PRIORITY SETTING

While the size of the mine/UXO problem is uncertain, one thing is clear: few people in the demining community currently believe it is practical to remove all mines and UXO.

GPC’s research shows a near unanimity of opinion that the remaining mine/UXO problem must be prioritized, so that those minefields or areas of UXO that are causing the most difficulties to local populations are dealt with first. This pragmatism is driven by a number of factors, including concerns about the sustainability of long-term funding. The issue of “donor fatigue” is addressed at greater length in the Market Section of this report.

The effort to prioritize mine action activities is obviously fraught with difficulty, as definitions of “priority” may vary from organization to organization and from country to country. These different definitions are then applied to a base problem of an uncertain number of mines.

The United Nations Development Program has attempted to bring a common understanding to prioritization questions with its recent, Study of Socio-Economic Approaches to Mine Action. The Study is an important contribution to mine action, as a first step in improving closer co-ordination with development initiatives and providing transparent indicators to assist in priority setting.

Priorities in specific fields of operations are often set by Mine Action Centres (MACs), whose primary role is coordinating of mine action activities in a given region or country. These MACs identify the most pressing needs (based in part on survey data) and develop programs to meet those needs. The role of MACs in the market for humanitarian demining equipment and technology is discussed throughout this report.

RATE OF DEMINING

The number of mines remaining to be dealt with at any given point in the future depends on how quickly mines are being removed from the ground. Needless to say, the rate at which new mines are laid is also a relevant fact in the equation. The study does not deal with that issue, but rather focuses on the lifespan of humanitarian demining more broadly.

Most estimates from reputable sources, such as demining NGOs of long-standing or donor governments, seem to suggest that humanitarian demining could continue at the same scale for up to ten years.

The timeframe issue is also being pushed by requirements in the Mine Ban Treaty that all States Parties are required to meet, such as stockpile destruction and mine removal obligations.

“In respect to mine clearance a longer timeframe than the short-to-medium may not be relevant. The time during which landmines will be considered as a humanitarian crisis, with the accompanying government and donor interest, is probably finite ... While the worldwide landmine problem may remain with us for decades, the current crisis will not.”

The use of mechanical means for humanitarian demining operations – Handicap International report, May 2000

Representatives of the ICBL indicated that assuming current levels of funding and clearance, most priority areas in the world could be dealt with by 2010. This is also the U.S. government’s target. At current clearance rates of approximately 100,000 mines per year (according to ICBL figures), that would result in the removal of close to 1 million landmines from priority clearance areas. As mentioned earlier, there are a number of different views regarding how priority areas are defined and whether the 2010 deadline is realistic.

Regardless of these differences, it is fair to say that there is a sense of urgency in the demining community about the need to tackle the remaining problem. A general concern is that funding to continue demining will diminish as priority areas are cleared. This suggests that long term research and development projects for the purposes of humanitarian demining may not come to fruition in time to secure a place in the market.

HOW HUMANITARIAN DEMINING TAKES PLACE

THE PLAYERS

There are a number of different organizations actively engaged in humanitarian demining around the world. However, there are four that most affect the demand for humanitarian demining equipment and technology. Donor countries are addressed in the next section as drivers of supply.

NGOs

Non-Governmental Organizations are key players in the provision of humanitarian demining and mine action services. They have been



fundamental to this initiative since it began and were an essential element in the drive to establish the Ottawa Convention.

NGOs have been established around the world to respond to the landmine crisis, including in mine-affected countries such as the Balkan states. The mandates of these NGOs differ in some respects. Some are more focused on pure clearance, while others have a more developmental approach. These different mandates can affect their receptivity to the use of particular technologies or items of equipment. The authors of this study consulted various humanitarian demining NGOs. The largest and most influential of these are:

- Handicap International (HI);
- Norwegian Peoples Aid (NPA);
- Hazardous Areas Life-support Organization (HALO Trust); and
- Mines Advisory Group (MAG).

NGOs are direct users of the equipment and technologies and as such influence the demand for specific pieces of equipment. According to NPA, “limited and irregular purchasing power” contributes to their interest in “safer, cheaper, faster” incremental improvements to existing equipment. This tends to be broadly representative across the NGO community.

Companies

Most of the new players are commercial companies. Names such as Danex, Bac-Tec., ABC, ECC, and DeDeComp join the familiar oldies such as Bombs Away, Gerbera, RONCO, MineTech, and Mechem. With the massive funding available for work in the former Yugoslavia, European groups from equipment suppliers to Explosive Ordnance Disposal (EOD) companies are keen to get involved, and new allegiances and companies arise weekly.

Journal of Humanitarian Demining,
Andy Smith, 1998

Commercial companies are another major provider of demining (mine clearance) services. These companies, like any other commercial entity, are driven primarily by profit.

Companies bid on projects that are being let by donor countries, Mine Action Centres and other donor organizations, such as the Slovenia International Trust Fund (ITF).

Depending on the nature of the funding mechanism, companies may not compete directly with NGOs for demining contracts. For example, the ITF indicated that while it tenders most of its projects, it does not open the same projects to both NGOs and companies. Depending on the conditions in the country, the ITF decides which type of player will be eligible to bid on the work and lets the tender accordingly.

Some companies are particularly prominent players in humanitarian mine action. The U.S. State Department funnels its entire bilateral budget through a demining company called RONCO. The company is the State Department’s “interlocutor” for mine action around the world. When the U.S. government identifies projects it wants to fund, RONCO is engaged to implement the statement of work, either directly or by

subcontracting for services. The exception is the Balkans programs, which are run through the Slovenian International Trust Fund.

Many of the larger companies already have stockpiles of equipment. Mechem (which has just recently been integrated into the Government of South African) is considered by some to be the best demining technology company in the world. This is partly due to the fact that Mechem's development of new technology is directly informed by their field experience. Mechem develops much of its own equipment, however, Dr. Vernon Joynt of Mechem says the company is not opposed to acquiring equipment from other sources.

Both the role companies play and the business focus of their operations make them important players in influencing demand for humanitarian demining equipment and technology.

Militaries

Militaries are another important participant in this process, although there appears to be reluctance among a number of countries involved in humanitarian demining to engage them.

Militaries are responsible for humanitarian demining in many post-conflict scenarios. Virtually, the entire South and Central America humanitarian demining program (as coordinated through the Organization of American States) is carried out by local militaries. The same is true for some parts of Africa and Asia.

Many respondents felt that local militaries would continue to take an increasingly large role in humanitarian demining. They point out that engaging militaries to perform this task serves a number of useful goals, including engaging soldiers that would otherwise be unemployed.

This potential role could give militaries a more significant influence on the demand for equipment and technologies. It may also give more of an edge to equipment designed to be used for both military and humanitarian demining.

Mine Action Centres (MACs)

A MAC's primary responsibility is to coordinate mine action in a given region. This process often includes setting priorities for what needs to be cleared, when, and how. While MACs do not procure equipment for these projects, they often specify the tasks that need to be accomplished by equipment in a given project, thereby influencing demand in that area.

Many representatives of MACs that were interviewed indicated they were responsible for certifying which type of equipment could be used in

their field of operation. Admittedly, not all MAC's have the resources to fill this task. Nonetheless, this indirectly influences demand.

Finally, MACs are often called upon by companies to test and evaluate prototype technologies. This process leads to increased awareness of new products as they become available and, where information is shared, allows others to assess technologies in a given environment.

THE PROCESS

"At present, humanitarian demining in most affected areas begins with a UN-led emergency response, which is controlled by ex-pats, who usually have a military background and who are largely paid for by "ear-marked" donations from UN countries. Those donations sometimes take the form of staff and goods.

At the same time, as the UN arrives (and sometimes before), the specialist charitably funded [NGOs], which are funded by an individual government's aid budget or by trusts and donor charities, tend to move into the area.

Following the charitable groups come the commercial companies."

Andy Smith, Journal of Humanitarian Demining, 1998

Despite the best intentions of the individuals and organizations involved, humanitarian demining tends to occur in a haphazard manner, with little international coordination.

As can be seen in the accompanying quote by Andy Smith, when an emergency response is required, all of the players (including militaries where applicable) flood to the region. Even when a MAC is established, in some cases not all groups operating in the area are required to coordinate their activities through the Centre.

One of the results of this lack of coordination is that there tends not to be a clear expression of demand for equipment and technologies to meet the requirements of given fields of operation. Different groups may have similar needs, but will often seek to acquire their own technology rather than working together with common equipment.

This means that in some cases, the best equipment for the job doesn't get used because demining groups weren't aware of it, didn't have the time to test it, or didn't have the means to acquire it.

"When we bought equipment for work in Kosovo, we had to deploy very quickly, so we chose equipment that was already being used there by other organizations, that was proven to work. Ideally, if we had time, we would ask prospective suppliers to trial their equipment in the particular area we were working in."

CIDC spokesperson

THE ROLE OF TECHNOLOGY IN DEMINING

"The requirement for demining technologies is quite urgent, because current methods are slow and dangerous. Currently, it'll take decades to clear mines. Technology seems to be the only real way to improve the situation."

Al Carruthers, Defence Research and Development Canada.

Technology has always been a critical element in demining, but until recently that technology had changed very little from the basics developed and refined fifty years ago:

- A metal detector to find the mines,
- A prodder to enable a deminer to accurately define and identify the mine, and
- An explosive to destroy it.



The perception that time is running out for mine action is a major factor that contributes to a significant demand for demining equipment that can increase the speed at which deminers can work. It is estimated, for instance, that vegetation clearance can take up to 65-70% of the humanitarian demining process. The use of vegetation clearance machines in Cambodia has increased the speed of this activity by a factor of 3-4 times. As such, it is clear that there is a demand for existing equipment to be made more available in the field as well as new efficient technologies that can be quickly brought to market.

SCENARIO-DEPENDENCE

The demand for humanitarian demining equipment and technology is heavily affected by the specifics of the situation in which demining is taking place. This can encompass physical, socio-economic, and political factors. Each field of operations is unique, which materially affects the demand for equipment and technologies.

Impact of Geography & Climate

A phrase often heard from interviewees is that most mine action technology is “scenario dependent”. This refers to variances of physical characteristics (such as topography, terrain, local vegetation types, and climate) that limit the applicability of technologies across different operational scenarios.

Depending on the mineral content of the soil, the reliability of mine detectors can fluctuate wildly, as some heavily mineralized soils can confuse the readings. However, detectors that are more likely to make mistakes in heavily mineralized soil may be better at detecting minimum metal content mines in another environment.

Brush-cutters can vary in efficacy depending on the type of brush encountered. A mini-flail may be extremely effective at moving through low grasses and shrubs, but may be defeated by thicker jungle brush.

Protective gear is only effective if it is worn, and deminers working in hot and humid conditions will not be able to wear heavy protective clothing without taking frequent breaks, or leaving themselves open to the possibilities of heat stroke. For example, protective clothing supplied to deminers in Afghanistan sat unused because it was too hot to wear.

