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Is it Time for New Terminology in Land Release and Technical Survey?

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Survey and Land Release: Lessons from Recent Country Experience

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Suspected Hazardous Areas bring fear to local communities and hinder socioeconomic development, but in most cases the majority of the land contains no mines at all. Survey for land release may put an end to this fear, and it allows for an accelerated solution to the landmine problem.

Mines kill; clearing mines saves lives. With the dramatic fall in the number of new victims in most mine-affected countries, however, the primary justification for mine action today is to support development. Suspicion that land is mined interferes with community and national economic development, poverty reduction, reestablishment of communities, and private-sector investment. Suspected Hazardous Areas reflect community fear. Land release supports development by eliminating this fear.

Unnecessary Practices

The total area suspected of being mined is too large for the resources available for clearance throughout the world. The process of fully clearing all such areas is slow and expensive, and it requires many decades to complete. Most suspect land has no mines; in my experience, less than 5 percent of SHAs prove to have any mines in most countries, and many clearance operations find none at all. Two-thirds of the clearance tasks concluded by Handicap International–Mozambique in 2008 found no mines/explosive remnants of war.

Landmine-hazard information is essential for planning by community and development operators—if their project crosses through a suspected-mined area, they want it cleared. For government ministries and nongovernmental organizations, this may include specific plots of land where they plan to build a school, market or road. For private investors, this may include land to provide access to or expand factories, commercial farms, natural-resource mines or oil fields. A poor farmer may decide to accept the risk directly. A commercial contractor may not be able to obtain insurance for its work until the land is certified safe. In such situations, a land-release approach will provide a more rapid response to development-operator needs, while requiring fewer resources and leaving more resources for other tasks. For example, a majority of Mines Advisory Group–Cambodia tasks support international NGO community-development projects. The NGOs want to be certain that there are no mines in their project sites, and they insist on clearing the land. While their desire for "peace of mind" clearance is understandable, it results in poor use of resources. In 2007, in the absence of a nationally accepted land-release approach, over 50 percent of MAG's clearance tasks produced no mines.

> Surveyors frequently respond to community concerns and uncertainty by identifying SHAs where the community fears them to be, even though more complete information might indicate there was no hazard.

Until recently, it was customary for Norwegian People's Aid–Angola to clear 100 percent of any area identified as suspected of containing landmines. This policy resulted in the clearance of many areas without mines and a low ratio of mines found to hectares cleared. Since early 2008, NPA (with the support of the Geneva International Centre for Humanitarian Demining) has been developing a land-release approach to Technical Survey in Angola.

According to a concept paper by NPA–Angola, "In the past, no risk-management assessment was ever made to evaluate this risk, and the alternative option chosen was to manually clear ever-increasing areas of land, almost always without finding any mines. This 'safe' option was in fact a wasteful use of mine-clearance resources. These resources, which are often scarce, should be used to the benefit of the local people with actual landmine problems. Land-release concepts similar to the model used by NPA will ensure an efficient clearance of minefields and a higher percentage of land returned safely to society."[1]

Extensive Technical Survey for resettlement of internally displaced persons, Zobjug, Azerbaijan, released after mechanical preparation and visual inspection.
PHOTO COURTESY OF ANAMA

Landmine Impact Survey

Land release does not save lives directly, since the land released generally had no evidence of mines in the first place. Clearing land without mines is an expensive way to enable development and is a poor use of resources. It is reasonable to clear all mines, to release all areas that are not mined, and to investigate further those areas that are doubtful in order to determine which areas have evidence of mines and which areas do not, and to clear or release them accordingly. The land-release approach is a significant change to both the strategic and operational roles of mine action. It centers on the collection and use of improved information to more effectively apply demining assets and return more land to safe use at a quicker rate.

The mine-action database, often based on a national Landmine Impact Survey, contains the best information available at the time it was collected. The LIS is, however, based primarily on local suspicion about potential hazards on land not in use. It indicates the extent of the problem, the area affected, the number of victims, the number of communities and people affected by landmines, and the socioeconomic activities blocked. How can it be that well-documented SHAs turn out to contain no mines or ERW, and the vast majority of area cleared has no mines at all?

The strength of the LIS is the focus on the impact of landmines on communities, but it tends to provide large and imprecise estimates of SHAs. These surveys were always conducted with the expectation of technical follow-up for operational planning. On the other hand, there is substantial evidence that the local population does not use some parcels because they suspect that mines may be present, even though the site proves to contain no hazards. In the absence of complete information, surveyors frequently respond to community concerns and uncertainty by identifying SHAs where the community fears them to be, even though more complete information might indicate there was no hazard. At the same time, there is substantial empirical evidence that local populations make use of land previously recorded as hazardous. In some cases this may be in spite of the hazards, while in other cases it may reflect local knowledge

> It is likely that there are similar misjudgments in other countries that have recorded communities as mine-affected based on community suspicion.

that the specific parcel does not contain hazards. The Information Management System for Mine Action created certain distortions in the data; for example, repeat identification of the same SHA due to its influence on more than one community may appear as "pancakes" on IMSMA-produced maps.

When the LIS is conducted by teams trained and equipped to produce more precise SHAs, the results are dramatically better. For example, during the Angola LIS, one of the six implementing partners included precise polygon figures as a task of the survey teams. As a result, the average size of SHAs produced in their area of operation was only one-ninth the average size for all other implementing partners combined. Adding this task to the survey teams required slightly more time in each mine-affected community but did not measurably increase the calendar time required for the survey fieldwork as a whole.

