

The Bosnia and Herzegovina Mine Action Information System

With technological advancements in mind, the Bosnia and Herzegovina Mine Action Center has maintained a current and efficient mine-action information system, working through a variety of difficulties. BHMAC has developed a system to accommodate a growing collection of demining reports and maps to aid efforts to cleanse the nation of mines and other explosive remnants of war.

by Zoran Grujic [Bosnia and Herzegovina Mine Action Center]

The life and blood of a mine-action program is the information system. It is one of the most criticized, yet frequently used mine-action tools. The Bosnia and Herzegovina (BiH) mine-action information system program, originally called “The Database,” started in 1996. At the time, Microsoft Windows® 95 made networking simple and a must, but the geographic-information systems that were available created a challenge for information-systems teams.

The BiH team was tasked with developing a network-based information system that could handle scanned images. In addition, there was a need to enable standard database operations and provide abilities to use SQL statements (relational queries). Last but not least, the system would need real GIS capabilities to make accurate, quality and clearly readable maps in less than 20 minutes from the request time.

The data workload was described by the Annex 1A, Chapter 4, Parts I and II of the Dayton Peace Accords,¹ forcing former warring factions to remove minefields and submit their data on remaining minefields and booby traps. The deadline was short, so the system needed preparation and full operation from Day One.

It was immediately clear that BiH had no indigenous resources that could cope with the problem; therefore, help was requested from the international community during the London Peace Implementation Conference.

The international community agreed to support the effort and program implementation began in March 1996. The U.S. Department of State funded two contractors that were tasked with various assignments. Infrastructure creation and staffing were assigned to RONCO Consulting Corporation, a leading international demining company, and database creation was tasked to FGM, Inc., an information-technology company from Washington, D.C. (U.S.).

Initial Configuration

The problem had been identified; the experts were in place to provide staffing and infrastructure, and U.N. Department of Peacekeeping Operations provided the software.

At the time, the database-management system was the U.N. preferred Borland Paradox® and the recommended GIS software was MapInfo®. That software combination shaped the entire Bosnia and Herzegovina Mine Action Information System’s existence.

Paradox proved to be a good system for networking a database and the program language was simple enough for new database administrators/programmers to learn in less than a week. The database continues to use Paradox (version 11) today, but the program has had many upgrades and has evolved into a more sophisticated information system.

The other half of the “software marriage,” MapInfo, proved to be an excellent tool for mapping and cartography in general. In the beginning, the Geographical Section General Staff of the British War Office provided a gazetteer, which provided basic conditions for spatial queries. Paradox 11 and MapInfo 10 continue to work well together.

Initial Challenges

According to their obligations prescribed by the Dayton Peace Accords, former warring factions provided more than 16,000 minefield reports to NATO implementation task forces. Data were entered and submitted to BHMAC (then known as UNMAC), together with some 1,100 mine incident data reports also entered into the database and charted on GIS. The puzzle became more complex on a daily basis. At the time, procedures for demining were mostly unclear. The peculiarity of BiH’s

contamination—scattered, small, irregularly shaped minefields; single mines and well-organized minefields in areas where terrain allowed—set a new challenge not only for the information department but also for those involved in demining operations.

In October 1996, the first meeting on humanitarian-demining standards took place in Copenhagen, Denmark. Therefore, we were absolutely and totally free to make all possible mistakes—and we made most of them.

Centralization

The information system's initial structure was created primarily around minefield data and incident data. As program development progressed, the database became more complicated.

The database was centralized. The entire data-entry process was completed and housed in Sarajevo headquarters on 10 networked computers. The server ran on the Windows NT® 3.5 operating system—the best that was available at the time.



A network rack containing equipment. All photos and graphics courtesy of the author.