There are as many examples of scenario-dependence as there are scenarios. The consequence of this is a need for different equipment in different situations and a greater demand for multi-purpose adaptable technologies.

“It is almost self-evident that mine detection methods and requirements will vary significantly over such diverse terrain as grassland, mountains, paddy fields and deserts. This diversity requires innovative equipment solutions that take into account wide variations in operational setting ... Climatic conditions & fluctuations can have a profound effect on the conduct of demining related activities. For example, in South Eastern Europe, demining stops during the winter season because the cold has rendered the ground too hard for prodding or the safe excavation of buried mines and UXO.” (sic)

Mine action equipment: Study of global operational needs
GICHD - March 2001

Toolbox Approach

A favourite catch phrase of the humanitarian demining community is the “tool-box approach”. This means that there is no one piece of equipment, system, or practice that can accomplish everything deminers need, so they will assemble a variety of “tools” for a given job.

This, in part, is what leads many demining organizations to seek incremental improvements to existing technology, thereby allowing them to better fill out their “tool-box”. The notable caveat highlighted by many respondents was that the benefit gained must exceed the cost of the new piece of equipment.

“A custom designed demining machine to meet all demining requirements could be as simple as an armoured tractor, with mobility enhancements, with the modular capability to employ a tool to meet every other function required for demining.”

The use of mechanical means for humanitarian demining
Handicap International, May 2000

To further accommodate this reality, some developers are responding by providing multi-purpose technology. In effect, rather than providing a simple “tool” for the deminer’s “tool-box”, they are trying to supply entire sections of a tool-box, rather like a Swiss army knife. Such machines are already being field tested, such as the Pearson Survivable Demining Tractor and Tools. This British machine is a basic tractor chassis with various attachments for brush cutting, demining, and tree extraction. According to Handicap International such machines are the wave of the future. It should be noted that these multi-purpose machines do not replace the toolbox approach, rather they are important additions to the toolbox of humanitarian demining equipment and technology.

CAPABILITY AREAS

Within the ambit of humanitarian mine action, there are various broadly defined tasks that can be accomplished. These are generally referred to as capability areas. Some of these capability areas are particularly receptive to improvement by the introduction of appropriate technology. The following are some descriptive examples.

Aerial Sensor Arrays

There is a lot of interest in the humanitarian demining field to discover a technology that would quickly and clearly delineate mined areas. Deminers are unanimous in their desire to have their teams spend less time working in areas that turn out to be mine-free. The problem has been that technologies in this area have not so far been successful in coming up with sensors or combinations of sensors that will accomplish all the necessary tasks under all conditions.

Data Fusion

Unlike the other capability areas in this study, data fusion is not a product; it is a sub-process of design of a larger product. It’s place in the demining market is to take inputs from different types of sensors and

create from them an enhanced picture of buried objects, so that landmines and UXO can be accurately identified and marked.

Inputs can be from a variety of sensors, such as infra-red, metal detectors, digital cameras, ground penetrating radar, and nuclear sensors. Data fusion can be used with the aerial sensor array mentioned above, or on vehicle mounts. In theory, it also could be used to create what may be the most desired piece of equipment in humanitarian demining, a hand-held mine detector that actually detects mines, not just their metal content.

Rendering Safe Mines and UXO

This heading covers a multitude of different methods of disposing of mines and UXO. These range from massive machines to crush and grind mines, to machines that spin mines in a metal cage causing them to detonate safely, to flares which burn through the casing and explosive components, to explosives which simply blow up the mines or ordnance.

One technological improvement in this area is an explosive that is safer to handle and easier to transport than the traditional alternatives.

Personal Protective Equipment

Personal protective equipment is the term for the combination of suits, boots, helmets and visors intended to shield deminers from the worst effects of a landmine detonation. While not suggesting that any demining organization would knowingly compromise the safety of its deminers, there are always tradeoffs between maximum safety and maximum productivity for deminers, as effective protection can sometimes lead to ineffective demining.

The protective gear can be too restrictive to allow deminers to move freely, it can be too hot, or it can actively impair their abilities to detect mines, in which case it is an open question as to whether it does indeed enhance safety. The challenge for the humanitarian demining market is to develop personal protective equipment which is light enough for deminers to wear with relative comfort, but that will still shield them from the worst effects of blast or fragmentation mines.

Prodders and Probes

Prodders are probably the most basic piece of equipment in a deminer's toolkit. A prodder can be as simple as a piece of wire or a bayonet, or as complex as an instrumented prodder designed to tell the user the nature of the material that the probe has contacted. Some recent designs have also focused on mitigating the effects of accidental detonation by adding blast shields designed to help protect the hand of a deminer.



Prosthetics

One of the unfortunate inevitabilities about landmines is that they create amputees. Typically, civilians who encounter landmines, particularly the blast type, lose one or both feet or legs. Hands and arms can also be lost particularly to the insidious “butterfly mines” which are often picked up by curious children. It is estimated that there are millions of amputees in mine affected countries. Prosthetic limbs, particularly feet, tend to suffer from extensive wear and tear, eventually rendering them useless. A new, more durable and comfortable form of prosthesis could be of great benefit to these victims.

Shallow Water Detection

Mines are sometimes placed in water on purpose, either in tidal zones off beaches or in the shallows of lakes or rivers. They can also simply end up in water through flooding, hurricanes, or erosion. In either case, there is a requirement to find and remove them. The underwater mines not only cause a direct hazard to anyone or anything that comes into contact with them, but mines and UXO can also release toxic substances as they age, creating threats to the environment and human health. Although mine detectors can work underwater, at present, there does not appear to be a product on the market purpose-built to detect and classify these submerged hazards.

Testing and Evaluation Equipment

Testing and evaluation of equipment is gaining an increased focus. The International Testing and Evaluation Program (discussed later in this document) is expected by some observers to have a profound effect on the field, as it is intended to provide unbiased information about the capabilities of equipment and technologies.

As testing becomes more prevalent, devices that can measure the effectiveness of equipment become increasingly important. One such development is the surrogate mine, a mine-like device that can mimic aspects of a real mine, without the attendant dangers of using live mines. However, it is worth noting that there is disagreement in the demining community about the usefulness of such a device.

Vegetation Clearance

Vegetation clearance is simply the act of removing vegetation from suspected mined areas in order to gain easier access to the mines beneath, as well as revealing any tripwires or other above ground triggering devices. Such vegetation can range from grass to mature trees. As noted earlier in this study, deminers working in Cambodia estimate that brush clearance machines improved their productivity by 3-4 times.

While many vegetation clearance machines do exist, there is room for incremental improvement in the field.

CONCERNS REGARDING TECHNOLOGY

Many of those interviewed expressed a number of concerns regarding the development and use of technology. The two most prevalent, cost and impact, are outlined below.

Cost

“The cost of developing the technology may be more than the cost of clearing mines using existing technology.”

Paul Heslop, HALO Trust

Many people involved in humanitarian mine action are ambivalent about the use and development of more mine action technology. While they appreciate the benefits that accrue, particularly in the areas of speed and safety, they cannot help feeling sometimes that if all the R&D money spent on developing new technologies were simply applied to existing methods, then more mines would have been cleared in a shorter time.

It is apparent from the research that it is mostly NGOs who tend to question the cost/benefit balance of technology. The NGOs’ attitudes may be influenced by the fact that they are concerned about dwindling funding available for their operations and see technology R&D as competition for those funds.

On the other hand, developers and their donor government backers believe more firmly that the money being spent on R&D will ultimately pay off in improved mine action efficiency.

These attitudes are important, because they both reflect and shape attitudes in the market. If NGOs resent the spending on R&D, it may make them less receptive to trial and use such equipment.

“It is generally acknowledged that technology will not, at least in the short term, provide significantly improved mine detection and clearance equipment for the user community. Improvements are likely to be evolutionary, with emphasis being given to better understanding the capabilities of existing technology.”

Report of UN Secretary General 1999

Perhaps the last word on the debate as covered in this report should go to a more impartial observer.

“Enormous sums of money continue to pour into high-technology research, while year after year, fieldable equipment fails to materialize. Periodically, a ‘new’ technology is publicized, captures the public imagination and succeeds in securing major funding. This has happened recently with airborne multi-spectral systems, radar and biosensors, none with any real promise of transition to the field in the foreseeable future.”

Colin King, Jane’s website

Socio-Economic Impact of Technology

Receptivity to the use of technology in particular countries may be affected by the place of demining in local economies. As has been remarked, much demining is still performed manually, using relatively simple tools. The people using these tools and performing demining tasks are for the most part locally engaged. Many countries where demining is currently being undertaken either have chronically depressed economies, or their economies have been severely stressed by recent conflict. Under these circumstances, a steady paying job, even an inherently dangerous one, is a desirable commodity.

NGO's, being sensitive to these concerns, may hesitate to introduce mine action technology that will significantly speed up the process, as this could be seen to be jeopardizing local jobs.

The same can be true of the mine-affected countries themselves. Chad is a good example of this thinking. A humanitarian deminer in Chad receives approximately \$300 / month, a salary that allows him to feed his family and resolve many of the social ills he would otherwise be facing. In an interview, a representative from Chad's mine action program indicated that the benefits of gainful employment for locally engaged deminers are a high priority for the program. In fact, this is why they do not invite NGOs to perform mine clearance, rather they ask the NGOs to train and supervise indigenous deminers.

TECHNOLOGY GAPS

While attitudes to the development and use of new mine action technologies vary, there is an almost unanimous opinion that particular new technologies, if they were to be developed, would be adopted with enthusiasm.

MINE DETECTION

The major gap identified by interviewees is for a mine detector that actually detects mines, rather than the current technology, which detects the metallic components of mines. The existing detection technology can be uncertain when it is confronted with highly mineralized soils, soils contaminated with many other metal fragments (such as a battlefield), or mines with a very low metal content.

AREA REDUCTION

A related gap is for a remote sensor that can accurately delineate minefields, so deminers do not waste their time searching for mines where none exist.



CONCLUSIONS ABOUT DEMAND

Despite the reservations expressed about the place of technology in humanitarian demining, there does seem to be a general opinion that technology will play a growing role in mine action.

For that to happen, individual technologies must overcome the skepticism widely prevalent in the user community. Deminers will want technologies only when they have been proven to work, and proven to work either in specific scenarios, or across scenarios.

Demand can be found in the following areas:

EXISTING EQUIPMENT

"In the area of technology, there is a growing acceptance that a more universal application of existing equipment could enable mine action to be conducted more effectively, cheaply, faster and most importantly with less risk."

UNMAS website

There is a constant demand for existing equipment and tools to assist the humanitarian demining effort by making it safer, faster, more reliable, and more cost-effective.

INCREMENTAL IMPROVEMENTS

As with any environment there is also a significant demand for incremental improvements to existing technology. As demining organizations gain experience, they inevitably identify ways to do things better, both in terms of practices and use of technology.

