



# EMAPBOARD: COLLABORATIVE MAPPING

DURING A CRISIS, EFFECTIVE RESPONSE AND RECOVERY REQUIRE INCIDENT MAPPING, ESTABLISHING PRIORITIES, DEVELOPING ACTION PLANS, AND IMPLEMENTING THE PLAN TO PROTECT LIVES, PROPERTY, AND THE ENVIRONMENT.

GIS-based disaster management systems should allow disaster managers to quickly access and visually display critical information. Based on location, this information can be shared with disaster response personnel for the coordination and implementation of emergency efforts requires more than 'classic' GIS functionalities. The ARC research studio iSPACE currently develops a modular open-source software environment for disaster management applications called eMapBoard.

## History

Some of the lessons learned in the last several years give clear indications that availability, management and presentation of geo-information play a critical role in disaster management. Geo-information technologies offer a variety of opportunities to aid management and recovery in the aftermath of manmade catastrophes (ie. industrial accidents, traffic collisions, terror attacks, complex emergencies) and natural disasters such as earthquakes, fires, or floods. Recent examples include the Indian Ocean Tsunami of December 2004 and the hurricane Katrina of August 2005 in New Orleans. It is absolutely crucial that information on the spatial extent and the intensity of the consequences of such events are available within a short time to support policy and decision makers with information. Satellite imagery

from destroyed beaches and towns in Indonesia or Sri Lanka were extremely helpful in the case of the Tsunami and the damage assessment and disaster management operations.

## Data issues

Still, disaster management poses significant challenges for a timely data collection, data management, appropriate utilization of existing data, and the integration, visualization and communication of the data. Effective disaster management requires a thorough use and understanding of the semantics of the heterogeneous geoinformation sources with their specific characteristics: scale/resolution, dimension (2D or 3D), classification and attribute schemes, temporal aspects (up-to-date-ness, history, predictions of the future), spatial reference system used, etc.

An even greater challenge is the distributed data capture in a collaborative working environment. It is often stated that the major problem in disaster management is not lack of technology, but lack of information about the information. Typically, disaster management depends on large volumes of accurate, relevant, on-time geo-information that various different organizations systematically or not systematically create and maintain. In principle, most of this information is described in catalogues and is registered in geo-information infrastruc-

- Directly support disaster management operations
- Allow for geo-tagging documents
- Supports spatial awareness for the users
- Support the communication between headquarters, mobile units and first responders
- Serve as a means to mobilize external cooperation, assistance and loans
- Become a tool in post-disaster resource allocation
- Become a tool in long-term risk mitigation strategy setting
- Determine needs for reconstruction and mitigation
- Support clean-up operations as soon as possible
- Use a narrow time window for documenting perishable damage to buildings and infrastructures.
- Create reports and historical records



FIG. 1: System requirements opposed to the widely used disaster management cycle.

tures, such as the Infrastructure for Spatial Information in Europe (INSPIRE), based on OGC, ISO, and CEN standards. But next to various somewhat positivistic statements from the GIS community recent empirical studies have exhibited problems with availability, access and usage of reliable, up-to-date and accurate data for disaster management.

### Communication

Effective (fast and good quality) exchange of data between the users and between the system and the users in real-time is crucial in disaster management. We have to "communicate spatially". Such a system is intrinsically spatial in nature. Questions of location are

indispensable for forecasting the expansion of toxic air pollutions, for evacuation planning, for defining safety zones, for estimating or assessing damage, and last but not least for providing a common spatial awareness to all actors involved. Generally, collaborative situation mapping systems should include many features (Fig. 1).

A disaster management system must be able to utilize existing information on demand. This requires interoperability. Today, such linkages are realized as Web Feature Services (WFS). This way the costs to create a disaster management map are reduced. Obviously, the intended use is an extremely important factor in design and creation of a

given data set. Similarly, a digital image of a large city at the resolution to which we are accustomed in normal photography would be immense. There is a trade-off centering on the concept of intended use and therefore what really must be displayed on a given image or graphic.

Additionally to the 'classic' GIS tasks there is the aspect of near-real-time reactions and collaborative working environments including the links between headquarters and mobile clients, or disaster managers and first responders, respectively. GIS is a powerful tool for integrating people, organizations, and their efforts. Spatial Data Infrastructures (SDIs) are important frameworks for the development of a web-based system to facilitating disaster management. The design and implementation of a SDI model and consideration of SDI development factors and issues, together with development of a web-based GIS can assist disaster management agencies to improve the quality of their decision-making and increase efficiency and effectiveness in all levels of disaster management activities.