Initial construction as of August 1997 can be described with the few squares and lines as shown above in Figure 1. In the beginning, the idea was to stress simplicity of structure; the entire system was actually a tasking mechanism, using minefield reports and incident data to determine where to demine and what basic abilities were needed to

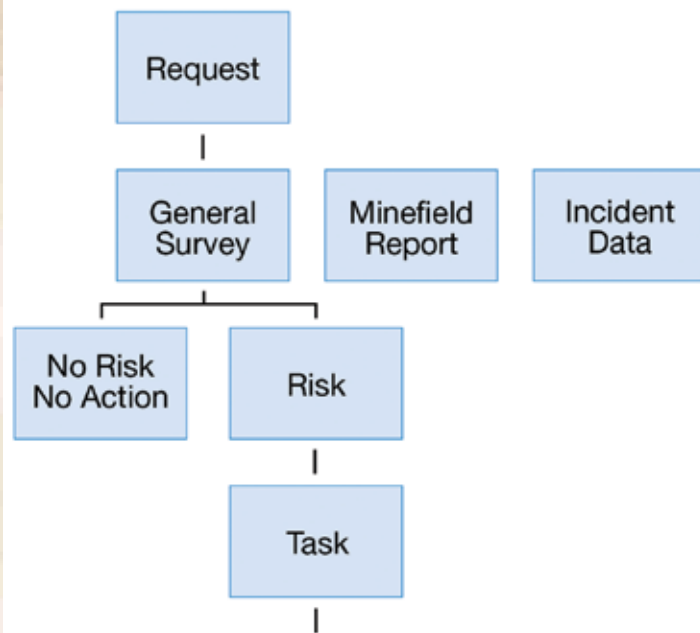


Figure 1. First version of BHMIC's data structure.

enter demined areas. A lot of modules added later were not even conceived when it was first constructed.

A request for action initiated the process. At that time, the program was based on emergency response; therefore, exceptional request tracking and the ability to respond quickly was essential. The system used contamination information (minefield and incident data), and a General Survey was the main action. Following the assessment, the task order was issued and clearance was completed. All these aspects were also presentable on maps.

As soon as demining activities started, a dilemma appeared. Geographic Section General Staff maps Series M709 in 1:50,000 scale were up-to-date but useless, as they were not available to the warring factions during the conflict. As a result, ground features referenced on minefield reports were not identically described. In addition, the elevation points did not have the same heights as shown on maps used during the conflict. The only solution was scanning all Yugoslavian Army maps and registering them as future reference material. Consequently, the first and the most important lesson learned was that information systems must be able to use the same raster backdrops as the military forces use during the conflict.

Expanding Statewide

After 1998, the information system and all assets for demining activities at the state level was handed over to BiH national authorities. Foremost was the request for the necessary decentralization of the system. As a result, the system was split between the following three locations:

1. The Mine Action Centre of Republic of Srpska, which began keeping data for its territory

2. The Sarajevo location, which received an additional server for the Federation of Bosnia and Herzegovina Mine Action Center data
3. The BHMIC headquarters, which kept a consolidated database for the entire state

Scanned images were also divided among these centers and program priorities were shifted from emergency response to planned mine action. The database needed to be amended accordingly. This meant that the database structure became a bit more complicated, as shown in Figure 2 below. The blue squares represent new modules added in order to enable full application of the information system into mine action. Field activities were reshaped almost daily, and the well-structured database became the very core, not only of the information system, but also of mine-action activities.

When we were unable to put something into the information system, it indicated that business logic for the activity in the matter was wrong. Since the system was designed from the ground up, implementing operational ideas into the information system revealed inconsisten-

cies or redundancies. The process was iterative, and as the project's scope evolved, the system was developed according to operational needs. System changes were never cosmetic; if something needed to be added, it usually related to linked activities and the system's corresponding information layers.

While we worked as the emergency-response project, all data were presented as dots. Several attempts were made to show no-risk and at-risk areas as shapes, but the accuracy of reports was simply too low to produce maps that were current and not misleading. Raster maps used (Scale 1:50,000) were no longer detailed enough, so we shifted to 1:25,000 scaled maps. Cadastral mapping, showing the boundaries of land parcels within a given region, was also introduced at that time, but since Cadastral maps were so accurate, we were unable to register images properly and were unable to correlate the maps with the vector data we had at the time.