However, an important limitation on this demand is the cost-benefit analysis of the incremental improvement. The issue, as raised by a number of users surveyed, is how the cost of the new / improved piece of equipment compares with the marginal improvement (rate of demining, safety, accuracy) that can be expected by employing it.

RADICAL ADVANCEMENTS

Finally, respondents indicated that there is also a demand for radical advancements in technology in a few key areas (area reduction and close-in mine detection). While the demand for these new technologies is widely held, many interviewees indicated reservations about the amount of money being spent in these areas, relative to the likelihood of anyone producing a useful product in a reasonable time frame.

TRENDS

The duplication of effort in these research projects around the world is another major concern – for users and researchers alike. This will be discussed further in the following section on Supply.

While there are differing views on the amount of money that is spent on research and development, and there are definite problems (as will be seen later) with the communication of users' requirements to developers, the general view is that technology improves the demining process.

Although UNMAS identifies safety as the most important factor, most people interviewed believe it is the sense of urgency generated by the prospect of finite funding that has motivated a greater acceptance of technology in mine action.

This suggests that technology already developed that demonstrates a capacity to help demining teams work more quickly and efficiently has a chance of being used, subject to the constraints of this market. It also suggests that the development of new technology to address humanitarian demining may find itself without a market, unless it can be developed quickly.

3. THE SUPPLY OF EQUIPMENT & TECHNOLOGY

Having established that there is a demand for humanitarian demining equipment and technology, the next major issue in defining the market is to identify the supply.

This section provides an overview of the characteristics of the supply of humanitarian demining equipment and technology. It then provides a brief snapshot of the types of equipment and technology that are available or being developed, including a focus on dual-use technologies. Finally, this section provides some conclusions about the supply of humanitarian demining equipment and technology.

It is important to note that this section does not assess the quality or efficacy of these products, as this would go well beyond the scope of the terms of reference. We have, however, included individuals' views on particular pieces of equipment where relevant.

CHARACTERISTICS OF SUPPLY

There is an abundant supply of humanitarian demining equipment and technology currently available and being developed around the world. The range of explanations for this varies from sincere interest in the initiative to self-interest and profit taking.

Irrespective of motives, the research and analysis for this study identified three principal drivers of the supply of humanitarian demining equipment and technology. These are governments, commercial companies, and NGOs and charitable organizations. The following describes each one and provides some insight into the factors that appear to influence their decision-making processes.

GOVERNMENTS

Historically, there has been a fairly large government investment in humanitarian demining R&D. The ICBL's Landmine Monitor 2000 identifies "more than US\$140 million in funding for R&D on demining technologies and equipment, including US\$40 million in 1999 [alone]." That is probably a conservative estimate, as the ICBL does not believe it has captured the global total in its figures.

Research for this study was unable to uncover more precise figures. In most cases, the representatives from foreign governments that were interviewed either could not or would not give us exact figures for R&D spending.

It does appear however, that the initial mad rush to develop new equipment and technologies for humanitarian demining has begun to lose momentum, particularly as it becomes clear that there is no “silver bullet” that can respond to all demands in every scenario. This recognition is what drove the Dutch government to completely cut its funding to the NOM 2000 R&D initiative – an attempt to develop a “silver bullet” mechanical humanitarian device. Government representatives from the Netherlands indicated that they have withdrawn funding for the program and are focusing all of their resources on providing support for mine action programs, rather than R&D projects.

The ICBL also identifies projects or programs funded by South Africa, Canada, the U.S., Sweden, Germany, and the European Commission.

Factors that Influence Decisions

The processes that countries use to make R&D investment decisions tend not to be strategic when viewed from an international perspective. Each country has a different model that it applies to its decision-making process. The result is an uncoordinated approach to development of new technologies, driven by myriad factors within each country.

“Unfortunately, there is ... substantial duplication of effort and capacity. Among vegetation cutters for example, there are numerous designs offering similar attributes, while basic capability gaps (such as the ability to work on steep slopes, very soft ground or rocky terrain) remain largely unresolved.”

Jane's Mines and Mine Clearance Yearbook 2000-2001, Colin King

Virtually every donor examined – including Canada, the U.S., the EC, the UK, Norway, Germany, France, Japan, and South Africa – identified the desire to create jobs and support national companies as a major factor that influences their financial contributions to R&D. There is nothing surprising about this. In fact, most demining organizations are used to this approach, and as one representative from a major NGO indicated, they “understand this is how the game is played.” The consequence of this approach, however, tends to be substantial duplication of effort and capacity without due consideration to requirements.

Another important factor driving countries to produce competing versions of similar technologies or capacities is the desire to “fly the flag”. As humanitarian demining emerged as a popular and high profile cause, certain governments saw that visible involvement in the cause could bolster national pride and prestige. As a result, national governments invested in the development of large pieces of demining equipment, which were then donated to mine-affected countries.

It is important to note that one of the things that does not tend to influence the decision to invest R&D in a particular technology is the users’ demand. There appears to be a disconnect between field requirements and the equipment in which governments were investing. Not only was this pointed out by many of the field deminers interviewed, but was also admitted to by the governments themselves.

As the Director of CCMAT, Dr. R.D. Suart indicated:

“Market signals don’t get transmitted back [to donors/developers] because the people who use the equipment are not the people who pay for it. And the donors, they often are not seeking the maximum bang for their buck. They are making the donation, somebody else is doing the work, and so you don’t get [the demand for] the most efficient application of funds.”

Notably, this lack of communication goes both ways. A number of those interviewed expressed frustration and disappointment with the test and evaluation process and the lack of information they receive. For example, an ITF representative recounted an experience in Bosnia, where an infrared sensor was tested, but the results were never relayed back to the user groups. This lack of communication breeds skepticism and a sense that users get nothing out of participating in this process.

This disconnect happens despite the fact that the U.S., Canada and the European Commission each have organizations that are responsible for identifying promising technologies and helping develop them for humanitarian demining purposes. In every program of this nature that was identified, the country’s military was actively engaged, if not responsible, for these organizations, and heavily influenced the decision-making process. While there is a significant difference between military and humanitarian demining equipment requirements, it was agreed by most respondents that the defence-related backgrounds of these organizations provided them with the ability to test and evaluate equipment and technologies.

COMMERCIAL COMPANIES

Aside from a few exceptions, commercial companies are the group most directly involved in the development, production, and supply of most humanitarian demining equipment and technology.

Companies in many countries responded positively to the media and government attention surrounding humanitarian demining, particularly after the signing of the Ottawa Convention. This was demonstrated in Canada, where 80 companies responded to a government request for interest, although not all of them were able or ready to supply equipment and/or technology to the humanitarian demining community. While there are undoubtedly some firms merely looking to take commercial advantage of the international focus on mine action, there are also countless companies driven by more humanitarian concerns that are looking to build a better demining tool to help eliminate the crisis.

In addition, many commercial demining companies develop and supply their own technology to support their humanitarian demining efforts. Some examples of this include:

- Mechem, South Africa
- MineTech, Zimbabwe
- RONCO, United States of America
- UXB International, United States of America
- CIDC, Canada

Factors that Influence Decisions

“Sustainability demands that we address the current near-total reliance on importing both equipment and "know-how" from a very few of the richest countries of the planet. Almost all demining tools and equipment are currently imported to the poor countries from the rich countries; visors, metal detectors, hand-held radar, and specialist protective equipment, mechanized vegetation clearance, and high cost advanced detection systems. Not only does this make them very expensive but it also makes them essentially unrepairable where they are used and less comprehensible to the end user.”

Humanitarian Demining
Technology Development Program
- website

Many companies that have branched into the humanitarian demining field have done so partly because they are in a similar line of business already, either in the military or civilian sphere. For instance, CCMAT is now testing a brush-deminer designed specifically for humanitarian demining purposes. Another Canadian firm that makes personal protective gear for military and security applications has now designed gear specifically for humanitarian deminers.

In these examples, the core business supports the humanitarian line, both in terms of R&D effort, and financially. Most companies indicated that were it not for revenues from other lines of business, as well as substantial support from governments, they would not be able to develop and supply humanitarian demining equipment and technology.

Favorable publicity can also be an aspect in commercial decision-making. Some companies indicated they received media interest in the humanitarian aspect of their business as well as inquiries from potential investors drawn by the company's humanitarian work. While this is unlikely to be by itself a sufficiently significant factor in inducing a company to enter the field, it is most definitely an additional benefit for those that do.

Finally, there is evidence that some companies take advantage of interest in humanitarian demining to link their product or technology to the field, in order to raise their share price. Often this is done by claiming that a notable NGO has endorsed their product, whether the NGO has done so or not. Notably most NGOs say they do not endorse any products, and this practice just makes them more skeptical of companies. Of course, this behaviour is not limited to this market.

NGOS & CHARITABLE ORGANIZATIONS

Not only governments and companies are involved in fostering the development of mine action technology. Some of the largest demining NGOs, such as MAG and HALO, have been known to create their own mine action equipment, largely through remodeling existing equipment.

Many NGOs indicated that while there is a place for “high technology” in humanitarian demining, the most useful products tend to come from existing equipment that is adapted for humanitarian demining, sometimes in the field of operations. While these incremental improvements do not represent a leap forward in mine action technology, they are effective, and as the users themselves develop them, they are well adapted to field conditions.

An excellent example of this can be found in the development of mechanically assisted demining equipment. As humanitarian demining expert, Andy Smith explains:

“While huge sums are being spent on monstrosly heavy and strong machines that many believe will never work adequately, some demining groups, such as the NPA in Angola, have taken existing ‘mine-clearance’ vehicles (the Aardvark) and used them in a more realistic role as an area-reduction and vegetation-clearance tool, and these applications have not involved any significant revision of the original machine.”

Further examples of this in-the-field development can be found in the Dual-Use Technology section below.

Thus some NGOs are effectively meeting their own requirements and adding to the overall supply of humanitarian demining equipment and technologies, even though they tend not to market their products to others. A notable exception is MAG’s effort to build a workshop in Cambodia to service humanitarian demining equipment, including heavy machines. The intention is for the services of this workshop to be offered to others.

Development Technology Workshop

The Development Technology Workshop is a charitable organization whose sole purpose is to develop mine action equipment. It is an offshoot of the University of Warwick, in England and is a registered charity. The DTW researches and designs mine action equipment, which it then hands over to mine-affected countries to build. The “Tempest” a mini-flail designed by DTW is currently being made in Cambodia, while improved hand-tools and visors are being manufactured in Zimbabwe and Cambodia. As its working methods would suggest, the DTW is driven by a development-based philosophy that includes building capacity in mine-affected areas. Although DTW is a charitable organization with unproven results, it competes directly with private companies developing equipment and technology for humanitarian demining.

THE DEVELOPMENT APPROACH

Various NGOs and governments (including CIDA) have international development as a core element of their mandate. This is a factor in the commercial arena as it is implicated in the spread of particular technologies to different countries, and in the development of local companies.

