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Feature

Demining Technologies

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Introduction

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Humanitarian mine clearance is a new phenomenon in the world. Therefore, well-coordinated and concrete steps need to be taken at international levels to address this issue. The Humanitarian mine-cl earance technology has evolved at organizational, regional, and national levels in various parts of the world. However, at the international level, very little has been done so far to learn from these individual but practical lessons. The current effort s to develop humanitarian mine-clearance technology is either not coordinated or is poorly coordinated with field-level requirements. Efforts are required to organize the humanitarian mine-clearance technology at the international level and to develop international-level criterion, procedures, and standards that could enhance the effectiveness, cost efficiency, reliability, and safety of humanitarian mine clearance.

Components Essential to Humanitarian Mine Action Programs

In order to be effective in addressing the landmine problem, one must be familiar with the components of humanitarian mine action. Therefore, the term "mine clearance" has been progressively replaced by "mine action," which is a term that covers all of the essential aspects of humanitarian mine action.

Mine Awareness

This component aims at reducing civilian casualties caused by mines and other explosive devices by educating civilians on the identification and the avoidance of risks associated with living in a mine-contaminated environment. Conducting min e awareness is particularly important when refugees and internally displaced persons return to their mine-contaminated home towns. Mine awareness has proved to be an effective measure in reducing civilian casualties caused by mines and unexploded ordnance (UXO).

Mine Clearance Training and Monitoring

This component provides individuals and teams with the skills required for the safe and efficient removal of explosive devices. This component also ensures the quality of the mine action work through regular monitoring and refresher training for the mine clearance personnel. Based on the results of the monitoring, procedures are revised and updated, and new trials are conducted with the intention of introducing more effective and safer procedures. In this regard, the testing of new equipme nt and the providing of necessary training to mine clearance personnel is another important responsibility of this component. In addition, this component investigates and analyzes mine clearance accidents to identify key areas for improvement in the safe ty performance of mine clearance personnel.

Minefield Survey and Planning

This component consists of two main parts: general (Level One) survey and technical (Level Two) survey. A general survey aims at the identification, mapping, and recording of areas contaminated by mines and UXO to quantify the type, size, an d scope of the mine problem with which to be dealt. A general survey provides an overall picture of the mine problem in a particular area and assists in effective planning and efficient allocation of mine action resources. A technical (Level Two) survey aims at detailed and precise marking, mapping, and recording of the minefields and contributes to the effectiveness of mine clearance activities through the preparation of areas for clearance operations. Minefield surveying and planning play key roles i n the effective and efficient conduct of mine clearance operations.

Mine Clearance

This component aims at making mine contaminated areas safe for productive use through the application of safe and efficient clearance and destruction technology designed to remove the threat of mines and other explosive devices. This use of technology is the component requiring most of the resources of mine action and that physically eradicates the threat of mines.

Mine Action Management Information Systems

The fundamental function of this component is data management. This component, which consists of comprehensive computerized database and mapping systems, aims at accurate record keeping, facilitating long- and short-term planning, and the ef fective coordination of mine action activities. Assisting the prioritization of mined areas for clearance is another main function of this component. In addition, this component facilitates decision making and assists in research and development of new demining procedures and mine clearance technology.

Current Mine Clearance Technology

The clearance of landmines is a complex problem. Mines have been placed in residential (urban) areas, farm land, grazing land, irrigation canals, roads, etc. A single approach or one type of technology cannot be applied for the clearance of all type s of terrain. Therefore, a "Tool Box" approach has to be adopted, and different procedures and technologies have to be used for the clearance of different types of land.

Humanitarian mine clearance technology currently used in various parts of the world is based on the use of very basic equipment, techniques, and procedures developed in recent years. However, the use of this simple technology, with proper procedures, has proved to be practical, cost effective, and reliable. Afghanistan could be a good example of the use and the evolution of this type of technology. Use of such

technology should continue and should be further improved and expanded. The currently-used c learance technology in Afghanistan is simple but cost effective and reliable. The current three main approaches to humanitarian mine clearance include:

- **Manual Clearance with the Support of Metal Detectors and Prods**

  In this method, mines are located with the help of a metal detector and examined with a prodder or a bayonet to identify if the detector reading is only a metal fragment or a mine. If the reading is only a metal fragment, that fragment is removed from the area to prevent further signals. If the reading is found to be a mine, then the mine is subsequently destroyed by using explosive charges to detonate it. This method is useful for the clearance of areas contaminated with anti-personnel landmines. Despite being a slow process that is associated with some safety concerns for the person involved, this method has proved to be practical and reliable.

- **Manual Clearance with the Support of Explosive Detection Dogs**

  In this method, mines are detected with the help of explosive detection dogs. When a dog gives an indication, the indication is rechecked with a highly sensitive metal detecto r and then is manually investigated. Deminers then dispose of any fragments or mines that are found. This method is particularly appropriate and useful in the clearance of areas with a low probability of mines and areas contaminated with minimum metal mines . This method has proved to be relatively quick, but safety concerns remain.