Better Information

It is important to periodically resurvey and continually update the national database with improved local information. Information improves with follow-up surveys for one or more reasons, including the following: more sources will be available to provide more complete information and more accurate descriptions; local populations will have learned more about their situation; local populations will have been using parts of the SHA and in the process, encountered or not encountered evidence of mines; local populations and/or clearance operators may have conducted clearance in the area; and General Survey teams may be trained and equipped to more precisely estimate the boundaries of the SHA.

For example:

- In Bosnia and Herzegovina, the original estimate of contaminated area made in 1996 of 4,200 square kilometers (1,622 square miles) has been repeatedly revised downward to reflect improved information and clearance. The beginning 2008 estimate was 1,755 square kilometers (678 square miles), with only about 100 square kilometers (39 square miles) expected to require full clearance.
- In Cambodia, MAG and The HALO Trust identified nearly 800 square kilometers (309 square miles) of LIS-suspect land reclaimed for use by villagers, while the Cambodian Mine Action Centre determined that, in the high-casualty districts which it resurveyed, 76 percent of the LIS SHAs were no longer suspect, although another 46 percent not originally included in the LIS should be added.
- In Azerbaijan, based on systematic review on the ground with district administrators, the Azerbaijan National Agency for Mine Action reduced the total SHA to 306 square kilometers (118 square miles) from 746 square kilometers (288 square miles) in the LIS, with the further estimate that only 29 square kilometers (11 square miles) will require full clearance.
- Ethiopia provides the most dramatic example of change: resurvey of 1,018 communities in 2008 (two-thirds of the 1,492 affected communities identified by the Ethiopian Landmine Impact Survey) confirmed 892 communities as mine-free, including 28 with mine problems eliminated by spot-clearance activities of the survey teams, and cancelled over 95 percent of the SHA.

How is this last example possible? Was Ethiopia's LIS severely flawed? Is it simply that the local popula-

> If there is a reason to believe that the area and number of mines are small, the Technical Survey operator will often clear the hazardous area within the framework of the Technical Survey.

tion understood how to play the aid community and provided answers that were most likely to obtain more resources? The Ethiopian Mine Action Office staff involved in the resurvey process found that in nearly all cases, the community had a clear and reasonable basis for their suspicion. Common reasons for suspicion included past or current location of military positions or trenches and knowledge of past mine incidents. However, in the vast majority of cases, the survey team determined the suspicion did not reflect the current presence of mines/ERW. While there is no indication that this degree of misapprehension is widespread, it is likely that there are similar misjudgments in other countries that have recorded communities as mine-affected based on community suspicion.

This Jangamo, Mozambique SHA was not cultivated for many years until it was released through Non-technical Survey.
PHOTO COURTESY OF THE AUTHOR

Quality information about landmine hazards is essential for quality mine action. First, overall information provides an overview of the national problem and is the basis for determining broad priorities, national strategy, multi-year plans and resource requirements. Second, improved information enables a national program to refine an imprecise SHA and thus more accurately delimit a demining task area. In so doing, it may release large amounts of land listed as suspect in the national database but sometimes used by the local population. This data also supports local planning efforts for land use, economic development and investment, as well as for mine-action priority-setting among SHAs. Third, further information gained within the task area may enable the clearance operator to reduce it to a smaller area for full clearance. This supports task planning and improved focus of demining assets on specific square meters of land containing mines. The mean number of mines found per hectare of cleared land in the countries reviewed more than doubled since the introduction of Technical Survey.[2] As a rule, the General Survey cancels significant areas from the database, making it available for investment planning, and prepares specific requirements for Technical Survey. Both Technical Survey and clearance release land to end users and remove it from the database.

Technical Survey for Land Release

While the specific General Survey criteria applied in each country are based on national experience, individual countries tend to incorporate many of the same criteria: local use of the land in a way that would have encountered mines if they were present; indications of past military activity in the area—including military installations and evidence of the presence of mines—and community conviction that the area is free of or affected by mines.

High-quality standards, standard operating procedures and professional judgment must be exercised to determine whether the information collected is sufficient to warrant the release of a given area. Examples of criteria considered by different programs include:

- Locals have used the land in question for farming, cattle grazing or other agricultural activities for a specified period (e.g., three seasons) without evidence of mines

Experienced staff in each of the programs affirmed that their programs could advance more rapidly without sacrificing safety if they were allowed to adjust the interpretation of standards based on acquired experience.

- Land in question has been plowed completely to a specific depth at least three times
- There have been no mine/ERW incidents reported for at least a specified period of time
- No emplanting of mines was reported or observed
- There are no military installations nearby
- There were no military confrontations in this area
- No evidence of mines or ERW has been found
- Survey team checked high-suspicion spots and found no evidence of mines
- Locals are confident that the area contains no threat

Several countries have concluded that it is beneficial to include qualified demining/explosive-ordnance-disposal staff on the General Survey teams in order to verify information and to resolve small tasks. The Bosnia-Herzegovina Mine Action Center uses deminers on General Survey teams to check the spots where incidents have been reported. The Ethiopian Mine Action Office found that experienced deminers were an essential component to enabling General Survey teams to disconfirm many entire SHAs, and to resolve about one-sixth of valid SHAs caused by small-area contamination.