“The major advantages to a development approach are:

- Equipment made locally is cheaper, so more donor money can be spend (sic) on digging up mines;
- Donor money stays in the country it was intended for;
- Local jobs and skills are created with accompanying benefits to the local community;
- The equipment is well adapted to local maintenance and operating conditions;
- Creation of a long-term, sustainable indigenous capacity for production of demining equipment.”

*The use of mechanical means for humanitarian demining –
Handicap International – May 2000*

This development approach to demining has led to the establishment of local capacity to produce demining equipment in several mine-affected countries. This not only provides competition to equipment from donor countries, but it is competition with a decided edge, as it is often cheaper, easily locally repairable, and it provides jobs and revenue in troubled economies.

TYPES OF EQUIPMENT & TECHNOLOGY

The following snapshot of the types of equipment and technology has been derived from discussions with experts in the community and an analysis of the 2000-2001 Jane’s Mines and Mine Clearance Yearbook.

PRODUCT / TECHNOLOGY CATEGORIES

In the interest of attempting to simplify an otherwise complex market, the study identifies the following three product / technology categories that are approached differently in terms of supply. The first two categories include all of the nine capability areas described above.

Products and technologies in the categories function very differently in the context of the market, in terms of time to market, quantity of supply, development and production costs, and replacement / life cycles.



These distinctions are particularly important with respect to limited purchasing power vs. large demand in the market for humanitarian demining equipment and technology. This issue will be discussed in greater detail in Section 4, the Market for Equipment & Technology.

Large-Scale Machines & Technology

When technology is discussed in a humanitarian demining context, it often refers to this category. Some of the characteristics of the products and technologies included in this category are:

- Large-scale equipment
- Typically high production cost
- Low volume of sales
- Generally lengthy time from concept, to prototype, to production
- Often high cost of operation and maintenance

Large machinery: Includes the following capability areas:

- Shallow-water Detection
- Vegetation Clearance.

Jane's reports that there are over 17 countries currently producing large machinery and mine clearing systems.

Complex electronic equipment: Includes the following capability areas:

- Aerial Sensor Arrays
- Data Fusion

According to Jane's, at least 8 countries have operational systems and technologies currently available, with another several actively engaged in research and development.

Mine Action Tools & Equipment

This second category covers a wide variety of products and technologies that share the following same general characteristics:

- Small-scale equipment
- Typically lower production cost
- High volume of sales
- Some are consumables
- Most are ubiquitous components of the Toolbox Approach
- Generally low cost to operate and maintain

Consumable demining products: Includes the following capability areas:

- Rendering Safe Mines and UXO

Jane's reports that there are over 8 countries currently engaged in mine disposal activities.

Humanitarian demining tools: Includes the following capability areas:

- Personal Protective Equipment
- Prodders and Probes

According to Jane's, there are at least 6 countries actively manufacturing some form of personal protective equipment, and over 15 countries that produce some form of mine detection product, including prodders and probes.

Other mine action equipment: Includes the following capability areas:

- Prosthetics
- Test & Evaluation Equipment

Some broader mine action technology, such as victims assistance-focused prosthetics and test and evaluation devices are also counted in this category, though they are not considered tools. They do, however, share the characteristics of the category as outlined above.

There is little data on the competition for these capability areas. Jane's identified 4 countries that are actively involved in victim assistance programs, including prosthetics development. Notably, a search of medical journals would likely provide more comprehensive results, as these products are not exclusive to humanitarian demining. In the context of mine action, the International Convention of the Red Cross is the most significant purchaser of prosthetics, while also being one of the largest suppliers.

General Operating Equipment

This last category includes cars, computers, radios etc, equipment that is essential for mine action, but is not specialized mine action equipment.

Although this category is not being examined in this study, the necessity for these products requires allocating some of the finite resources that are available for mine action, thereby reducing the resources available for humanitarian demining equipment and technology.

DUAL-USE TECHNOLOGIES

The initial supply of humanitarian demining equipment and technology came largely from products and systems that had been used for other purposes – specifically military. Demining has been an important part of military operations for as long as there have been modern landmines, thus adopting equipment and technology from military use and applying it to humanitarian demining was a relatively simple first step to meeting the demand.

“Breakthroughs in technology require much investment in research and development. This tends to favour equipment and products with a large consumer market and with the potential for significant profits. Major investments may also be required for reasons of national security. Thus any major breakthroughs in technology that will benefit future demining equipment may come from other areas of research, including the military research and development community. The process of demining equipment procurement must be creative in applying new and perhaps unconventional technologies to achieve a paradigm shift in capability.”

Mine action equipment: Study of global operational needs
GICHD – March 2001

In addition, equipment and technology used in commercial environments (e.g., construction, farming, forestry and mining) is being adapted for humanitarian demining purposes with generally positive results so far.

The development of demining technology as an offshoot of a company’s core business tends to be more sustainable for the company concerned. Many of the firms interviewed for this study frankly recognized that the development of demining technology was unlikely to pay off in the normal commercial sense. It was sustainable, with government support, as an adjunct of R&D being conducted for wider purposes. It also brought other benefits, such as favourable publicity for the companies involved, and exposure in some non-traditional markets for its other products. In fact, there are those in the community who feel that “unless you are talking about a dual-use technology, forget it.”

Another aspect of dual use for technologies is their utility in UXO clearance. Removing UXO is an allied use, and sometimes a requirement of humanitarian demining equipment. The removal of UXO can be in itself a market. Interviewees have referred to UXO on former military ranges that must now be cleaned up as a potential market for humanitarian demining technologies. As an ICBL representative remarked, while landmines have been banned in much of the world, conventional warfare continues, so the market for equipment to aid in locating and removing or destroying UXO will continue.

Military – Humanitarian

Until recently, military needs drove advances in mine clearance, such as flail and roller systems to detonate mines. Militaries could not afford to wait for the slower and more painstaking traditional methods of clearance. Battle situations demand trade-offs. Defence establishments had the capacity to develop equipment that would ensure that every single mine in a given area or path was made safe, however, when under fire, such techniques would be too slow. Therefore, military equipment and procedures tend to make trade-offs between speed of clearance and thoroughness.

That is not a high enough standard for humanitarian demining, where a local population must be assured that it is in no danger from a former

minefield, where a single casualty from a missed mine could be enough to undermine the confidence of a local population in clearance operations.

Purely military equipment has some other specific drawbacks for humanitarian use. It is often too expensive. While militaries will spend millions of dollars on single pieces of equipment essential for their tasks, deminers would balk at such amounts, no matter how effective the equipment.

Military equipment is often over-engineered for humanitarian demining. It's capabilities were designed for different sets of circumstances, so its armour may make it too heavy for humanitarian use, or its controls may require specialist operation.

Equipment designed for militaries may also be insufficiently durable for the daily use it would be put to in humanitarian mine action. It may be designed for short bursts of high performance, rather than long daily grinds.

In the early 1990's, technologies began to be developed that were more specifically focused on humanitarian demining. Some of those, such as mini-flails, were adapted from ideas already current in military demining. But it is the adaptation, not the direct use, of military equipment that is frequently the key. The adaptation may just be in how the equipment is used, or it may be in a reengineering of the product for humanitarian use.

Adapting Mature Commercial Technologies

Dual-use technologies derived from commercial equipment flows quite naturally in some cases. For example, some vegetation clearance machines were adapted from commercial brush-cutters, used in forestry and other industries, while aerial sensor arrays under development have much in common with aerial sensing used by the mining industry.

According to experts like Adrian Wilkinson from GICHD, some of the most successful humanitarian demining equipment is adapted in the field from commercial off-the-shelf (COTS) products. Many NGOs and companies have taken existing commercial equipment, which is substantially cheaper than its military counterparts, and adapted it for their own use.

These organizations have converted back-hoes, tractors, and road-graders to significantly speed up the process of clearance. Many of these groups made fairly minor adjustments (usually armouring) to the existing equipment to make it safe and robust enough for humanitarian demining.

The Pearson, described above, is an excellent example of adapting a product for humanitarian demining, then building attachments and modules to provide for multiple operational scenarios.

Finally, the concept of dual use from commercial or development applications is attractive to donors from a development perspective as well. Not only would contributing such equipment aid development in a country by clearing landmines, it could continue to pay dividends long after the mines were cleared, possibly be readapting it to its original commercial, agricultural, or industrial use.

CONCLUSION ABOUT SUPPLY

It is clear that there is an abundance of supply of humanitarian demining equipment and technology. However, there are a few conclusions about this supply that are notable:

DUPLICATION OF SUPPLY

As a result of the lack of international coordination in the research and development of new technologies, many countries around the world have developed and produced very similar products.

This leads to unnecessary duplication of supply without any economic benefit to the end-user, such as lower prices.

DEVELOPER DRIVEN

A traditional economic supply model requires open and constant communication between users and developers. This can be driven by direct communication, consumer groups, market testing, and/or by simply looking at sales figures for a product to assess demand.

The supply side of humanitarian demining equipment and technology has no such system of input and feedback. Developers make decisions, often without any direct input from users. Many respondents indicated that companies that are developing new technologies should engage user groups directly at an early stage to help direct the R&D effort in a way that will be useful for humanitarian demining. This does not appear to be happening consistently at this time.

DUAL-USE TECHNOLOGY

It is clear from the research that equipment and technology derived from existing applications – either military or commercial – are far more likely to succeed in a humanitarian demining context. Their intrinsic advantage is the ability to be sold to both markets, thereby increasing the

customer base for these products and allowing the demining product to be subsidized by other product lines.

While products derived from military applications tended to be introduced more quickly than their commercial counterparts, they have had a number of difficulties making the shift to humanitarian demining.

Adaptations of commercial equipment for humanitarian demining purposes have a number of advantages, from price to availability of parts. As such they tend to be preferred by user groups.

SUPPLY AS COMPETITION

“The United States developed and built something called a mini-flail back in the late 80’s, early 90’s, we introduced it into the demining arena back in 93-94. Everybody said “Oh yes, it’s nice, it’s nice,” but nobody purchased the mini-flail. In fact, Lockheed Martin originally bought the rights to manufacture it and mass produce it. They realized very quickly that nobody wanted it, and so they dropped it. And yet if you turn around and look around the world, you’ll find about six different mini-flails and mini-flail-like systems. The Slovenians have one, the Croatians have one, and then you have other systems that are very similar like the Cambodian Mining Workshop/DTW effort on the Tempest. So why is that? Well, each one of those is manufactured in their own countries, and so the Slovenians use their local one, The Croatians use their local one and the Cambodians use theirs. So the mini-flail sits here at Fort Belvoir as a museum piece.”

Col Z, U.S. DoD

Competition is usually an indicator of a market’s health. However in *this* market competition is a result of excess supply. Non-market forces such as national pride and domestic industrial development drive this supply. The desire of states to create their own industries often results in very similar technologies being produced in a variety of different countries. Moreover, the absence of international coordination results in frequent duplication of function in equipment, often without any corresponding improvement in efficiency.