Between 2000 and 2003, the International Trust Fund for Demining and Mine Victims Assistance, with support from the European Commission and U.S. Depart-

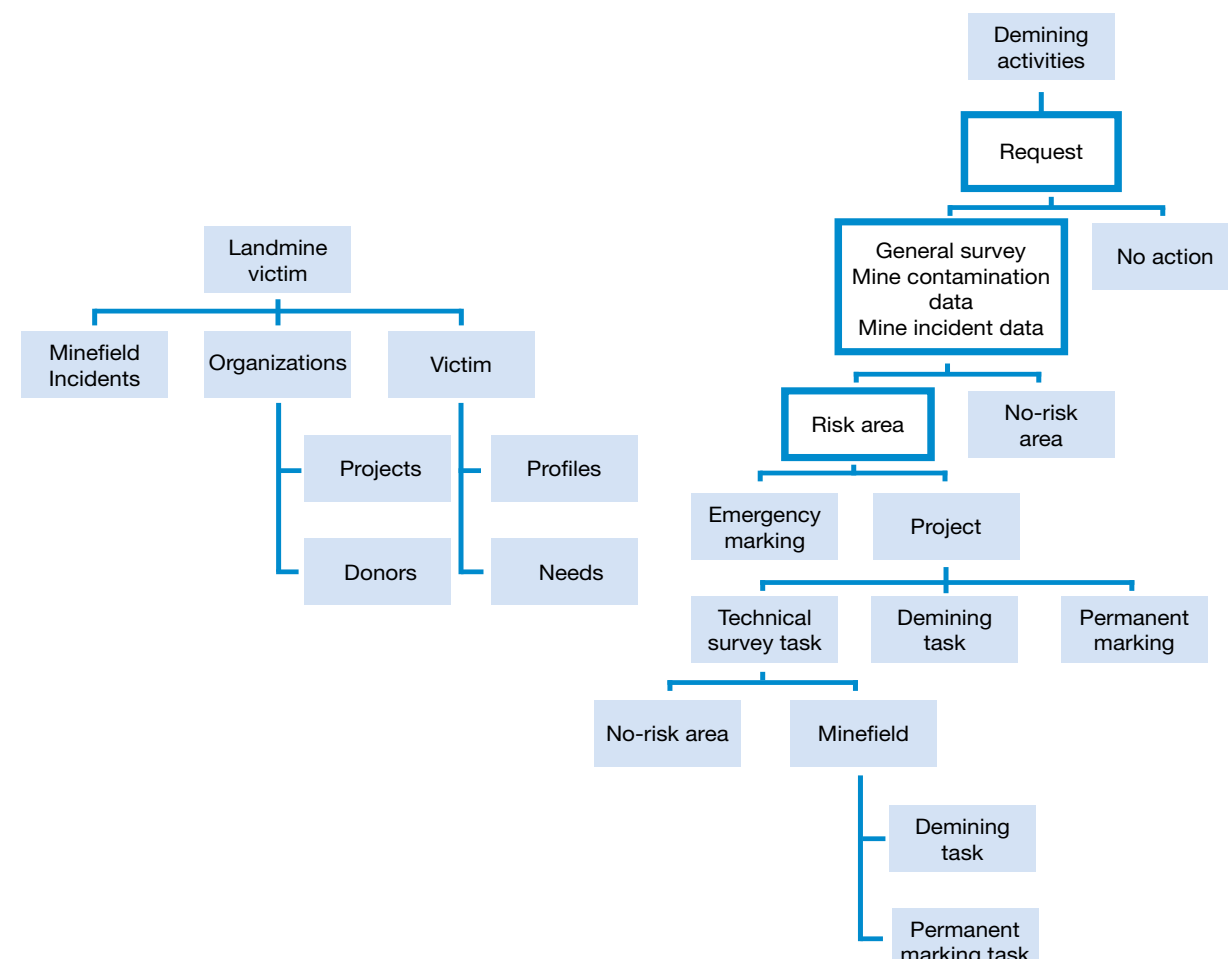


Figure 2. Database structure, 1999–2001.

ment of State, implemented the GIS for Mine Action in South-East Europe project which provided low-resolution data of the entire region (including BiH), orthophoto of high priority minefields, and new hardware and software equipment. The GIS project also trained BHM MAC staff in information technology, image processing, and other competencies in order to improve their planning, implementation and monitoring of mine actions.

When the Japanese government provided a donation of equipment to BHM MAC on 2 March 2001, the differential global-positioning service was introduced and accuracy of less than 10 centimeters (3.94 inches) (that is, allowing for more accurate measurements) was achievable. This provided a basis to begin developing a system to trace activities in the field and to show and keep data accurately, exactly as it was taken from the field. At the same time, the state showed increased interest in our data. On the positive side, our reports became a prerequisite for reconstruction projects. More negatively, however, a number of court cases were demanding accurate historical data. The system had to be improved once more.