The purpose of Technical Survey for land release is to provide confidence that a specific area contains or does not contain mines. It starts from the assumption based on experience that a specific SHA probably contains no mines and that the way to negate that hypothesis is to adequately test the land to find evidence of mines. Assets are applied according to nationally accepted standards and standard operating procedures for "all reasonable efforts" to identify areas with evidence of mines.[3] These SOPs are "lighter" than for clearance, and typically include mechanical preparation of the full site, or lanes provided by machines or mine-detecting-dog teams, with extensive visual inspection or checking by a single dog. If the suspicion is confirmed, the area is subjected to full clearance, building on relevant actions already taken during the Technical Survey. In practice, if there is a reason to believe that the area and number of mines are small, the Technical Survey operator will often clear the hazardous area within the framework of the Technical Survey. If no evidence is found, the specific subsection may be released as an area without evidence of risk. To the extent that this is practical, the amount of clearance and cost will be lower than with full clearance of the entire task site. In Azerbaijan, the Azerbaijan National Agency for Mine Action has found that the cost per square meter of releasing land through Technical Survey is about one-third the cost of traditional clearance.

Standards for Land Clearance and Release

In Ethiopia, areas within the polygon produced by Non-technical Survey are identified as *risk* and *low-risk* areas. Risk areas are understood to be minefields that require clearance. Low-risk areas are ones without sufficient information to classify as risk areas or to rule out such areas. Sampling and other verification methods are applied to low-risk areas to determine whether they contain mines or can be released. Since the purpose is to find any evidence of mines, the most likely locations are all checked (e.g., paths, water sources, clumps of trees), while other areas may be sampled. In principle, 100 percent of the designated area will be treated in this way and released as an "area without evidence of risk" unless specific evidence of mines is found. When evidence is found, nationally accepted SOPs are applied to determine the extent of area to be cleared, often only a small portion of the initial task area.

Developing national standards and SOPs for Technical Survey involves the application of professional judgment gained through years of experience in the national program. Experienced staff in each of the programs affirmed that their programs could advance more rapidly without sacrificing safety if they were allowed to adjust the interpretation of standards based on acquired experience. Some of the options included: partial ground preparation with increased use of visual search, single-dog searches, coverage of sites by flails or brush cutters, faster detector sweeps and less sweep overlap.

Some programs adjust the extent of "light" methodologies according to the degree of confidence in the suspicion that an area contains mines. NPA–Angola established a six-step scale extending from "certain there are mines" to "certain there are no mines," with intermediate steps reflecting weak and strong suspicion (but not certainty) that there are or are not mines in a given area. If there is certainty of mines, the land is cleared; conversely, if there is certainty of no mines, the land is released. If there is strong suspicion that there are mines, a higher percentage of the area will be sampled and verified in order to find any evidence of mines; conversely, if there is strong suspicion that there are no mines, a lower percentage of the area will be searched or verified to find any evidence of mines. Finding (or failing to find) evidence of mines would result in certainty that there are (or are not) mines, and the corresponding action (clearance or release) would occur. The specific level of sampling and verification may be guided by international experience, but should be determined based on national experience. NPA–Angola distinguishes specific percentages of coverage for different demining assets when used for land-release Technical Survey, according to program experience regarding the reliability of each asset in finding evidence of mines.

Improved Mine-action and National Standards

In addition to the value of a land-release approach to General and Technical Survey, recent country experience highlights several related measures to improve the support of mine action for development:

- With increased release of land without full clearance through Non-technical and Technical Survey methods, there is a need for appropriate documentation (not a clearance certificate) that declares the land to be an "area without evidence of risk." This documentation may be a legal requirement for many development organizations. It is not a statement that the area is mine-free, because it has not been cleared; it is a statement that a reasonable effort was made to find mines and no evidence of mines exists. Land release does not simply lower the priority of an area to leave it for later treatment. Land that has been determined to be an area without evidence of risk can be used with confidence and should not be subject to further clearance efforts unless the situation changes.
- The objective of mine-action programs should be to ensure that all land achieves an "end state" as an area without evidence of risk, based on the application of "all reasonable efforts" to all SHAs throughout the country. Even so, isolated mines/ERW and possibly entire previously unknown minefields may appear over time, and there will be a need for an institutional capacity to respond to such cases. This response could be through a contracted specialist entity, through civil protection or the military, or it could be a residual capacity of the current national operators.
- An essential component of that residual capacity is the continuing existence of the national mine-action database with the record of all past SHAs, all clearance and other land-release actions. When future changes in land use are proposed that could increase risk (e.g., excavation for urban construction), if appropriate, information can be checked and the site verified and cleared, much like if there were geological, environmental or other land-use issues. This applies whether the land has been cleared or released based on new information.