This duplication also weakens mine action by taking away funds that could be spend either on another facet of R&D, or on another mine action activity.

Limited funding coupled with national interest means that any donor country that produces a piece of mine action equipment is extremely unlikely to purchase a similar piece of equipment from any other country. The inevitable result of competition is a smaller market for any one of these products.

4. THE MARKET FOR EQUIPMENT & TECHNOLOGY

“It is not a traditional market, there is absolutely nothing traditional about humanitarian demining. It’s a mish-mash of government, non-government, private, you’ve got militaries working with activist organizations. It’s got it’s own rules for doing business.”

Col. George Zahaczewsky,
U.S. DoD

Having established that there is both demand for and supply of humanitarian demining equipment and technologies, one might assume that a traditional market exists. This is clearly not the case. The market for humanitarian demining technologies is anything but traditional and does not respond to standard market approaches.

The reasons are discussed further in this section, however the defining factor is that the users of technology generally are not able to purchase it, while those that purchase it, generally do not need or use it.

As such, as Dr. Sieber – Unit Head of the European Commission’s Joint Research Centre Institute for Systems, Informatics & Safety – describes it, “there is an artificial market that is representing the need for technology, however, the reality is that mine action in general only survives from donor funds.”

This, of course, is not news to anyone with even a passing familiarity with humanitarian demining. This study endeavours to characterize the market further, by providing an assessment of the size of the market for humanitarian demining equipment and technology, an overview of how it operates, and an outline of some of the factors that affect adoption of certain technologies over others.

SIZE OF THE MARKET: SMALL AND SHRINKING

“The market for humanitarian demining equipment and technology is ...”

“Small and erratic”
Ian Mansfield, UNDP

“Based on false economy”
Dave McCracken, TMAC

“Ill-defined”
David Rowe, BHMAC

“As large as local donor’s budget”
Vernon Joynt, Mechem

“Extremely limited”
Tim Carstairs, MAG

“Only going to get smaller”
Bill McDonough, OAS

The general consensus among respondents was that the market for humanitarian demining equipment and technologies is small and shrinking. There are a number of reasons for this, as outlined below.

LIMITED DONOR FUNDING

As previously stated, the market is exclusively donor driven, and the amount of money available for mine action is a definite limiting factor on market size. Donor governments contribute virtually all the funding for humanitarian mine action, with smaller amounts occasionally raised from private donors.

It is difficult to ascertain exactly how much each government is spending on mine action, and then to further break that figure down into amounts that might be available to be spent on demining technology.

Representatives from a number of donor countries were interviewed to better understand how much they contribute to humanitarian demining annually, and whether that was likely to increase or decrease. This data has been augmented with figures from the UNMAS Mine Action

Investment Database (which was developed as an in-kind contribution by the Government of Canada). Recognizing that the database is incomplete, the following figures serve as a rough estimate of the general size of the market as it currently exists. The following data are based on interviews:

All figures are approximations, quoted in U.S. dollars.

United States of America

- State Department is responsible for a budget of \$40 million annually
- Defence Department (SOLIC) has a budget of \$25 million for R&D

United States = US\$65 million annually

- **Slovenia International Trust Fund (ITF):** Congress committed to match the money raised by ITF, for mine action efforts in the Balkans. ITF was able to raise \$28 million from other sources (80% from other donor countries; 20% from companies and organizations). As such, the U.S. contributed \$28 million over 3 years to the ITF.

The fund has been exhausted, but ITF is lobbying congress for another three-year extension for up to \$20 million per year. At the time of writing there appears to be a reasonable chance that ITF will receive the extension.

Norway

- Government of Norway has committed \$24 million per year as part of the country's \$120 million over five-year pledge – expires in 2003

Government officials indicated that there still remained about \$40 to \$50 million of unallocated/unspent funds remaining. They suggested that this would need to be spent over the coming 18 months. They describe the major focus of projects for Norway as mine clearance.

Norway = US\$24 million annually

United Kingdom

- UK budget is \$14 million annually as part of a three-year commitment that has just been renewed to 2004

UK government officials indicated that 90% of their funding goes toward mine clearance, although one of the government's objectives involves development and testing of new technologies. Notably, the UK appears not to spend money on victim assistance, but rather focuses its efforts in this area on prevention.

It appears that the UK will now be directing its contribution through UNMAS earmarked and un-earmarked funds.

United Kingdom = US\$14 million annually

Canada

- Canada has committed just over \$13 million annually as part of its almost \$66 million 5-year commitment to mine action programs, which expires in 2003.

The Canadian program focuses broadly on mine action, including policy advancement, clearance, R&D, and victim assistance. Canada allocates funds through both bilateral and multilateral projects.

Canada = US\$13 million annually

The Netherlands

- The Dutch government commits between \$12 - \$13 million annually to mine action projects. This has recently been increased from the previous level of \$8 million annually.

The Dutch program is only available on projects for States Parties and generally focuses on mine clearance. R&D is not part of the Dutch humanitarian demining fund.

Netherlands = US\$12 - US\$13 million annually

Germany

- Germany contributes \$10 million annually to mine action programs around the world.

German funds tend to go toward existing projects, with preference to signatories of the Convention. The German contribution does not include R&D, which is funded separately by their Research Ministry.

Germany = US\$10 million annually

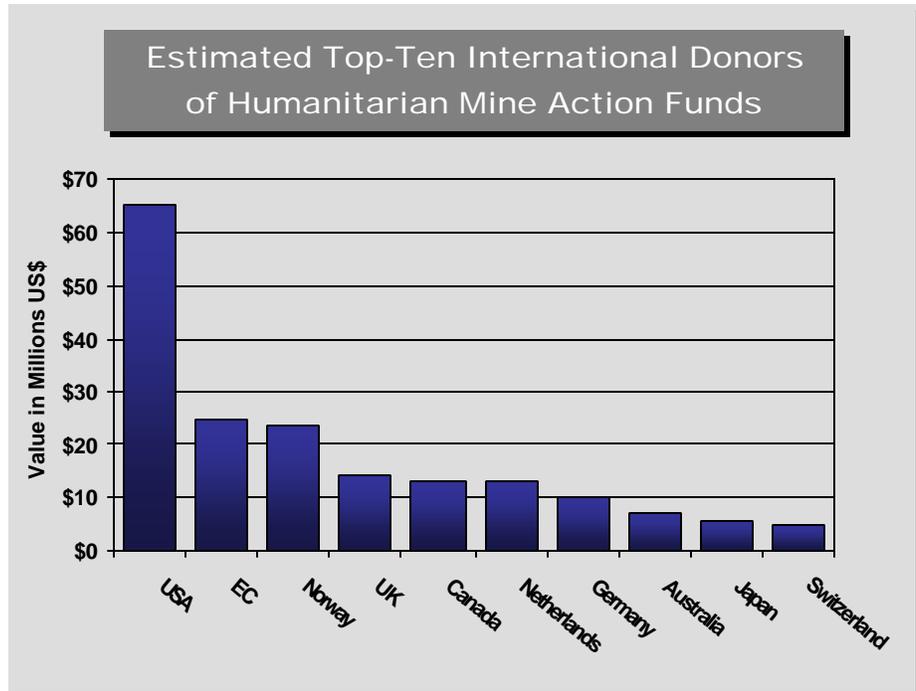
Other Major Donors

According to the UNMAS Mine Action Investment Database, the following countries round out the top-ten list of donors:

European Commission = US\$25 million annually

Australia	=	US\$7 million annually
Japan	=	US\$5.6 million annually
Switzerland	=	US\$4.7 million annually

Based on these figures, the total annual budget for humanitarian mine action appears to be approximately US\$181 million, and can be represented by the following chart of top-ten donors:



Although the figures are not concrete, what can certainly be extrapolated from them is that hundreds of millions of dollars have been spent on mine action, and continue to be spent annually. The question of interest to this study is, how much of that money is available to be spent on equipment, or mine action technologies, particularly those from Canada?

According to respondents, the percentage of money currently spent on mine action equipment by users tends to be small compared to what is spent on human resources and logistics. Although no one had precise figures, Dr. Sieber, of the European Commission, estimated that equipment typically accounted for about 10% of the mine action budget. This includes equipment not specifically designed for mine action – General Operating Equipment – such as cars and computers.

It is important to note that some respondents indicated that their budget for equipment and technology fluctuates with the life-cycle of a mine action project. One respondent suggested that in year-one of a given

project, his budget for equipment was as high as 50%, but in year two, it had dropped to less than 10%.

Based on the rough estimates above, the budget for humanitarian demining equipment and technology is somewhere around \$20 million annually. With the cost of some of the mechanical demining devices reaching into the millions of dollars, coupled with the number of mine action projects underway around the world, there appears to be very limited funds available for equipment and technology.

DECREASING DONOR FUNDING

There are differing opinions regarding the future of donor funding and its impact on the market for equipment and technology.

In general, respondents indicated they perceived that donor funding would be decreasing over the next three to five years. Norway, for example, indicated its funding would be decreasing substantially, and Germany expects funding to decrease (or at best, stay the same).

Clearly, there are exceptions, such as the Netherlands, which has just increased funding, and potentially, the United States, if Congress approves the extension of ITF funding to \$20 million per year.

Real Funding Declining

Irrespective of whether nominal funding is decreasing or staying the same over the coming years, the general consensus is that “real funding” is declining.

U.S. State Department officials provided a useful example of this reduction in real funding. They argue that “Even though our funding has stayed the same, we’ve increased the number of programs that we’re responsible for ... over the last four years, we’ve had relatively \$35-\$40 million, but we’ve gone from 18 to 25 to now 37 countries, still with about the same funding.”

A notable concern relates to the ITF. If the fund is not replenished and the U.S. wants to maintain its commitment to the Balkans, it will have to use money from the \$35-\$40 million base pool funding, which heretofore has not been used for anything in the Balkans. This would serve to stretch the resources even more thinly.

Most donors, including the UN, are facing a similar dilemma.



Donor Fatigue

Virtually all of the respondents indicated that they were increasingly worried about donor fatigue. This is driven by concerns that the countries who contribute the most resources to mine action programs are wearying of contributing millions of dollars per year to a problem that does not appear to be getting appreciably smaller.

“People just don’t want to throw money at something if they don’t see light at the end of the tunnel.”

U.S. State Department

Many in the demining community are concerned by the perception that there have been limited visible positive results, despite all of the money that has been spent on mine action. Many feel that donor expectations were unrealistic at the outset of this international campaign, and now that the world is several years into the process, countries are beginning to understand how complex the issue really is. As such, they worry that many donors may feel that it is not worth continuing to fund an issue that is not producing results.

There is a perception in the demining community that humanitarian mine action, as an international crisis, has passed its peak of public focus. Many respondents, from NGOs to donor countries, indicated that there is a real risk that other important international issues, such as AIDS, will eventually draw finite donor funds away from humanitarian demining.

