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. Above, the boundary of the "probably mined" area is shown by the unattended vegetation next to the school building, highlighted by the arrow. Below, 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 Robery 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 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.

Table 1: A Taxonomy of Technical Survey Processes

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 which 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.

(Click the image to enlarge)
Table 1: A taxonomy of Technical Survey processes.

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.

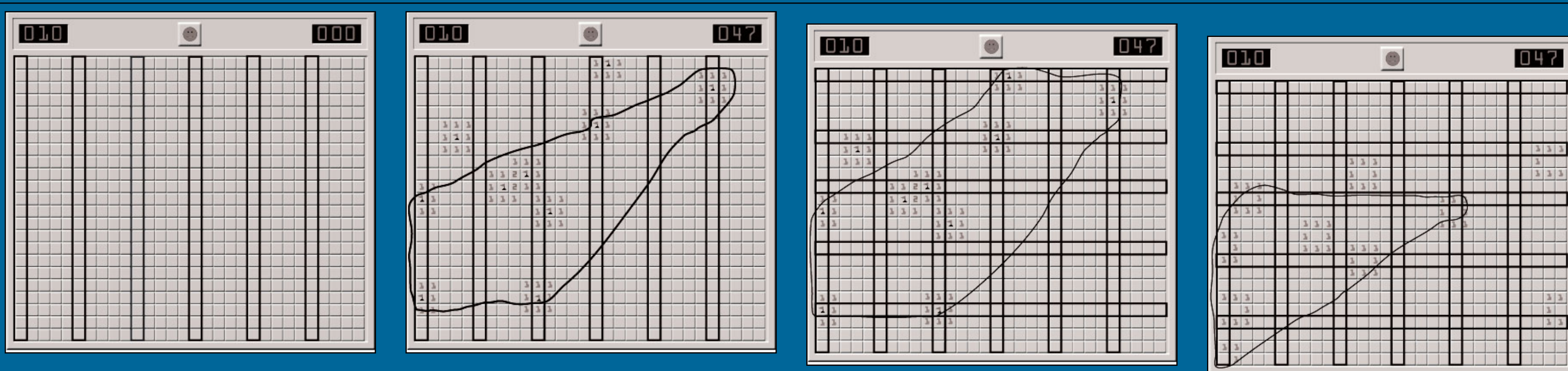
Table 2: Analysis of 10 Minesweeper Games

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 (checksum)	10	10	10	10	10	10	10	10	10	10			

(Click the image to enlarge)
Table 2: Analysis of 10 Minesweeper games.

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 following Minesweeper screenshots. In the first screenshot, 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).



Using Minesweeper as a random generator to test breaching techniques, the stars represent where landmines were found and marked.
All Minesweepeer images were created by MAIC under Microsoft's "Game Content Usage Rules" using assets from Minesweeper©, Microsoft Corporation

In the second screenshot, 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 process would have found 80 percent of the mines. However, this still leaves two mines unaccounted for.

In the third screenshot, 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, 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 processor 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.

Table 3: Classification of Land Contamination

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.	

(Click the image to enlarge)
Table 3: Classifications of land contamination.

Where definitions are not mutually exclusive, problems of ambiguity can b e 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 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).

Table 4: Proposed Definitions

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 which 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 which are having 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.

(Click the image to enlarge)
Table 4: Proposed concept definitions

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.

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.

Editor's Note: *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://www.mineactionstandards.org/whatsnew/whatsnew_06-2009.htm.*

Biography

Robert Keeley, Director of RK Consulting Ltd., is a former British Army Bomb Disposal Officer who has been working in humanitarian mine action since 1991. He was head of the United Nations Mine Action Centre in Croatia until 1997 and has also worked for Handicap International, Mitsubishi Research International (on behalf of the Japanese Ministry for Economics, Trade and Industry), European Landmine Solutions and as a consultant. Keeley has a doctorate in applied environmental economics from Imperial College London.

Endnotes

1. IMAS 08.20: *Technical Survey*, Second Edition, United Nations Mine Action Service, New York, NY (1 January 2003). http://www.mineactionstandards.org/IMAS_archive/Amended/Amended1/IMAS_0820_1.pdf. Accessed 22 July 2009.
2. A list is effective when it is (a) exhaustive (i.e., contains everything) and (b) mutually exclusive (i.e., when an item can only appear in one category in the list). The list at Table 1 fulfills both these criteria.

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