Although situations may have changed significantly since the LIS was conducted, the LIS report is in most cases the internationally accepted baseline regarding the landmine problem of each country, and it should be updated regularly to reflect both operational progress and improved information. In addition to traditional indicators of efficiency of clearance teams, programs should report on the effectiveness of land release, together with indicators of overall program effectiveness in reducing the landmine problem. Such indicators might include:

- Number of LIS-identified high-, medium- and low-impacted communities free of SHAs
- Total area or percentage of released land in use
- Amount and percent of suspect area released (seek high[4])
- Number of mines found per hectare of task polygon (seek high)
- Number of mine-clearance tasks without mines (seek low[5])

Community/end-user information is essential to determine when the mine-clearance effort is finished. The work of the mine-action program is not complete if end-users are not using land that has been released because they are not confident that it is safe. An excellent example of how to ensure that land has been effectively released from mines and suspicion is provided by the 2004–07 HALO Trust–Mozambique mine-impact-free districts project. Convinced that clearance of all mined areas in the four northern provinces of Mozambique was nearly concluded, HALO undertook a systematic resurvey of all communities in those provinces to determine whether there were any remaining mined areas affecting the communities, to clear any that might be identified and to obtain written acceptance from the community and local authorities that their areas were now mine-impact-free. In the process, HALO identified 74 previously unknown SHAs and cleared an additional 176 mines, which represents an additional 16 percent of SHAs (two-thirds of which proved to contain no mines) and a 0.2-percent increase in total mines cleared in the four provinces. Communities previously not comfortable using the land were prepared to use it once their suspicions had been removed by these actions. This situation is a good example of the need to remove community suspicion of mines as part of the professional completion of mine action. Most programs have paid only very limited attention to this issue. However, as programs near completion at the national and local level, it is important to document this progress with the community, donors and other stakeholders.

In order to take full advantage of Technical Survey and land-release approaches, there is a need for a national strategy on the subject, national standards and SOPs to implement it and supportive IMAS.[6] Similarly, the type of quality assurance appropriate to Technical Survey needs to be determined—ground sampling is still appropriate for clearance, but not as relevant to survey as information-gathering. National standards and quality-assurance procedures should be adapted to permit careful development, testing and wider use of land-release procedures to increase the effectiveness of mine action. The Survey Action Center is currently working with the National Demining Institute to make the land release in Mozambique operational.

Conclusion

Effective implementation of the land-release approach will accelerate solutions to the landmine problem through improved information-gathering. Experience has shown that large areas and numbers of SHAs can be released from suspicion by teams combining General and Technical Survey skills, resulting in more effective use of clearance assets by ensuring they are concentrated as much as possible on areas likely to have mines. Land release is a better way to ensure that more communities and development projects benefit sooner from a solution to the landmine problem.

This article draws on research the author conducted for the GICHD ("Survey and Land Release"), and the Survey Action Center ("Mine Action Program Use of LIS Information Several Years after Survey Completion" and "Use of Minefield Information by Development Operators"). The opinions expressed are those of the author, and do not necessarily reflect those of the GICHD, SAC or of individual programs cited (Angola, Azerbaijan, Bosnia and Herzegovina, Cambodia, Ethiopia, and Mozambique). ✥

See Endnotes, page 62

For additional references related to this article, see http://tinyurl.com/krx5y.

Charles Downs is a mine-action consultant. He has worked in international development for over 30 years and was Chief of the Mine Action Unit of the United Nations Office for Project Services from 1999–2004. He has been part of the Geneva International Centre for Humanitarian Demining and SAC efforts to encourage national governments to integrate land release in their survey and clearance efforts, and has assisted the United Nations Development Programme–Colombia in development of its mine-action strategy. Downs is also a Professor of International Project Management at New York University's Wagner School.

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News Brief

Geneva Call Holds Second Meeting

Geneva Call, a nongovernmental organization dedicated to working with armed non-state actors to facilitate compliance to international law regarding civilian rights, held its second meeting for the *Deed of Commitment for Adherence to a Total Ban on Anti-Personnel Mines and for Cooperation in Mine Action.* More than 40 representatives from 28 signatory groups, representing 25 countries, attended the meeting in Geneva on 18 and 19 June 2009. The meeting was held to discuss the challenges NSAs face in implementing humanitarian norms, in particular the banning of landmines. The meeting was the first of its kind to allow participants to express their own views on how they could implement a wide array of humanitarian issues, with particular interest paid to the protection of women and children in conflict-ridden areas.

In 2009, Geneva Call has successfully convinced non-state actors—internationally non-recognized and partially state-recognized groups—to sign the *Deed of Commitment.* According to Geneva Call, four separate groups have signed the document since March 2009, and since the inception of the document in 2001, 39 non-state actors have banned the use of anti-personnel mines. Most of the NSAs operate in conflict-torn regions in Africa and the Middle East.

Is it Time for New Terminology in Land Release and Technical Survey?

by Robert Keeley [RK Consulting Ltd.]

Overlapping terminology has contributed to confusion in the demining process and stunted the development of Technical Survey as a potentially effective concept. This article points out places where ambiguity exists and suggests ways that the terminology can be clarified.

In these two pictures, taken in Senegal in 2005, the concepts of "probably clear" and "probably mined" are clearly demonstrated. The boundary of the "probably mined" area is shown by the unattended vegetation next to the school building, highlighted by the arrow. In the picture on the right, the school playground is seen to be in regular use by the population. The problem comes in differing perceptions of "risk." What will happen when the little girl's ball (circled) someday disappears into the bush behind her?
ALL GRAPHICS (EXCEPT MINESWEEPER) COURTESY OF ROBERT KEELEY

Put three deminers in a room together and you are likely to get five definitions of the term *Technical Survey.* Disagreement about the exact definition of *Technical Survey* exists because the term has not been clearly defined. This ambiguity is problematic for two reasons:

1. Technical Survey and land release can improve the productivity of demining. If deminers choose a different method because of the ambiguity in Technical Survey terminology, they may resort to manual demining. Manual demining is slow, expensive, and in areas where the contaminated land is of marginal value, it can mean that the cost of remediation outweighs the economic benefits of clearing the land. As a result, there is considerable incentive to improve the productivity of demining.
2. Where one finds ambiguity in a concept's definition, there is, theoretically, the possibility of turning to the International Mine Action Standards for guidance. Unfortunately, while the current edition of the relevant standards (IMAS 08.20[1]) provides excellent advice on the color and spacing of marker posts once a survey is completed, it provides little advice as to how a Technical Survey might actually be conducted. This manifest weakness damages the effectiveness of what is otherwise a very helpful set of guidelines.