DEMAND FACTORS LIMITING SIZE OF MARKET

Section 2 (above) of this study identified a number of the factors that influence demand for humanitarian demining equipment and technologies; among them are several that limit the size of the market.

Scenario-Dependent Nature of Market

It has been clearly established that the demand for humanitarian demining equipment tends to be specific to given scenarios and fields of operation. Put another way, what works in Nicaragua does not necessarily work in Afghanistan.

Factors such as geography and climate of the field of operation, intended future use of the land being demined, and experience or skill level of the demining team all affect the demand for specific equipment and technologies in given mine action programs.

The consequence of this scenario-dependence is that technology is often developed to meet specific needs and those needs may not be transferable across the spectrum of mine action programs. By definition this factor limits the size of the market for any given piece of equipment or type of technology.

“The political element makes the size of the market uncertain, so we’re putting more emphasis on military products.”

Med-Eng Systems Company
Spokesperson

Political Sensitivities

Political sensitivities may also limit the market for particular technologies. Apart from the obvious problem of whether the mine-affected country is under international sanctions, or bilateral sanctions, there are also some technologies that may not be accepted by the host country. An example of this is the aerial sensing technology which records and maps information about the mine-affected country. Some mine affected countries may not wish to have their country mapped in such a fashion, particularly if the information is in the hands of a private company or NGO.

Potential dual-use of equipment, technology, and training in countries that have unstable governments and/or non-state actors further limits the ability of demining organizations to demand certain products and services.

Socio-Economic Impact

Another form of political sensitivity has already been discussed, the socio-economic impact of mine action technology. Put bluntly, some respondents clearly indicated that they would not be inclined to use humanitarian demining equipment that takes demining jobs from local people.

While many respondents from the developed world disagreed with this philosophy, there is no doubt that it does exist, and demand decisions are influenced by this view – among recipient countries and demining organizations.

Size of Demining Community

The overall size of the demining community is small relative to scope of the problem. Some have estimated that there are a maximum of 20,000 humanitarian deminers around the world, with only a handful of donor countries actively engaged in the process.

Individual preferences, existing stockpiles of equipment, and influence of donors make this small community a very limited market for current equipment suppliers, let alone new entrants.

Demand Volume Relatively Small

Many respondents indicated that the amount of equipment that is actually required in humanitarian demining is relatively small. Ian Mansfield, Mine Action Team Leader of the Emergency Response Division at UNDP, provided the following example of the market for detectors.

Handheld detectors are perhaps the most ubiquitous advanced equipment currently used in humanitarian demining. Mr. Mansfield estimates that the size of the humanitarian demining worldwide market for handheld detectors is approximately 10,000 units. By comparison, Schiebel recently sold 17,000 handheld detectors to the U.S. Department of Defence.

SUPPLY FACTORS LIMITING SIZE OF MARKET

Supply factors also limit the size of the market. The most notable one is the funding practices of most donor nations, and the influence this has on which equipment and technologies are supplied to mine action programs.

Funding Practices

As noted earlier in the document, the demand for demining technologies does not necessarily translate to a larger market for any given technology or piece of equipment. Funding practices from most donor countries serve to limit the size of the market for specific humanitarian demining equipment and technologies.

Tied Aid: The first of the practices that limits the size of the market is tied aid. That is the practice of donor countries specifying that the aid they provide be spent on equipment produced in that donor country.

There are differing opinions regarding the degree to which this takes place. Most donors that were interviewed insist that they do not tie their aid. However, most recipients of donor funds and observers of humanitarian demining indicate that almost every country ties its aid to some degree or another.

“...the Italians fund the Italians, and the French fund the French, and if you’re funding the French organization, they’re likely driving in a Citroen or a Peugeot, while the Japanese organizations are driving around in Toyotas. A donor has massive impact on what you buy and whether they’ve got national priorities.”

Paul Heslop, HALO Trust

For instance, deminers receiving money from the U.S. government say that they are asked to buy American by preference. If they do not list an American source for the equipment they desire, they are asked to provide a written justification. Many respondents indicated that the same is true for the European Union.

Other countries that respondents indicated tie their aid to some degree include: Norway, Germany, Japan, Sweden, the UK, and Canada.

There are plenty of examples of where aid is tied, or at least slanted to the technology or equipment of the donor country, but there are also examples where that is not the case. Some countries, such as the Netherlands, appear not to tie their aid at all; while others that do tie their aid, don’t do so all the time.

Also, while users are often under pressure to buy large equipment produced by the donor country, it is not unheard of for them to buy the

equipment they want, regardless of national origin. This is said to be most true of the largest demining NGOs, which raise money from a variety of sources to help them sustain longer-term projects. For instance, NPA has bought British-produced Aardvarks (a mechanical demining machine) with Norwegian government money.

“In some cases, donors have forced unsuitable and ineffective equipment on national programs and local demining projects. This has harmed the relationship between donors, researchers, industry and the User community.”

Mine action equipment: Study of global operational needs
GICHD - March 2001

Donations in Kind: A concept allied to tied aid is the practice of donations of equipment. Some donor nations will supplement (or substitute) their financial support to demining organizations with contributions of equipment made in their country.

The performance of donated equipment is a sensitive issue with deminers. While they do not wish to offend donors, they have on occasion been given equipment that is practically useless for the job in hand. There are stories of mechanical demining equipment being donated that was too large for local infrastructure to support, so it simply sat idle.

It should be noted, however, that the donation of unsuitable equipment appears to be the exception rather than the rule. Most donors tend to be very responsible with donated equipment, providing tools and technology that is suitable to the requirement.

Humanitarian demining organizations often identify a requirement for a particular piece of equipment and approach a donor government for funding. If a company from that country manufactures the equipment or something that has similar specifications, the donor will often purchase the product domestically and donate it in kind.

“Users tend to request technology that is available from German companies.”

German government official

Many groups will only request equipment from a donor that is produced in that country. In fact, humanitarian demining organizations indicated that when they identify a desired piece of equipment (often as a result of a company’s promotional efforts), they frequently work with the manufacturer to convince that company’s government to purchase the product and donate it in kind.

The net effect of these funding practices is to substantially limit the size of the general market for humanitarian demining equipment and technology. This is particularly true for Large Scale Machines & Technology, but applies to a lesser extent to Humanitarian Demining Tools as well.

If one considers how many countries produce duplicate equipment and technologies, it is no wonder that the size of the market for any particular product is very small. One respondent opined that the market for Canadian demining technologies is as large as the Canadian government’s budget for humanitarian demining and no larger.

HOW THE MARKET OPERATES: INEFFICIENTLY

The market for humanitarian demining equipment and technology is not only small and shrinking, but it is also highly irregular and unstable. It is an inefficient market, where decisions are made without sufficient information and different marketing systems apply in different regions of the world.

DECISION-MAKING

The title of this section assumes that there are decisions to be made on the adoption of mine action equipment. As illustrated above, that is not often the case, especially with equipment that is defined by low volume and high cost. In those cases, it is common that the decisions will have been made by donors, either directly donating the equipment in question, or directing that their funds be spent in certain ways. Even in the lower cost, higher volume sector of the market, government involvement still skews decision-making.

The prime users of humanitarian demining equipment, the NGOs, can also affect decisions on what equipment gets used. One method is for them to raise money that does not come with strings attached, allowing them to spend on whatever equipment they please. This does not appear to be a regular occurrence, and is not feasible for any but the largest of the demining NGOs.

Another approach for NGOs to take is to contact the national governments of countries producing equipment that the NGO particularly desires, and request a donation of that equipment. While it is true that the donor decides whether or not to grant the request in such a case, it is the NGO that initiates the process of getting that particular piece of equipment into the field.

Mine Action Centres can take a similar approach with donor countries, asking that they provide a particular piece of equipment, although it is more usual for them to outline capacities they need to be filled, and leave the decisions on how those capacities may be filled to the donors.

The group that is the least constrained by political considerations in decision-making is the commercial deminers. They will tend to make decisions based on more traditional influences, such as price and effectiveness.

Some respondents indicated that their decision-making is constrained by not being aware of what products are available. One source of information about available equipment and developmental technology is the U.S. DoD's Humanitarian Demining: Developmental Technologies 2000-2001 catalogue. Some user groups, including the Organization of

American States (OAS), actively seek equipment that receives a positive review in this document.

OPERATIONAL SCENARIOS

Markets are further defined by the types of relationships between donor governments, NGO's, host countries, commercial deminers, and the UN. While there can be an almost infinite variety of permutations of these relationships, they tend to follow certain patterns, depending on the approach to demining in that particular country.

MAC vs. Non-MAC

Mine Action Centres are national authorities, often UN-sponsored, tasked with organizing mine action in particular mine-affected countries or regions. Where there is a traditional Mine Action Centre established, procurement of mine action technology tends to follow a particular pattern. MACs are generally responsible for planning, organizing, and ensuring quality control of mine action activities. Accordingly, they establish demining tasks, order them based on local priorities, tender for demining services from NGOs and companies, and identify the specifications for equipment to be used. In some cases, they also certify equipment, technologies, and companies that are allowed to operate in their region of influence.

This is notably different from the haphazard approach taken in many other countries, where there is little or no coordination, and mine action is driven by bilateral interests between donors and recipients.

Kosovo vs. Non-Kosovo

The mine action undertaken in Kosovo is so far unique in the history of humanitarian demining. It is included here as a category to demonstrate a particular pattern that could conceivably be repeated in a future conflict zone. It has been cited by UNMAS as an example of "how the system *should* work."

Many countries and NGOs wanted to be involved in clean up in Kosovo, due to the urgent need, and the high-profile nature of the work. Rather than allowing projects to sprout up in an uncoordinated fashion, donors to the mine action made their money contingent on all activity being coordinated through the Mine Action Centre. This allowed more refined prioritization and allocation of resources, thereby limiting the duplication of effort and procurement that often characterizes mine action programs.

Because of this coordinated effort and international focus, Kosovo is expected to soon be one of the least mine affected countries in Europe, outstripping countries such as France and Belgium which are still

contaminated with the debris of two world wars. If the Kosovo model can be repeated in non-emergency response operations, it may be possible to mitigate many of the inefficiencies in this market.

Conflict vs. Post-Conflict

As a rule, humanitarian demining is not undertaken in conflict zones, due to the potential danger to deminers. However, demining can take place in other parts of a country where conflict is occurring. This can pose special constraints on demining, as certain equipment, such as mine neutralizing explosives, cannot be shipped into countries in which a conflict is occurring. The presence of conflict in a country can also further strain infrastructure and supplies, rendering equipment with a heavy dependence on either resource less useful.

Post-Conflict vs. Assisted Development

As highlighted in the UNDP Study of Socio-Economic Approaches to Mine Action, the primary objective in a post-conflict environment is minimizing harm. As such, the equipment that is required tends to be focused on what is generally available in order to do the job quickly and safely.

