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Data Standardization

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Data Standardization

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Introduction

As the international community has placed increasing emphasis on efforts to identify, classify, neutralize, or remove landmines or other unexploded ordnance (UXO), the need to communicate information concerning the location, description, and hazards associated with these munitions has become apparent. Numerous database structures have been created to store information about the various munitions. However, different organizations, countries, or individuals have adopted their own unique data definitions and database structures, and these differences could affect the kinds of information available through these sources.

Background

The Clinger-Cohen Act of 1996 requires federal agencies to establish processes ensuring that information technology projects are implemented at acceptable costs and within reasonable time frames. In addition, these projects must contribute to tangible and observable improvements in mission performance. In order to achieve these objectives, the Department of Defense (DoD) established the Defense Information Systems Agency (DISA) as information technology coordination point for all DoD Principal Staff Assistants. The Defense Environmental Security Corporate Information Management (DESCIM) Program Management Office (PMO) was created to support the Deputy Under Secretary of Defense for Environmental Security (DUSD-ES) information program. DUSD-ES tasked DESCIM to support the Department of Defense Explosives Safety Board (DDESB) in developing its Defense Explosives Safety Management Suite (DESMS) to automate key explosives safety activities designed to support the Explosives Safety and Joint Service Explosive Ordnance Disposal (EOD) functions, Commanders, and Defense Policy-Makers.

The Importance of Database Structure

As its name implies, a database is constructed in standardized blocks of data. Each data element must have a defined value, a set of characteristics, and a relationship to other data elements. Database structure defines how the separate data elements relate to each other and how users access the elements so they can be combined to provide needed information about a particular subject. Well-defined and well-structured databases allow users to perform queries to obtain groups of data and to produce information. For a query to function properly, it must be directed to the proper database cell in order to obtain the desired data. A logical data model is created to identify and to portray properly the data relationships the database will contain. Database designers develop the physical model from the logical data model to implement or operationalize this physical model in a software program.

The Importance of Data Quality: The Starting Point for Standardization

The value of multi-million-dollar systems is actually determined by the most fundamental component of the system. In the case of data-intensive systems, quality data serves as the foundation of the database, the basis for the accuracy of the information users hope to obtain or communicate, and the source of the facts users need in order to conduct analyses. The more users rely on output from automated/management information systems, the more important it is to start with quality data. To achieve quality data, the data development process must follow a disciplined, structured, and well-defined approach--a sequential development process that ensures completeness and validity, structural integrity, business-rule integrity, and conformance to conversion rules.

The Problem with Demining and UXO Data

Communicating information about mines is a compound problem because not only might the database structures used by demining activities differ, but also the terminology used to describe the munitions might differ. The lack of standardized structure and terminology makes it difficult to pass data to other activities; therefore, it becomes difficult to warn people of the dangers that might be present in a database situation. Difficulties in passing along this information also make clean-

up more complicated. As clean-up is undertaken, planning and coordinating becomes more difficult because the munitions might be inconsistently or improperly identified; their location might be erroneous, or several groups might attempt to clear the same area while other areas are overlooked. The need for data standardization is critical to using data for effective planning and response and for ensuring the safety of both the affected populations and the responding personnel.

Problems with Standardization

While the DoD has mandated standardization efforts, many DoD-supported activities still use definitions and database structures suitable only for "stand alone" computer operations, which are only useful for their individual purposes. Therefore, when these activities must interface or report to standardized DoD systems, their informal data structures and terminology complicates the effective exchange of information among systems or even among different functions within the same organization. When non-standardized data is exchanged, it is never certain that the data communicated is what the sender intended or what the receiver understood.

Actions Being Taken to Correct Problems

The Defense Environmental Security Corporate Information Management (DESCIM) attempted to meet data standardization requirements and to facilitate the exchange of valid data. The Defense Explosives Safety Management Suite (DESMS) has been a major beneficiary of the DESCIM effort because of DESCIM's development support and its investment in logical data modeling. The DESCIM investment is beginning to pay off for the explosives safety community, and it might also benefit other explosives operating areas. Among the DESMS suites, the Unexploded Ordnance Module (UXM) could be the most beneficial to international demining efforts.

The UXM is based on a standardized data dictionary of ordnance terminology and table structure that can facilitate humanitarian demining efforts world-wide. By improving the accuracy and the availability of mine information, the UXM can improve the safety of workers and of local populations in the affected areas. The UXM logical data model is structured in the Information Definition (IDEF) approach, which, although not universally used by agencies outside of the DoD, provides a data-rich dictionary from which international data standardization efforts can proceed and from which common

terminology can be developed.

The UXM supports identification, tracking, reporting, and management of UXO (including mines, bombs, and explosives) and uses standardized data, which is validated by service-functional experts and is structured in a relational database according to DISA data standards. Because it is a data-rich system capable of supporting other users, the UXM is being considered as the automated data-management tool that will assist the Bureau of Land Management with assessing potential explosive sites found on lands under its control.

This data model relies upon standardized data to facilitate communication among diverse activities that have different functional roles. The model is able to facilitate communication because it uses standardized data that consists of supports operated by providing a single and a common structure to facilitate reporting, coordination, command, and control.