Work is being undertaken by the Geneva International Centre for Humanitarian Demining and others to revise IMAS 08.20. Hopefully, this revision process will help clarify some of the confusion over definitions. In addition, this article aims to clarify these concepts and will do so in three ways. First, it will set out a taxonomy of current concepts in mine action to highlight where we are misapplying terminology. Second, it will critique one of the Technical Survey concepts and demonstrate how this confusion is allowing poor techniques to persist. Third, it will set out ideas for a clarified set of terminology in order to help direct future discussions of these issues.

Existing Terminology

According to IMAS, “The primary aim of a Technical Survey is to collect sufficient information to enable the clearance requirement to be more accurately defined, including, inter alia, the area(s) to be cleared, the depth of clearance, local soil conditions, and the vegetation characteristics.”[1]

The phrase “including the area(s) to be cleared” suggests a role for Technical Survey in what is known as *area reduction*. This differs from the role of Technical Survey laid out in the rest of the definition, which relates more to gathering information about the land to be cleared, but not about how to perform the clearance process. It may be the multiple roles for Technical Survey that lead to some of the confusion in its terminology.

I have found at least eight different Technical Survey (or closely related) concepts in mine action. These are summarized on the next page in Table 1. Readers will see that definitions 1–3 are most strongly related to the concept of area reduction. Note that this table only defines the processes and does not outline the various strengths and weaknesses of the different approaches. Some of these concepts, specifically Ser. 1, 3, 5 and 6, are simply referred to as *Technical Survey* by their practitioners—they do not have their own names. The names in column (b) have therefore been added to differentiate between them.

The term *risk reduction* (Ser. 8 in Table 1) is a good example of the problem of ambiguity. The same term has also been used to describe a clearance project where full clearance techniques are used, but where it is recognized that the project will not be able to deal with all of the landmine/UXO contamination—exactly the converse of the definition described in Table 1. Similarly, the term *land release* is sometimes used to describe a comprehensive suite of processes rather than simply “cancellation” of land already in use.

“Join the Dots” and Related Sampling Techniques

One of the main issues with the lack of clear terminology is that it allows conflicting concepts to coexist without a critical analysis of the problem. Technical Survey aspires to do the job faster and cheaper. However, just because the idea behind efficient Technical Survey exists, it does not mean the techniques necessary to achieve these goals have materialized.

This can be demonstrated through a critique of the process called “join the dots” in Table 1. At first glance, this technique, when sketched out on a scrap of paper, appears effective. However, this technique can only work where the density of the mine contamination has a maximum, not average, distance between mines that is less than the width of the breaching lane, or the breaching party would go right through the minefield by mistake.

This can be verified by anyone with access to a computer running Microsoft® Windows software. Simply select the custom option of Minesweeper, the computer game that comes with Windows, and vary the density of the mine pattern. Then prepare a plan for playing the game as if it were a breaching exercise. See what pattern you would have identified and how it compares with what was actually in the game; the lower the density of the actual contamination, the less effective the breaching plan will be. Statisticians would approve of this rather simplistic test because Minesweeper generates random numbers better than any sketch drawn by a human on a piece of paper. An analysis of 10 iterations of Minesweeper provides the results as set out in Table 2 (next page).

While more games would improve the statistical significance of the results, the mean percentage of mines discovered in the defined areas as a result of this sampling process can be rounded up to around 68 percent, with a confidence interval of around +/- 8 percent (i.e., the process will find between 60 percent and 76 percent of mines at this density and search pattern) and a confidence of 95 percent in the overall result of these calculations.

Please take a look at the Minesweeper screenshots on page 22. In the first screenshot (top left), the custom Minesweeper is set up to the maximum size of 30 by 24 squares (720 squares). The game is also set to 10 mines, giving a ratio of mined/non-mined of 1/72. The standard breaching pattern is then established (in this case, one lane every five squares) which is, therefore, sampling 120 squares (120/720 or 1/6 or 18 percent).