Once assisted development begins, the role of humanitarian demining becomes somewhat different, as priorities change and longer-term objectives can be pursued. Assuming donor interest remains sufficient, demining organizations can pursue technologies that meet the targeted requirements of the particular developmental situation. The reality is, however, that earmarked funding for demining is rarely maintained at this stage.

As such, a number of respondents highlighted the role of dual-use technologies as having potential in this operational scenario. They suggest that equipment that can be easily adapted from a demining role to a development role (construction, agriculture, industrial) would open market possibilities beyond just humanitarian demining. Some felt that this was the future of humanitarian demining over the long term, as donor funding for demining is folded into a country's broader development budget.

FACTORS THAT AFFECT ADOPTION

Regardless of who makes the decisions on getting equipment into the field, there are certain factors that will make it more or less likely that any given piece of equipment will be adopted.

Deminers will certainly use any equipment they are given, as long as it has some utility, and does not compromise safety. But they are looking for certain traits that will render the equipment more useful, and equipment that exhibits those traits will be bought or requested by the NGOs when they have an opportunity.

Donors too have an interest in seeing certain traits displayed in demining equipment. As noted, they do not want to see their prized machinery rusting away in a corner because it has not proved to be useful. They also have an interest in increasing productivity through the provision of appropriate demining technology, so that their humanitarian objectives can be met.

Factors that affect adoption are not necessarily inherent in the equipment itself. They also flow from how the product is tested, how it is marketed, and what support it is given and by whom.

The factors that affect adoption can be divided into two sections: factors that encourage adoption, and factors that are a barrier to adoption. These are listed below in no particular order.

FACTORS THAT ENCOURAGE ADOPTION

“Faster, cheaper, safer.”

That is how a representative of Norwegian Peoples Aid succinctly states what his organization is looking for in humanitarian demining equipment.

Desire for increased productivity is driven, in part, by a fear of diminishing funding in the future, and a natural desire to bring the benefits of humanitarian demining faster, thus benefiting a larger number of people.

“People are looking for a low cost answer. That’s probably not in the best interests of mine clearance in the long term but given the way the activity is financed, it’s a fact of life.”

CIDC Representative

Cheaper is also a factor of productivity. Obviously, if a piece of equipment costs significantly less than another, and performs the same or a similar function, either more pieces of that equipment can be bought, or the money saved can be applied to increasing productivity in other areas.

Safety is balanced against productivity as an adoption factor. If an incremental safety improvement brings about a drastic decrease in productivity, it is unlikely to be adopted. That being said, deminers are very interested in improving the safety of personnel where that can be achieved without major losses in productivity.

Outside of the “faster, cheaper, safer” mantra, there are other factors that encourage adoption. Many respondents emphasized that the equipment must be suitable for conditions encountered in the developing world.

Robustness

In light of the scenario-dependent nature of humanitarian demining, many organizations are looking for equipment and technology that has multiple applications. A piece of equipment that has removable parts, or is easily adaptable to different geographic / climatic conditions or different operational scenarios is more attractive, particularly to groups who perform other humanitarian work.

Durability

User groups indicated that equipment must be durable, to withstand unintentional or intentional abuse. The conditions in a humanitarian demining operation are often extreme, requiring that equipment be able to handle fairly rigorous “wear and tear.”

“I found a fellow one day using his three thousand dollar detector to bang marking sticks into the ground. It’s a great piece of kit, it’ll find a minimal metal mine, but it doesn’t work very well after it’s been used as a hammer.”

Paul Heslop, HALO Trust

Limited budgets also cause demining organizations to try to extend the life of particularly expensive equipment. Equipment should be able to survive even after extensive, if not excessive, use.

Finally, the nature of humanitarian demining is such that equipment does not always get used as the manufacturer intended, as the extreme example to the left illustrates. Equipment that works even after being mistreated is particularly useful.

Sustainability

As addressed repeatedly in this report, the conditions in most humanitarian demining operations are less than ideal. Moreover the supply chain for many of these programs is short and thin. Many items that are taken for granted in developed countries, such as spare batteries or a new LCD screen, are nearly impossible to come by in the jungles of Cambodia or the desert of Jordan.

Humanitarian demining equipment must be easily repairable, preferably using spare parts that are readily available in the field of operation. This is one of the key factors supporting the adoption of equipment adapted from standard commercial applications, such as tractors and back-hoes. Not only are parts easier to obtain, but mechanics in the field are more likely to be familiar with how to repair these devices.

Simplicity

Another factor affecting adoption of equipment is its ease of use by indigenous deminers. Many respondents indicated that they give preference to equipment that is simple, so that local deminers can use it with a minimum of training.

It should be noted that some developers of technology indicated that they did not feel this was a substantive requirement for humanitarian demining equipment and technology. While one could argue that not every piece of equipment used in humanitarian demining must be simple to use, the preponderance of evidence suggests that this is not a trivial requirement and does play a substantive role in users' decisions.

Demonstrated Effectiveness – Field Tested

In addition to the specific characteristics of the equipment or technology, the manner in which it is introduced to the humanitarian demining community also plays a significant role in adoption.

Respondents were almost unanimous in their view that a crucial factor in encouraging adoption is for the equipment to have been field tested successfully by an independent third party. It was the opinion of several respondents that a successful field test is the most important marketing effort for any piece of equipment.

This does not mean that companies should rush to field test their products. Rather a comprehensive battery of tests should be completed before a piece of equipment is brought to the field. Representatives from MACs and NGOs explained that they receive calls every week asking to be able to test a new product in one of their programs. In light of the abundance of supply, this should not be surprising. However, it speaks to the need to ensure that the product is fit for field trials in order to maximize the benefit from this process.

“The way CCMAT is doing things is the way to go ... If this is left to the commercial company, it's not done very well.”

Dave McCracken, Thailand Mine Action Centre

Canada was singled out by a number of respondents as having a good process for testing: first through CCMAT at the Defence Research Establishment, Suffield (DRES); then, only after the product has demonstrated its readiness in controlled conditions, supporting and coordinating field tests in relevant operational scenarios. Several respondents suggested this was a helpful process.

Company / Tester Credibility

Another factor that has an affect on adoption is the reputation and credibility of the tester and/or the company that makes the product.

“In terms of proposed Canadian technologies, the CCMAT stamp will help get a foot in the door, as CCMAT is respected.”

Hemi Morete, Program Officer, UNMAS

As with any industry, companies that produce good products tend to develop “customer loyalty” to their brand. Such that when the firm develops new products, user groups are more prepared to accept them. Testing by a reputable independent organization can also help market a particular piece of equipment. The evolution of the International Test and Evaluation Program (ITEP) has significant potential to provide the

credible independent testing that respondents appear to be seeking. ITEP is discussed in greater detail below.

Engaging User Groups at Development Stage

Both developers and users agreed that they need better communication at the earliest stages of developing new products. A number of NGOs suggested that they would be more receptive to new equipment and technology if they were engaged at the development stage and could provide their input regarding user requirements and operational constraints. Certainly companies that do this would generate greater interest in their product, at least within that NGO.

BARRIERS TO ADOPTION

Barriers to adoption are for the most part the obverse of those factors that encourage adoption. If equipment is too expensive, complex, and fragile, it is unlikely to be enthusiastically adopted by deminers, even if it is faster or more efficient than existing equipment in their toolbox.

Limited and Irregular Purchasing Power

The above outlines a number of criteria that, if met, may generate demand for certain products among user groups, such as NGOs. However, it is important to recall that with a few exceptions, user groups do not regularly have the funds to acquire equipment and technology from their own budgets.

Accordingly, while a group may want a given product, it is often unable to purchase it. The group then tends to seek special funding for the product, or more realistically asks the donor country in which the product is produced to donate it directly.

Skepticism of User Groups

A number of NGOs indicated that they are often skeptical of new entrants to the humanitarian demining market. This is based on a number of factors. Some NGOs have been “burned” by companies that test a product in an NGO demining program, then proceed to market the product as being “endorsed” by the NGO – even though no such endorsement was ever given. Tactics such as these, undertaken by less professional firms, have poisoned the attitude toward companies among many user groups, leading one NGO to suggest that the “spirit of the movement is compromised by the role of companies.”

Logistical Barriers

Finally, there are also logistical barriers to adopting new technologies. Some of these are obvious, such as availability of supply. Many new

products are being tested, however, full production is not underway due to the uncertainty of the market. Less obvious difficulties include access to import/export licenses, particularly for converted military equipment.

ROLE OF STANDARDS IN THE MARKET

The first standards for humanitarian mine action were issued by the United Nations Mine Action Service in early 1997. When the standards were devised, there was an automatic requirement to revise them every two years. That first revision is now almost complete.

Standards are a controversial issue in humanitarian demining, with different groups having very different views about their role and importance.

"The new standards will provide a frame of reference which will encourage, and in some cases will require, the sponsors and managers of mine action programs and projects to achieve and demonstrate improved levels of effectiveness and safety. The new standards will introduce agreed and consistent levels of post-clearance quality ... This will have significant procedural and equipment implications. The new standards will require all mines and UXO to be removed to a depth specified in each contract."

Mine action equipment: Study of global operational needs
GICHD - March 2001

As the humanitarian mine action sector matures, there is increasing pressure from donors for more international control and coordination to ensure their contributions are put to the best possible uses. The new standards being developed by UNMAS are seen by some as an important step in that process.

On the other hand, there are some very real and vocal concerns with the standards being developed by UNMAS. A number of user groups oppose the standards, claiming they are unrealistic and do not reflect the reality of humanitarian demining. Others suggested that they are too technical and are generally not understood by indigenous deminers in the developing world. Some accept that standards are fundamental to humanitarian demining, but feel that the UNMAS process is too bureaucratic and the money could be better spent on actual demining.

Ultimately, while it is clear there are differences of opinion on the importance and appropriateness of standards, they will likely be widely adopted by the humanitarian demining community, if for no other reason than pressure from donors.

INTERNATIONAL PILOT PROJECT FOR TECHNICAL COOPERATION (IPPTC)

According to U.S. DoD, the IPPTC was a pilot project designed to evaluate existing commercial off-the-shelf metal detectors suitable for humanitarian demining, identify which detectors are best suited for particular operational environments or geographic set of conditions, and serve as a test vehicle for a future international test and evaluation project.

The project was launched by the U.S. DoD and included:

- Canada's Defence Research Establishment Suffield (DRES)

- UK's Defence Evaluation and Research Agency (DERA)
- Royal Netherlands Army and the Dutch TNO-FEL
- European Commission's Joint Research Centre (JRC)

While this project was an important first step in the development of an international test and evaluation program, some controversy surrounds the results of the evaluation. As a result of somewhat unclear terms of reference, there are many in the humanitarian demining community who expect the final output to be a "consumer's guide" to mine detectors. Accordingly, when it became clear that the project focused only on low-metal mines, there were some who were prepared to discount the entire study. This confusion about the terms of reference appears to be the reason why release of the final report has been delayed.

