Title: The Information Management System for Mine Action - A spatial planning tool for humanitarian demining

Mine action (MA) is a term for all activities aimed at reducing the impact of explosive remnants of war (ERW). These include landmines, unexploded ordnance (duds), ammunition storage etc. Examples of mine action activities include surveys of varying scale and focus, clearance using a variety of methods, and mine risk education through schools and mass media. Mine action falls into both humanitarian and development domains – with MA programmes often starting during conflict and continuing many decades post-conflict.

The Geneva International Centre for Humanitarian De-mining (GICHD) is an international organisation which provides operational assistance, creates and disseminates knowledge, improves quality management and standards, and supports instruments of international humanitarian law, all aimed at increasing the professionalism and performance of mine action.

A core element of mine action is information management. Contrary to popular belief, mine action is not simply about clearing every minefield in the order in which they are discovered. It is an intricate process starting from discovery of suspected hazardous areas and ending in the release of land to the local community. In most conflicts contaminated areas are not properly documented or reported and the exact boundaries of suspected hazardous areas are often unknown. In other words, they are ‘fuzzy’. Mine action activities are hence applied in a sequence to increase knowledge of the problem and, secondly, to reduce the impact of the known hazard.

However, the MA domain is, like many others, limited by the resources at its disposal. These have to be prioritised between:

(1) reducing the fuzziness surrounding the hazards and their impact, and

(2) addressing the impact of hazards once it is known.

There is a plethora of mine action tools available to decision makers. The most commonly applied tools are manual deminers, mechanical demining machines and explosive detection dogs. These assets have strengths and weaknesses that depend on:

(1) whether the mine action task is to reduce fuzziness or to address the hazard impact and

(2) on the environment that the asset is applied in. Ground incline, undergrowth and ferro-magnetic qualities of the soil are all examples of characteristics of a hazard’s environment with relevance for estimating the effectiveness of a certain asset.

Appropriate information management routines will reduce the complexity of decisions involved in the above processes. Through the provision of a standard set of tools, the Information Management System for Mine Action (IMSMA), developed by the GICHD, can enable national mine action institutions to improve the way that they manage information. This tool has been continuously developed over the course of a decade. The most recent release of IMSMA Next Generation (IMSMA-NG) in 2008 has a new architecture that allows almost complete flexibility for system administrators to develop forms and processes for data collection, analysis and reporting. This means that the system can be applied to any mine action programme, but also other humanitarian and development domains.

IMSMA-NG is supplied by the GICHD free of charge following an application process. To help achieve this, the deployment cost has been kept down by including open source elements such as MySQL, iReport and Hibernate. An exception to the use of open source software is the GIS interface in which the ESRI ArcGIS Engine is used thanks to the donations of licences by ESRI. The deployment of IMSMA will reach its climax in 2010 with 600 clients in close to 50 mine-affected countries.

Process-oriented GIS

Among the challenges faced during the development of the tool, many related to the tool being a process-oriented spatial information system. This type of system has more in common with classical enterprise resource planning (ERP) tools in the commercial world than the spatially-oriented GIS solutions that are more common in the international humanitarian community. Although mine action is a very spatial domain, the step-wise increase of knowledge of hazardous areas makes the surrounding business processes equally important. The process-orientation allows for support in key business areas, such as tracking what kind of information gathering activities that individual hazardous areas have been subjected to. By knowing this, it is possible to estimate how crisp the information on the hazard is, as well as what methods could be applied to increase the knowledge on the area further. Out of a resource planning perspective, the process orientation allows for the tracking of what resources are used where and which resources that are available for future tasks.

Administrators of national IMSMA installations expect to be able to create an adjust forms for field collection of data. These forms should link to each other so that it is possible to query the database for statistics on the activities before and after an individual step in a process. In essence, it has to be possible to quantify what has been done to reduce the hazard and what remains to be done – without having exact data on the location or extent of the hazards. This is managed through the collection of qualitative and subjective data. A common source is interviews with residents in areas suspected to be contaminated. In order to increase the accuracy of the large amounts of data that is reported, each form that is received from the field is first entered into a temporary holding-zone in the database where it can be analysed by one or more experts without affecting official maps or statistics. The experts can chose to (1) include the content of the form and link it to existing data as necessary, (2) combine it with a different form, or (3) return the form to sender. The forms are usually submitted on paper, but the software accepts digital versions of the form generated by other IMSMA installations.