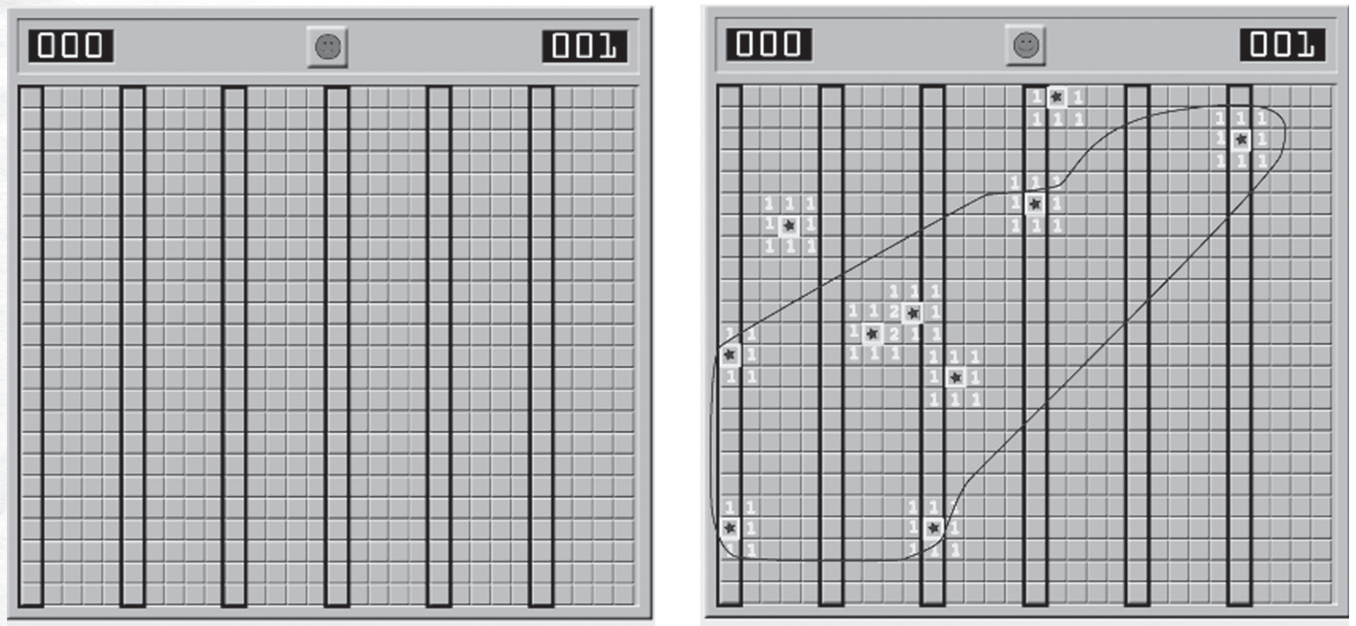
In the second screenshot (top right), the results are revealed. The breaching technique would have found five out of the 10 mines (50 percent), but use of the “join the dots” boundary marking

Ser.	**Description**	**Explanation**
(a)	(b)	(c)
1	Join the Dots	The insertion of a number of lanes at regular spaces into an SHA. Once a mine has been detected, the lane is closed. The boundary of the “definitely mined” area is then determined by joining the points together. The areas between the lanes are not searched.
2	Advance to Contact	Similar to Ser. 1 except the demining assets, particularly dogs and/or machines, advance on a broad front across the SHA so that all land is searched until contamination is found.
3	Percentage Sampling	A specified percentage of the SHA is sampled. If no landmines/UXO are found in the sampling, no further search is done. The “join the dots” process at Ser. 1 is a form of sampling.
4	Delineation	Demining teams clear a boundary around either an SHA or a project site within an SHA so that full clearance can be done within the boundaries. The process does not specifically reduce the area, although it may imply that the area outside of the demarcated boundary is not considered contaminated.
5	Investigation	Demining teams push lanes into an SHA in order to understand the nature of the contamination, required search depth and the soil and vegetation conditions. No land is released, and the process does not in itself define boundaries.
6	Land Release	This is a Non-technical Survey process by which possible SHAs are identified from preliminary General Survey processes. Land that has no specific mine indicators, and that is in general use, might be released without any further action; land that cannot be released might be subjected to Technical Survey and/or full clearance. Sometimes also referred to as land cancellation.
7	Risk Management	Although not a Technical Survey process, risk management is an analytical process intended to focus demining activity on land that is either most likely to be contaminated or is most likely to be used by beneficiaries within contaminated areas. Areas are thus reduced by disregarding land that is either not likely to be contaminated or is contaminated but has little socioeconomic impact. This concept can form part of the land-release process.
8	Risk Reduction	Although not a Technical Survey process, risk reduction is intended to maximize demining outcomes by focusing inputs on achieving a large area in which most of the mines are removed by the application of machines; the idea is that removing roughly 80 percent of the mines in a large area is more beneficial to the population as a whole than removing all of the mines in a small area.