INTERNATIONAL TEST & EVALUATION PROGRAM (ITEP)

"...An international test and evaluation program is being developed which aims to reduce duplication of testing and evaluation efforts by adopting a common program of equipment testing. The program will provide transparency between the establishments involved in testing and evaluation and with the donor and user communities."

Report of UN Secretary General
1999

Following on the experience of the IPPTC, a Memorandum of Understanding to establish an International Test and Evaluation Program was signed among six key players in May 2000. A secretariat was formed in October of the same year.

The countries involved are:

- Belgium
- Canada
- U.S.
- UK
- European Commission
- Netherlands

The ITEP program is expected to provide independent, scientifically robust, and unbiased testing and evaluation of new and existing equipment and technology.

The results of such tests, and their consistency with new standards, will help to provide some stability in the introduction of new technology to humanitarian demining.

Trends

There has been some recent discussion about the need for more international coordination of mine action efforts, including identification of global requirements, R&D, and procurement of equipment. Although these discussions are still at an early stage, they are an important trend that could have a substantial impact on the market for humanitarian demining equipment and technology.

5. CONCLUSIONS

This study began by attempting to answer a set of key questions:

- Is there a demand for equipment and technology?
- Is there a supply of equipment and technology?
- Is there a market for equipment and technology?
- And what are the characteristics of each?

It is important to recall the distinction between demand for a product and the existence of market in which that demand can be satisfied. This study assessed each element in isolation to identify where there may be challenges to the adoption of existing equipment and new technology.

IS THERE A DEMAND

Demand for equipment and technology in humanitarian demining is driven by a number of factors and led by the three principal user groups:

- NGOs
- Companies
- Militaries

It is generally agreed that technology has an important place in humanitarian demining. As such, there is a demand for equipment and technology that can contribute positively to mine action activities. While there remain few mechanisms to translate demand into the procurement of equipment and technology, it is clear from the research that there is a significant demand for:

- Existing equipment,
- Incremental improvements, and
- Radical advancements in technology (in a few select cases).

There is a sense of urgency generated, in part by the humanitarian crisis that landmines create, but largely by the prospect of finite funding that has motivated a greater demand for technology in mine action. Moreover, this demand becomes more acute as donors begin to require demonstrable results.

This suggests that effective equipment that is already developed has a good chance of being used if it can improve demining efficiency, subject to the constraints of this market. On the other hand, new technology may find itself without a market, unless it can be developed quickly.

IS THERE A SUPPLY

There is an abundance of supply of virtually every type of humanitarian demining equipment and technology. This supply is often motivated by non-market forces such as national pride, domestic industrial growth and developmental approaches. Principal drivers of supply are:

- Donor Countries
- Commercial entities
- NGOs

This abundant supply further constrains the market by providing competition without any of the benefits it would normally bring, such as responsiveness to user needs, continuing pressure to improve design, and pressure on price.

The result of excess supply is a smaller market for any one product.

IS THERE A MARKET

Despite the existence of demand and supply, the market for humanitarian demining equipment and technology is not a traditional one. The principal reason for this is the almost absolute reliance on donor funding for the purchase of any equipment to support mine action efforts.

In short, those who demand of equipment and technology generally are not able to purchase it, the suppliers of the products have no marketplace in which to sell their goods, and the purchasers generally do not need or use the equipment themselves, but donate it to the demanders. This confused process creates a difficult market for all concerned.

That being said, equipment does manage to get purchased and used in the field, indicating that a market of some fashion exists. Within that context, we provide the following conclusions about the market.

- **The market is small and shrinking.** There is a limited amount of donor funding available for all mine action activities, and equipment purchases are a only small percentage of this. Moreover, real funding is decreasing. Even where nominal funding remains constant, donors are becoming active in more countries and new NGOs are springing up. This means that the money available for any organization is likely to decrease.

There are a number of demand factors that further limit the size of the market, including the scenario-dependent nature of humanitarian demining, the socio-economic impacts of technology, political sensitivities, and the limitations of selling into a small market.

- **The market can be further split into three main categories: large scale machines and technology; mine action tools and equipment; and general operating equipment.** The market for large scale machines and technology is almost entirely based on donations of equipment by donor countries. Very little of it is actually bought by user groups. Mine action tools and equipment, because they are cheaper and higher volume have a slightly larger chance of actually being purchased by users, although they are still subject to the constraints of factors such as tied aid. The final category, general operating equipment, is not examined in this study, but it does reduce the market for the first two categories by taking up scarce funding

- **The market operates inefficiently.** Users can only indirectly influence the market. Suppliers have imperfect information about both user requirements and the operational scenarios under which procurement can take place. The market is largely defined instead by a third party, the donor countries, which dictate what technology is developed, who gets funding, and what equipment they can purchase.

OPPORTUNITIES AND CONSTRAINTS

Given the large caveat that the market operates inefficiently, there are still things developers of equipment and technology can do to encourage adoption of their product. These are:

- | | |
|-----------------|---|
| ▪ Price | ▪ Sustainability |
| ▪ Effectiveness | ▪ Simplicity |
| ▪ Safety | ▪ Demonstrated effectiveness (field tested) |
| ▪ Robustness | ▪ Company/tester credibility |
| ▪ Durability | |

There are also barriers to adoption; some of which can be avoided, others that inevitably make it difficult to function. These are:

- | | |
|--|-----------------------|
| ▪ Limited and irregular purchasing power | ▪ User skepticism |
| | ▪ Logistical barriers |

COMMERCIAL IMPLICATIONS

What does this all mean for companies interested in humanitarian mine action? Despite existence of demand for products, there does not exist an efficient market in which to operate.

This is demonstrated in the quote below from a recent study of the market for humanitarian demining mine detectors. As part of an EU program to evaluate the multi-sensor handheld mine detector concept, Thales (formerly Thomson-CSF) and ERA Technologies carried out an in-depth assessment of the market. As seen below, they concluded that despite the technical feasibility of the concept, the market is too small, unstable and inefficient to merit investing the resources necessary to develop the technology.

“Despite technical feasibility, the mechanism does not exist at present to design, develop, manufacture, supply and carry out in-service upgrades for products for a niche market whose timescales do not fit normal commercial product development parameters. It is also considered that the market size and take up rates do not lead to economical large-scale production runs. New detectors will only be developed and produced if there is direct and full funding for the costs of development and production, as the unique nature of the market does not meet any normal criteria for commercial investment decisions.”

The Market for Advanced Humanitarian Mine Detectors, Newnham and Daniels – Thales Missile Electronics Ltd and ERA Technology Ltd.

Companies engaged in mine action recognize the realities of the market. Generally speaking, they are looking for governments to fund research and development, production, and purchase of the finished product. In short, companies indicate that they will not take the risk of investing in this market, without a realistic expectation of a reasonable return on their investment. It is clear that companies have little confidence the market for humanitarian demining equipment and technology will provide a return on investment without substantive government support.

BIBLIOGRAPHY AND INTERVIEWS

The following is a detailed description of the key sources used for the development of this study. While all interviews are referenced below, only the most relevant literature resources are listed.

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The Use of Mechanical Means for Humanitarian Demining Operations – Various, pub Handicap International Mines Co-ordination Unit, 1999

To walk without fear (have to find details)

INTERVIEWS

The following individuals were interviewed for their views on the market for humanitarian demining equipment and technology. These interviews provided the anecdotal evidence that formed the basis of the analysis for this study. Interviews were conducted by phone, by e-mail, and in person.

Name & Organization	Title
Adams, Mark, Colonel United States Department of State	Deputy Director, Humanitarian Demining Programs
Bauer, Bill MREL Specialty Explosive Products Ltd.	Vice President
Béchir, Mahamoud Adam Republic of Chad	Coordinator, High Committee for National Demining, Ministry of Economic Promotion and Development
Elizabeth Bernstein International Campaign to Ban Landmines	Coordinator
Brabant, Stanislas Handicap International	Head of the Mines Unit, Belgium
Carruthers, Al, Major Government of Canada	CCMAT Manager Defence Research Establishment Suffield
Carstairs, Tim Mine Action Group (MAG)	Director of Communications
Deák, László, Government of Hungary	First Secretary, Department for Security Policy and Arms Control
Diduck, Melvin Environmental Mapping Canada	Vice-President
Gabourie, Rob Niagara Prosthetics and Orthotics	President
Goose, Steve Landmine Monitor	Program Director, Arms Division, Human Rights Watch
Gorrie, Helen Government of the United Kingdom	Department for International Development

Heslop, Paul HALO Trust	USA branch manager
Hirsch, Wolfgang (Lieutenant Colonel) Government of Germany	Technical Advisor, Federal Foreign Office
Horton, David Canadian International Demining Corps	Managing Director
Jakšić, Damir Croatia Mine Action Centre	Deputy Head of Operations
Joynt, Vernon, Dr. MECHEM	Divisional General Manager
Kelly, Dan Afghanistan Mine Action Centre	Program Manager
Kidd, Richard Global Landmine Survey	Program Manager
Mansfield, Ian United Nations Development Program	Mine Action Team Leader, Emergency Response Division
Markov, Alex Amtech Aeronautical Limited	Director of Engineering
McCracken, David Thailand Mine Action Centre	Technical Advisor
McDonough, William Organization of American States	Coordinator, Assistance Program for Demining in Central America Unit for the Promotion of Democracy
Morete, Hemi United Nations Mine Action Service	Program Coordinator
Palmer, David Computing Devices Canada	Business Unit Manager
Palmer, Douglas Med-Eng Systems Inc.	Product Line Manager
Patterson, Ted	Economist
Rowe, David Bosnia-Herzegovina Mine Action Centre	Program Manager and Strategic Advisor
Ruge, Christian Holmboe Norwegian People's Aid (NPA)	Policy Advisor

Sieber, Alois, Dr. EC Joint Research Centre	Unit Head, Technologies for Detection & Positioning, Institute for Systems, Informatics and Safety (ISIS)
Suart, Robert, Dr. Government of Canada	Director, Canadian Centre for Mine Action Technologies
Toso, Jaime Organization of American States	Consultant, Unit for Promotion of Democracy
van den Hurk Brennan, Polly Carolina United Nations Children's Fund	Global Landmines Coordinator, Humanitarian Policy Unit, Office of Emergency Programs
Veble, Eva International Trust Fund for Demining and Mine Victims Assistance in Bosnia and Herzegovina	Assistant Director for International Relations
Verbeek, Alexander Government of Netherlands	Senior Policy Officer, Ministry of Foreign Affairs
Wilkinson, Adrian Geneva International Centre for Humanitarian Demining	Head of Technology and Standards
Woodworth-Lynas, Chris Guigné International	Director, Seabed Innovations
Yearly, Bill Promac	Sales representative
Zahaczewsky, George, Colonel United States Department of Defence	Assistant for Explosive Ordnance Disposal, Munitions, and Demining, Office of the Assistant Secretary of Defence (Special Operations / Low Intensity Conflict)