- **Mechanical Clearance**

  In some parts of the world, various types of high-tech machines have been used to clear mines. However, according to the Afghanistan experience, these machines cost more than the manual mine clearance and are not very reliable. In addition, the maintenance of such machines is extremely difficult in mine-affected countries. Therefore, in Afghanistan, high-tech machines have been replaced by modified simple soil excavators (backhoes). These machines have proven to b e very effective in the clearance of residential areas and irrigation canals where mines are often covered by two meters of rubble and soil. These excavators can be further improved and used on a large scale for the clearance of residential areas and ir rigation canals.

All of the above-mentioned methods of humanitarian mine clearance are effective and practical in a specific type of terrain. Therefore, one single method cannot be used for the clearance of all types of terrain.

Current Problems of Humanitarian Mine Clearance

Most problems associated with humanitarian mine clearance could be avoided or resolved with effective management and planning. However, the lack of cost-effective and practical detection equipment remains a major challenge to humanitarian mine clearance. Some other common problems encountered during the humanitarian mine-clearance operations are highlighted below:

Limited Availability of Minefield Records

One of the main problems of humanitarian mine clearance is the availability of proper records on mined areas. Mines have been placed by various sources, including regular army, militia, rebel forces, etc. Most of the forces that have placed these mines have either kept very poor records of the location of their mines, or they kept no records at all. In many areas, various groups have placed their own mines beside the mines already laid by others.

Nuisance Mining

Generally, mines have not been laid in accordance with military doctrines. Various groups have laid mines according to their own security needs and have done so without taking into account the consequences of

their mines. The demining of su ch areas is dangerous and time consuming. To minimize the risks associated with nuisance mining and to achieve cost-effective mine clearance operations, suspected mined areas have to be surveyed, marked, and mapped by trained survey teams before demining teams can be deployed to these areas.

The Problematic Presence of Metal Fragments

Mines have usually been used in areas where heavy fighting has taken place. As a result of this factor, millions of metal fragments have been littered all over mined areas. The presence of metal fragments considerably hampers mine clearance operations by making them extremely slow and time consuming. Each piece of metal has to be treated as if it were a mine. In addition to slowing the operations, deminers lose interest and concentration due to the frustration of continuously digging up m etal fragments. This frustration sometimes results in accidents among the deminers. In Afghanistan, some 450 metal fragments are detected and investigated for each mine found.

Hard, Rocky, and Bushy Ground

The ground surface in some areas, especially roads where mines have been placed many years ago, is often very hard. Prodding for mines in such areas is very dangerous. If excessive force is applied, the chance of initiating a mine becomes very high, especially in anti-personnel minefields. Rocky and bushy ground also makes the task of demining slow and dangerous.

Demining Problems in Residential Areas

The residential areas of major cities, where fighting is usually centered, have been heavily mined. Walls and roofs have collapsed after mines had been placed in a house. In some cases, the area has to be dug out more than two meters to rea ch the original ground level. Clearance of residential areas is one of the most difficult and time consuming tasks of humanitarian mine clearance. Therefore, the lowest clearance rate has been experienced in residential areas.

Minimum Metal Mines

Minimum metal mines are also one of the main problems of humanitarian mine clearance. Some mines, such as Type-72 (anti-personnel) and TC-6, P2, P3, and M-19 (anti tank) contain minimum metal. It is almost impossible for common metal detectors to detect these kinds of mines.

Funding

Having sufficient funds is a major factor in successful humanitarian mine

clearance. The funding level of the mine action programs around the world is not satisfactory. For instance, the Mine Action Programme for Afghanistan has, on several occasions, suffered from severe funding problems. If more funds had been made available, large areas would have been cleared. This mine clearance would have allowed for an early return of land to productive use and accelerated the return of refugees an d internally displaced persons to their home towns. The rehabilitation and reconstruction process would have also accelerated, and more importantly, mine casualties would have decreased considerably among the civilian population.

Future Tasks

Humanitarian mine-clearance technology is still in its primary stages and requires much more input to be further improved and developed. The following points are to be taken into account while addressing the future tasks of humanitarian mine clearance:

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records of the location of their mines, or they kept no records at all. In many areas, various groups have placed their own mines beside the mines already laid by others.

Total Ban on Landmines

Unless the production, stockpiling, transfer, and use of new landmines are totally banned, the humanitarian mine-clearance effort alone will hardly achieve its ultimate goal of making the land safe from the threat of landmines. A total ban on landmines is, therefore, crucial for the total eradication of the landmine problem.