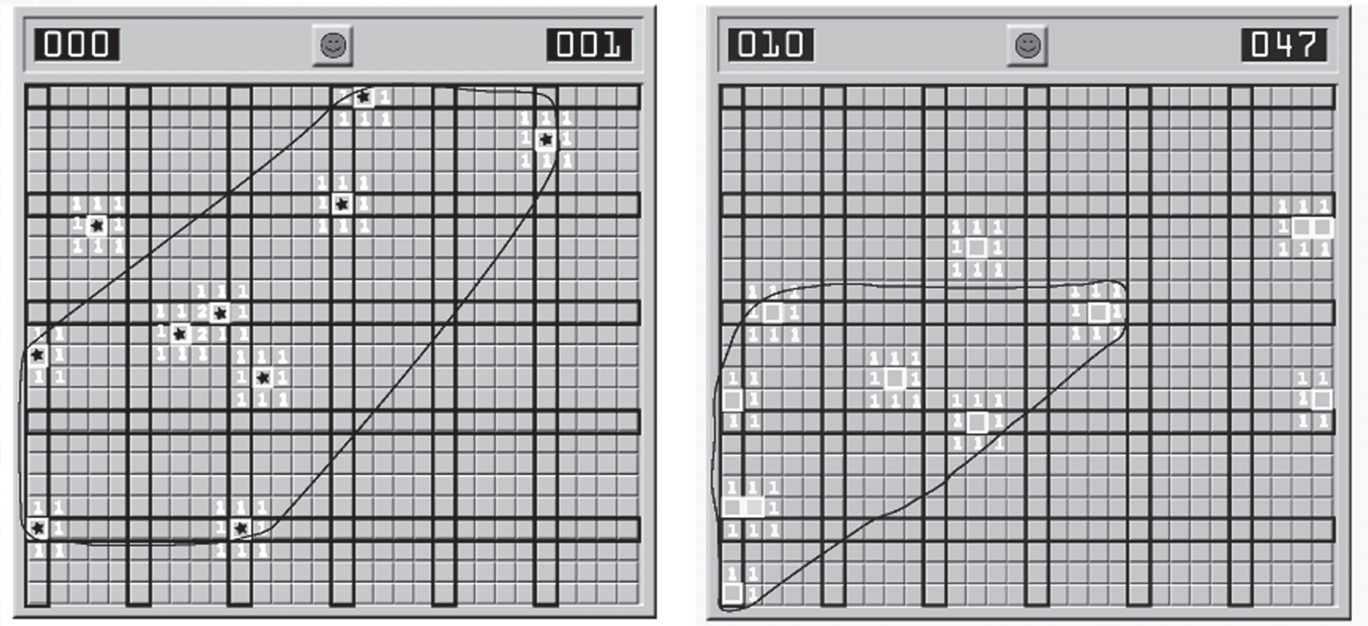
Table 1: A taxonomy of Technical Survey processes.

Item	**Game**										**Mean**	**SD**	**CI**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			
No. of mines found	5	4	3	7	4	4	5	5	4	7	4.8	1.3	.82
No. of mines included “by chance”	3	3	3	2	1	2	1	2	2	1	2.0	0.8	0.51
No. of mines remaining outside of defined area	2	3	4	1	5	4	4	3	2	2	3.0	1.2	0.77
Total (check sum)	10	10	10	10	10	10	10	10	10	10			

Table 2: Analysis of 10 Minesweeper games.



Using Minesweeper as a random generator to test breaching techniques, the stars represent where landmines were found and marked.
ALL MINESWEEPER IMAGES WERE CREATED BY MAIC UNDER MICROSOFT'S "GAME CONTENT USAGE RULES" USING ASSETS FROM MNESWEEPER®, MICROSOFT CORPORATION]



Using Minesweeper as a random generator to test breaching techniques, the stars represent where landmines were found and marked.
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process would have found 80 percent of the mines. However, this still leaves two mines unaccounted for.

In the third screenshot (bottom left), the agency has improved the quality of its breaching technique by adding some lateral breaching lanes, sampling 270 squares out of 720 or 37.5 percent (which also more than doubles the cost of the breaching). In this case, an additional one of the "missing" mines would have been found, but the results were still only 90-percent effective. The mathematical relationship between density of minefield contamination, percentage sampled and percentage effectiveness can start to be seen. One can imagine that eventually a sampling pattern is set so dense (in order to cover every mine), that it is actually cheaper to set out a simple clearance task.

In the final screenshot (bottom right), the game is replayed, allowing Minesweeper to generate another random pattern of the same density. In this case, our standard breaching grid not only identifies 50 percent of the mines, but also makes a significant error in estimating the boundary of the definitely-mined area. Thanks to Minesweeper, this thought experiment is easy to replicate independently.

It is unlikely that a potential customer of this process or beneficiary of this mined land will be content with these percentages. Remember, recognizing that risk is a function of activity means that a single missed mine is very significant when turning this land (which previously was not used due to a fear of mines) over to a population and encouraging them to use it. Their risk is increased because they have a greater chance of encountering a mine than if they continue to remain outside the perimeter, where they are at zero risk. Given that, in this model, where 37.5 percent of the area would have been searched, the cost is probably not cheaper than a full clearance project, which would have been simpler to administer and manage.

The model is based on a very high density of sampling—one lane in five—so it is conservative compared to "typical" suggested breaching patterns of one lane every 25 meters (82 feet), and it is evidently questionable even in areas of comparatively high mine density. Lower densities of contamination would provide even less impressive results. In short, sampling for mines is only likely to work where it can be strongly predicted that the mines are laid in patterns. Circumstances of "uncertainty" (e.g., random-patterned minefields and submunition-strike footprints) do not seem to lend themselves to sampling.

As an aside, I'd like to note that we often use the terms *risky* and *uncertain* interchangeably, but statisticians have recognized a conceptual difference for some time. For example, when asked to predict the "risk" of drawing the Queen of Spades from a new, "fair" pack of cards, it can be easily calculated as 1:52. This is because even though we don't know where in the pack of cards the Queen of Spades is, we do know that there is only one of them and there are 51 other cards in the pack. Now imagine a situation in which the dealer is seen to take an unknown number of cards from the pack and place them in her pocket, before asking you again to draw the Queen of Spades. We now do not know how many cards are still in the pack and even if the Queen of Spades is present at all. Thus, we are not able to use statistical methods of predicting the risk as we don't have enough information about the circumstances, and are in a condition of "uncertainty." In the context of demining, whereby minefields are laid in regular patterns, one can imagine being able to use a statistical method to calculate the risk of encountering a mine with a particular sampling method, but where there are unknown numbers of mines in irregular patterns, conditions of uncertainty exist.