Added Capabilities

New requests included records and mechanical tools for deminers' accreditation and mine-risk education activities. In addition, some requests were made to record data not directly connected to mine action. We were asked to take care of some logistical and human resources issues as well.

Donors' interest began to decrease, and public relations activities soon demanded a Web presence for the mine-action center. In November 2000, the BHM MAC website was developed³ using HTML coding, the most up-to-date way (at the time) to create websites. The BHM MAC servers hosted and updated the site. Figure 3 below shows the information-system structure at that time.

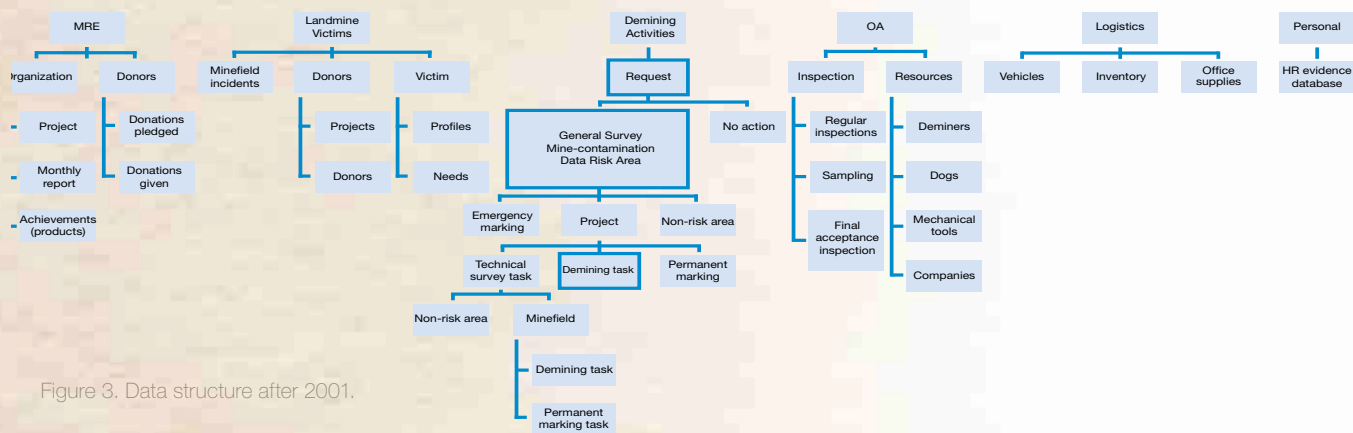


Figure 3. Data structure after 2001.

The system's previous generation is shown within the rounded square in Figure 3. All system elements are interacting; the database is level 3 normalized, meaning the database's logical design has been improved to avoid data duplication. Yet again, data modeling proved to be the cutting edge of the system. Procedures were then amended as needed once the basic layout was constructed. As a result, the information system followed thereafter.

Slowly but surely the system grew and became more complex. At this stage, the system was comprised of around 450 tables, 250 forms and more than 400 reports. The mapping function contained BiH 1:1,000,000, 1:300,000, 1:200,000, 1:100,000, 1:50,000 Defense Mapping Agency, 1:50,000 Yugoslav People's Army (JNA), 1:25,000 JNA and targeted areas 1:10,000, 1:5,000, 1:2,500 and 1:1,000. The system contains vector data describing all aspects of mine-action activities in BiH.

At this time, the system network was also improved. In the beginning, Sarajevo headquarters was connected to the Internet at 128/128 KB speed. In Phase 2, the network speed was increased to 1 MB/1 MB and regional offices were connected to the Internet at a lower speed. In Phase 3, all regional offices were connected to a virtual private network using Cisco® ASA, and the data were updated daily. Current performances are as follows:

- Sarajevo and Banja Luka nodes are in full replication and updated daily.
- Regional offices, excluding Banja Luka and Sarajevo, are updated daily or on demand.
- All locations have wired network 100 Base-T and Internet access 24 hours a day, seven days a week.
- Differential GPS is the standard measuring/reporting tool. Points acquired are downloaded into the system so that nothing has to be hand typed; therefore, errors are minimal.
- Cadastral mapping is the standard backdrop for