Securing Sufficient Funds

Securing sufficient funds and resources for the sustainability and expansion of the ongoing mine action activities is one of the main tasks of the future. Irregular funding or a lack of funding for mine action activities seriously affects th e productivity of these activities. If sufficient resources are made available, mine clearance operations could be expanded and high-priority mined areas could be cleared in a rather short time. These resources would save time and would allow for quick rehabilitation, repatriation, and resumption of essential socioeconomic activities and reduce civilian mine casualties. It is hoped that more funds will be allocated by the international community in the coming years due to the increased international aw areness of the landmine problem, and events such as the Ottawa landmine ban treaty and the award of the 1997 Nobel Peace Prize to the International Campaign to Ban Landmines (ICBL) certainly have helped to raise such international awareness. Initiatives such as Demining 2010 and "zero victims" are obviously steps in the right direction. However, the challenge is not only to secure more funds but also to make sure that the resources made available are properly and effectively used. Principles established by the ICBL working group on mine action are very useful in this regard, and they must be followed.

Research and Development Goals

The development of new machines, techniques, and procedures plays an important role in humanitarian mine clearance operations. Efforts must be made to develop new procedures and techniques as well as simple and inexpensive field-oriented equipment that can enhance the cost efficiency, productivity, and safety of mine clearance operations. The survey and research work can be divided into the following three fields:

1. **New Procedures Developments**

   The development and introduction of new procedures and techniques to the humanitarian mine clearance operations must be

given due attention. Trials have to be conducted and more appropriate techniques and procedures investigated and introduced to mine clearance operations. For example, in Afghanistan, the conduct of trials and the introduction of more appropriate procedures and structural changes in the mine clearance teams have considerably increased the pro ductivity of mine clearance operations. The clearance cost per square meter has been reduced from US$1.68 to US$0.65, and the number of mine incidents during clearance operations has decreased by 30-40%.

2. **Appropriate and Field-oriented Devices and Equipment Development**

The Afghanistan experience shows that the use of high-tech machines is neither reliable nor practical, nor is it cost effective. In 1995, after a careful assessment of the situation, the use of machines was stopped in Afghanistan. The cost of clearance per square meter of mechanical clearance was much higher than that of manual clearance for the same area. Also, the land cleared by these machines was not as reliable as la nd that had been cleared manually.

However, some simple machines such as backhoes can easily and cheaply be modified into effective mine clearance tools that are particularly helpful in the clearance of residential areas and irrigation canals. In Afghanistan, the use of these machines re vealed a 300% increase in the productivity of mine detection and removal.

The mine affected countries who are suffering from fragile post-war economic conditions cannot afford much of the sophisticated and expensive technology supplied by outside organizations. Terrain and weather conditions also restrict the use of complicated, high-tech clearance technology. Therefore, any research activity should be oriented toward and tested in the actual minefields. Input must be taken from real minefields, and those individuals involved in demining activities in the field must be consulted.

3. **Minimum Metal and Explosive Detection Devices Development**

Some practical progress has been made in the field of minimum metal detection (e.g., the development of a metal detector with high sensitivity). The introduction of a highly s ensitive metal detector to mine clearance operation in Afghanistan has, to some extent, helped with the detection of minimum metal mines. However, the cost of the highly sensitive metal detector is almost three times more than that of a common metal detector, and the

high sensitivity detector cannot be used in areas contaminated with large numbers of metal fragments.

The introduction of the mine detection dogs to the mine clearance operations in Afghanistan has considerably increased the productivity of demining operations. However, mine detection dogs have their own limitations and weaknesses. For instance, they cannot work in windy seasons, very hot or very cold weather, and cannot work effectively for extended periods of time. Therefore, the main future task for those involved in the research work of humanitarian mine clearance is the development of a cheap and affordable device that can detect explosives. Some sort of hand-held sensor or a radar system that can clearly determine the size and the shape of a buried object are also to be investigated.

Coordination and Formal Exchange of Experience

The world-wide humanitarian mine action programs should formally exchange the experiences and expertise they have gained in the field of humanitarian mine clearance. The development of a new and effective method and procedure requires time, energy, a nd resources. Existing techniques in one part of the world can easily be modified and adopted in another area, which saves time, energy, and resources. Therefore, a formal exchange of visits of technical and management staff of the world-wide mine action programs should regularly take place to allow an exchange of views and experience. This information exchange will help in the development of new techniques and procedures. An exchange, or secondment, of concerned staff among various mine action organizations for short periods of time can be another practical way to learn from the experience of others.

Conclusion

In order to address the landmine problem from a humanitarian viewpoint, all the interrelated aspects of mine action are to be taken into account. Even though the current technology used for humanitarian mine clearance is slow and not absolutely safe, it is still practical, reliable, and affordable. In order to enhance the productivity, cost efficiency, and safety of humanitarian mine clearance, due attention has to be paid to the development of affordable, easy to operate, and field-oriented technology. The efforts made in various parts of the world to address the landmine problem require coordination, and the experience and expertise gained in this field has to be exchanged. Sufficient funds must be made available for ongoing humanitarian mine clearance operations so that the high-priority areas are cleared as soon as possible to facilitate the return of refugees and internally displaced persons and to allow necessary socioeconomic activity to resume in mine-afflicted areas.