A critical reader might ask about the relatively small number of casualties in land that has been sampled under these unclear concepts. Personally, I know of at least three accidents that have occurred after this type of land sampling. While even one accident is too many, there are several explanations as to why there are few reported casualties. The main reason is that most of the land is not mined. In such circumstances, even a poorly executed procedure can appear effective because there is no potential for casualties anyway.

New Set of Concepts and Terminology

So far, examples of overlapping terminology that exist in the domain of mine action have been reviewed.

Category	Definition	Remarks
Definitely Clear	Land that has been cleared to IMAS or relevant national standards and has an available clearance certificate. The boundaries of the cleared area are clearly defined and identifiable.	
Probably Clear	Land that is in general use by the local population, and does not contain casualty reports or other indicators of contamination. May also include cleared land that does not meet the full criteria of "Definitely Clear."	
Probably Mined	Land that is not in general use, or does not otherwise meet the definition of "Probably Clear," but with only indirect indicators of actual contamination.	May include contamination but the boundaries of the actual contaminated area cannot be defined.
Definitely Mined	Land that can be identified as mined by the presence of one or more direct indicators and where the boundaries are clearly defined.	

Table 3: Land-contamination definitions.

Where definitions are not mutually exclusive, problems of ambiguity can be found and, therefore, need to be redefined. However, we should first review a few of the core concepts. One problem, presented by the discussion above, is a different acceptable end state from various survey processes than is expected from full clearance. While this may not be acceptable from a customer's or beneficiary's perspective, there can be no clear debate while the terminology is so disordered.

When discussing concepts and terminology, the principles in Table 3 (previous page) are suggested as a possible set of concepts. The list is ordinal where the least contaminated land is located at the top and the most contaminated land is located at the bottom.[2] This table is more logical than presently used terms, such as *Suspected Hazard Area*, *Confirmed Hazard Area* and *Defined Hazard Area*. It is also useful because it helps establish an end state for a survey or area-reduction process. For example, the use of these concepts would enable us to define the requirement of an area-reduction process much more clearly by identifying ***probably mined*** areas as either ***definitely mined*** or ***definitely clear***. Area clearance), however, would be a process that turns *definitely mined* into *definitely clear* areas. In the same concept, one could describe a land-cancellation process as one that identifies which parts of a suspect area are *probably clear* and, therefore, can be disregarded for further action.

One can then establish a hierarchy of mutually exclusive terms that covers the full spectrum of the concepts, which might help remove ambiguities. This proposed hierarchy of terms, with tentative definitions, is set out in Table 4 (below).

These concepts are ranked sequentially—in increasing order of time required to accomplish these tasks, but also in increasing order of expense and effectiveness. In terms of dollars per square meter, area clearance is far more expensive than a land-cancellation process, but it may be able to release much more land per intervention. It also allows the term *Technical Survey* to be saved for use in only one part of this series of processes. Indeed, it is now possible to consider the revised concept of *Technical Survey* as being an optional process only to be used when necessary. Note also that sampling is not recognized as being a generally applicable technique in this hierarchy of concepts.

Land Release	A combination of processes, including land cancellation, area reduction and clearance, by which land identified as being suspect by a Landmine Impact Survey or other initial assessments is returned for use to the community.
Land Cancellation	A process by which land that has no specific mine indicators and that is already in general use by the local community might be "released" without any further action; land that cannot be released might be subjected to area reduction and/or full clearance. The land released by such a process has not been treated by a formal mine-clearance process and is not defined as "clear"; the process is merely a recognition of an existing situation and is a means of directing effort toward areas that have a more identifiable impact on local communities.
Area Reduction	The systematic treatment of all of a potentially contaminated area to determine the actual boundaries of contamination. The technique used must be robust enough to allow the release of the land outside of the identified boundary as being clear to acceptable norms, such as those identified in IMAS or applicable national standards.
Technical Survey	The aim of a Technical Survey is to collect additional information, not always available in a General or Impact Survey, to enable the clearance requirement to be more accurately planned. This may include, for example, information on the type of contamination, the depth of clearance, local soil conditions, and the vegetation characteristics.
Area Clearance	The systematic search of an entire defined area to remove all landmines and/or unexploded ordnance to a specified depth, in accordance with acceptable norms, such as those identified in IMAS or applicable national standards. Depending on the nature of the contamination (i.e., landmines or UXO), either Landmine Clearance or "Battle Area Clearance" techniques may be used.

Table 4: Proposed concept definitions.

Conclusions

The term *Technical Survey* has been an ambiguous concept in the mine-action community. Redefining the term can help streamline the land-release process and avoid further confusion. To improve the *Technical Survey* definition, it must be separated from other concepts and be used to simply refer to the investigation of suspect areas for information-gathering purposes. This also allows room for the use of a series of new terms (or perhaps old terms used in a different way) that are mutually exclusive and fit into a simple hierarchy of land-release concepts. Technical Survey becomes a term to describe just one of these concepts as opposed to being an umbrella term for multiple concepts. The discussion on this topic is far from finished. Hopefully this article has helped clarify a few concepts for others to continue this conversation.

This article was written prior to the release of the new draft International Mine Action Standards related to Technical Survey and Land Release. Readers can view the new draft IMAS at http://tinyurl.com/newIMAS. ✥

See Endnotes, page 62

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