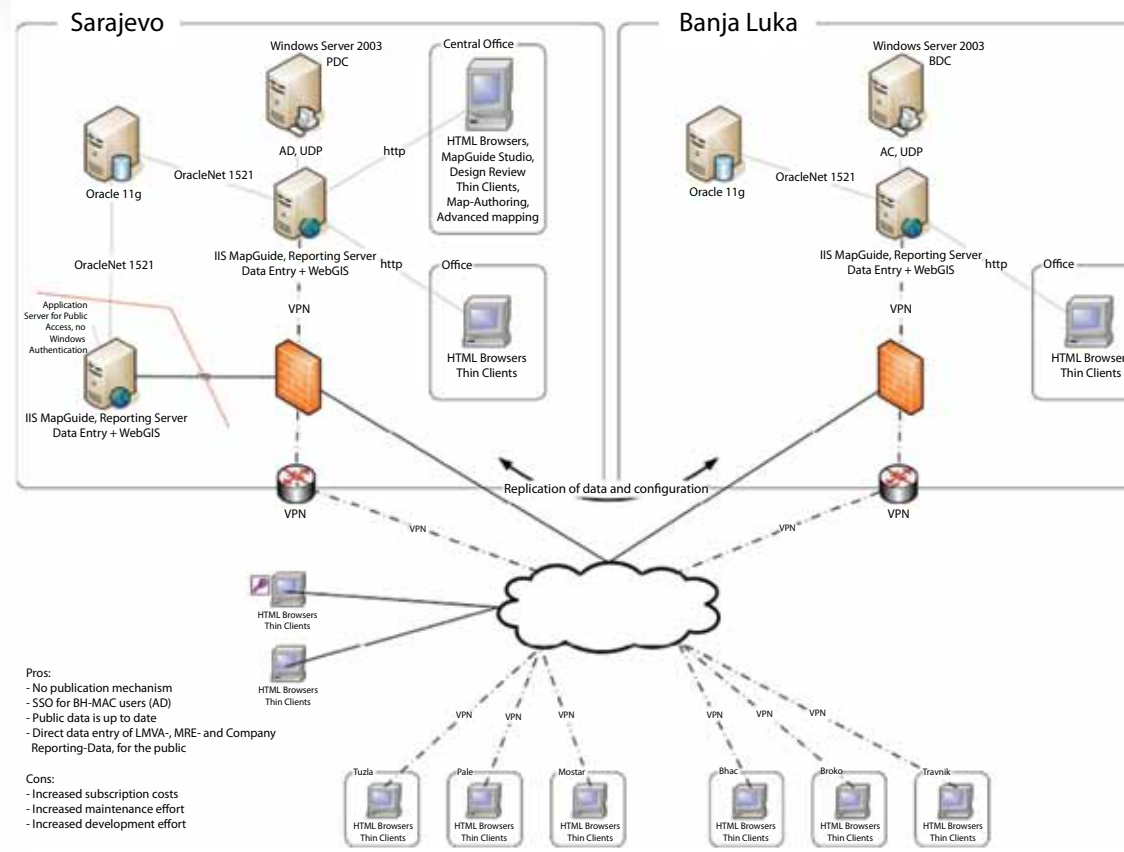


Figure 4. Future structure of BHM MAC Information System.

- reporting since differential GPS is in effect.
- All other maps are now used for planning and wider area analysis.

The Program's Future

The BHM MAC program has evolved to a point that real-time database management is needed. That said, Paradox struggles to meet the current demands. MapInfo might also have difficulties processing a huge data amount through a complex network. Therefore, retiring the old software combination and upgrading to a new database system is necessary. Figure 4 shows the new information-system structure. The system uses an Oracle® application using a custom-made GIS application. The initial activities began in March 2009, and the system is currently in its final development phase.

The database relations and data complexity will remain much the same as they were. Mapping backdrops will be preserved, and a new layer of data, utilizing full vector coverage at 1:25,000 scale, will be implemented. The system will use digital elevation data, making 3-D mapping possible. MapInfo will remain the main cartographic software, and the entire interface will be Internet-accessible, keeping data security in mind.

Currently, the system is in its final deployment phase, and expected implementation is sometime during this demining season.

Last but not Least

Developing a mine-action information system is not just about data, but is also a teaching endeavor. During the last 15 years, BHM MAC's information department has hired people to fill several new positions, including a U.N. database developer, chief of operations in Srbija, chief of logistics at BHM MAC, chief of operations at BHM MAC, Microsoft-certified trainers, and databank analysts, etc.

This benefit of the BHM MAC Information System is, by my opinion, equally important and definitely warms my heart. ♡

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