As mentioned above, the process-element of the software package allows for great flexibility. The processes and their output can be fully customised upon installation. This does however provide a challenge in the interoperability between installations. Without some common structure it would be impossible to exchange data or to standardise the visualisation of data. For this purpose it was decided to create a set of super-categories in which all data was to be stored. Data can only belong to one category. For mine action the main categories are: Hazard, Released land, Demining accident, Civilian accident, Communication, and Quality control. In addition, there are categories of auxiliary data such as organisation, gazetteer, point of interest. *Hazard* is used for data on areas suspected of being contaminated. *Released land* is used for data on areas that have been deemed safe. *Demining accident* is used for data on accidents that occurred during the mine action work. *Civilian accident* is used for data on accidents that do not fall under demining accidents. *Communication* is used for data on information campaigns to inform the general public on the risks of the explosive remnants of war, often via schools or mass media. *Quality control* is used for data on activities in place to verify data in the other categories. This categorisation allows for the adoption of the international standard for cartographic symbology of mine action. It also provides sufficient standard to enable some semi-automated exchange of information between installations.

The categories mentioned for mine action above can be translated into any other field. The concept is for the categories to contain (1) the spatial targets to be addressed, identified through some kind of field data gathering, (2) the results of the activities put in place to address the impact of identified targets, (3) the direct impacts of the targets on those involved in addressing them as well as, (4), the civilian population, (5) the broad scale activities aimed at educating the civilian population on how to live with the impact of the target, and, (6) the monitoring and evaluation of the activities falling under the other categories. The reader can conceptualise how this would translate into other humanitarian and development domains. Possible examples include: small arms, food security, post-conflict reconstruction and epidemics.

Appropriate technology for Enterprise Resource Planning

The needs for process customisation, process tracking and data validation, makes it challenging to implement a solution centred on a GIS platform – particularly in a multi-user environment where data has to be shared. Every installation of IMSMA comes with a MySQL database engine. The client, developed in Java, can be on the same computer as the server. In a networked multi-user setup one of the clients will act as a server. Code on the clients access the MySQL backend and generates a spatial database which can be read by the ArcEngine to present the data geographically.

Because these systems are primarily used in developing countries, the solution has to be intuitive and use appropriate technology. Open source technology (i.e. Hibernate, JasperReports, MySQL and JBoss) has proved to fulfill those two requirements. IMSMA is stable and no longer dependent on proprietary software that is subject to frequent updates and changes in the user interface. The end users, those conducting data entry or browsing data, can be trained in a matter of hours and their skills will remain relevant for a long time. To make IMSMA more accessible to those not speaking English, French or Spanish, all parts of the software can be translated by the local administrators by using a supplied third party application.

Due to the complex nature of the information management in mine action, the senior administrators that manage the information flow will still require several days of training in order to fully understand the organisational requirements in the set-up and to make continuous adjustments to the installation.

Conclusion

IMSMA is an example of how the ArcGIS Engine can be seamlessly incorporated into an existing software solution to provide a tool to display and manipulate information spatially. The environment which IMSMA was developed for requires stringent process-tracking of the information flows combined with considerable ability to customise the processes in the application. The application was developed to fulfill those needs, partly by using open source elements.

The flexibility of the IMSMA package has allowed for the application to be used in virtually all countries with landmine contamination with it being adjusted to the local needs and business processes. The level to which IMSMA can be customised makes it interesting for adoption in other domains in the non-profit humanitarian and development business that follows similar business logic.

Keywords:

ERP, GIS, IMSMA, landmine, eod, uxo, erw, gichd, mine action, ArcGIS Engine, open source