The Situation at Present

Demining efforts are currently being conducted in Bosnia, Laos, Cambodia, Eritrea, Angola, and many other countries. Several nations and private national agencies are involved in relief or in clean-up efforts that are often within the same region, area, or locality. Despite the presence of Mine Operations Centers in these countries, many relief agencies are unable to communicate with each other. This failure to communicate complicates decisions of how to best provide for these areas or what priority certain areas receive for victim relief or for munitions clearance. As was highlighted at the December 1997 Conference on Humanitarian Demining at James Madison University: inter-agency communication is lacking; an accurate feedback concerning on-going activities is unreliable; UN Mine Action Centers might not have visibility over agencies or activities within their areas of responsibility; Agency efforts are fragmented or redundant; communication is frequently limited to team members; and terminology is inconsistent among agencies. Moreover, software is expensive or inadequate, data and information is inaccessible to other agencies, mapping references are inconsistent, and mine locations are inaccurate.

Impact

As a result of problems identified by agencies attempting to provide demining support or relief, it was evident that a lack of effective

communication caused many of the demining difficulties that arose. Relief efforts became more expensive and were frequently redundant. Examples were cited where two or three agencies arrived at the same location to provide assistance to the same population. These agencies were not aware that the others were already present, and these additional individuals could provide little additional relief to the population.

Many agencies also related that the knowledge learned could not be easily shared. Many relief agencies had no system of cataloging worker experiences for use in developing training manuals or fact sheets on how to relate positively to the local population. Such materials would have been useful in helping workers learn how to communicate more effectively with the population and how to better understand the ways in which the population perceived the mine problems in these areas.

Discussion of problems in reporting led to the conclusion that the magnitude of the mine problem was improperly scoped because of erroneous or incomplete reporting. Information about the location of mine fields was often vague and was passed from person to person in a given area but was not passed to persons from outside that area. Similarly, visitors might share inaccurate information with persons in another area, so the true nature and location of the problem remained vague or unreported to agency personnel. In situations where mines were reported, the type of mine was often not known.

The combination of these situations impacts the safety of the affected populations and the demining workers in an area. Furthermore, mine or munitions information could also pose a problem; for example, many people did not know how to identify items as "mines." As a result, local populations were often unaware of precautions to take and might have been injured or killed when they came into contact with mines. Where the native population did know of such information, they completely avoided the areas in which such dangers were present. In either case, the use of the areas was denied, or people were put at risk if they entered them.

Standardizing Demining Data

To solve these data-related problems, it would be beneficial to create a Single International Data Standard to replace the current multiple country-agency databases used with a commonly-developed and collectively-agreed-upon data structure. The benefits of data standardization (database structure and definitions) include:

- **facilitating information exchange,**
- **reducing data maintenance costs,**
- **providing "rich" data and information,**
- **allowing easy access to information, and**
- **improving communication and coordination.**

These benefits would help deminers perform their task both efficiently and safely.

Objective

The objective now is to develop an international data standard to facilitate the development of accurate identification, tracking, and reporting of demining information. We suggest that the [DoD] UXO Data Model be used as the starting point to begin discussions of deploying an internationally-accepted demining data standard.

To implement a robust database in a relatively short time, a baseline for existing DoD logical data standards could be used to support the UXM. Because the DoD UXO database also contains information about mines and other types of munitions, it would provide accurate feedback to demining and to other agency assistance providers. Use of physical models in UXM would provide the basis for an effective tracking-and-reporting system possessing the ability to support a wide range of data, which thereby provides the information for determining the effectiveness of efforts being taken. This information could then enable the sponsors of demining activities to determine their return on investment. The information such a database provides could facilitate the development of a forum and as well as the development of a methodology that caters to the data needs of all assistance providers.

Data standardization based on the DoD model could facilitate accurate, consistent, and rapid access to the largest volume of information on explosives and mines as well as on geographical locations, management centers, and political entities. As DoD Data Models are produced from integrated standardized packages that received stringent functional reviews, they have been proven to meet field-user requirements. These models should be updated continually as dictated by user demands. DoD databases are constructed to facilitate a seamless exchange of data among a variety of unrelated users; thus, they are structured to support interoperability.

The UXO Model is maintained as a part of the world-wide information

infrastructure of DoD data management. It offers an accurate and complete functional view of mine and demining activities, is constructed to operate in a shared-data environment, is updateable, and improves communication and the exchange of information through common definitions.

The Road Ahead

The UXO Data Model is currently being validated by the functional and data-management communities, but it has not yet been submitted for formal DISA approval. The model will be implemented in the soon-to-be-fielded UXM physical model, and it will serve throughout the DoD as the basis for exchanging information about unexploded ordnances of all kinds. The use of the UXM software and its accompanying table structure and data dictionary support the use of the UXM logical data model as the starting point for the international demining data standard. The UXM will be in use at all sites where DoD UXO operations are conducted. Not only will normal Continental United States (CONUS) range clearance activities be supported, but the tracking of explosives clean-up at other locations on public lands is also being considered.

Including humanitarian demining activities in system tracking requirements would make the magnitude of the world-wide mine and unexploded ordnance clean-up problem more visible. It would also provide a solid basis from which to prioritize clean-up actions. Inclusion of the munitions and the explosives-recognition pictorial database would provide a complete data package to aid in recognition, classification, reporting, and disposal of unexploded ordnance. Using these resources within a fully-relational database structure using standardized definitions would allow for the international exchange of information among users who shared the standard.

Conclusion

The adoption of an international data standard for humanitarian demining would facilitate the development of quality data in a common database structure. The improved quality of data, in turn, would facilitate the exchange of information, which would improve safety for deminers and for the populations that they are serving.

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