### The eMapBoard approach

The system components are based on open-source or free software. Such a system should generally be relatively simple to use and the information offered should be 'just as much as necessary' rather than 'everything which might be of interest'. This statement will surely be advocated by a number of persons working hands-on in emergency response

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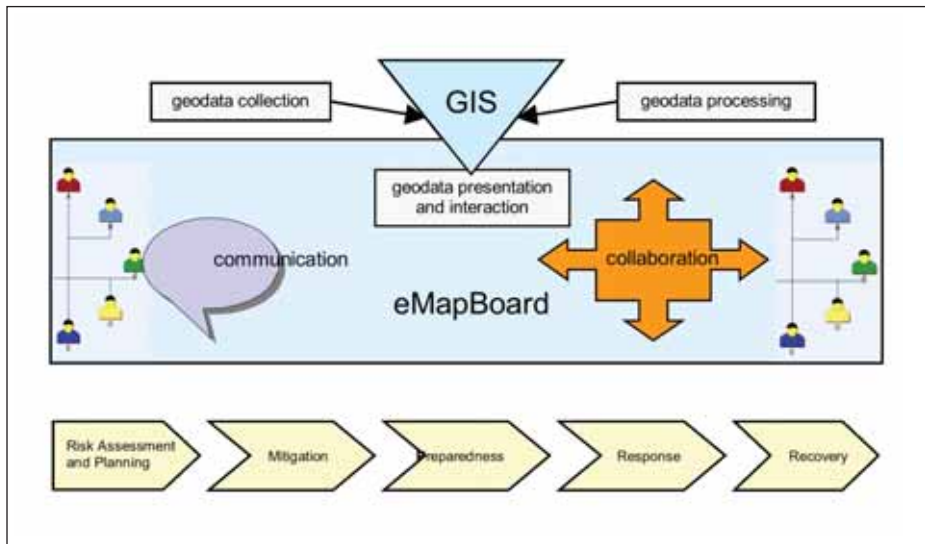


FIG. 2: The eMapBoard system focuses on communication and collaboration.

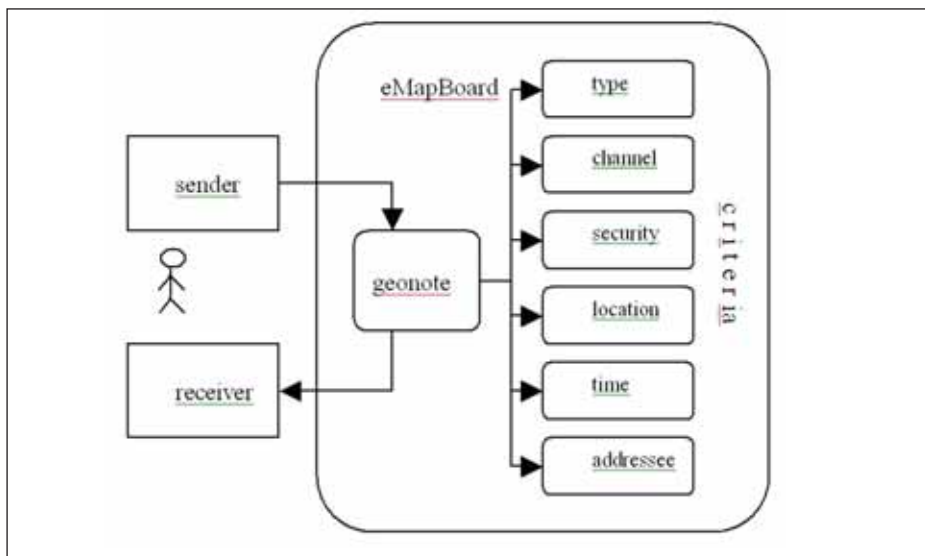


FIG. 3: Conceptual design of the eMapBoard user interface.

units. A range of different geo-information technologies is required for this, ranging from data collection (in advance but also real-time updates during 'action') via data processing (storage, search, analysis, knowledge-based translation and integration, etc.) to presentation and user interaction (Fig. 2)

A second issue is the communication aspect. It affects not only the outcome of a given risk assessment communication but need to be considered in the system design. Is the risk managed by an active and effective decision-maker at that level? Is the communication passed along yet another spoke to still another hub in search of an effective decision-maker at a more influential level? Or is the risk assessment suppressed with either no decision taken to alter risk or with sanctions applied to the messengers of risk.

The eMapBoard environment combines hardware devices (like GPS or Galileo receivers, mobile computer platforms, mobile phones, wireless ad-hoc networks, digital cameras, sensor webs, etc.) with software modules (like GIS-analysis, web-mapping services, remote sensing algorithms, content

management system (CMS), computer supported collaborative work (CSCW) systems, distributed databases, security software, and decision support tools) in order to make a flexible instrument for realizing information workflow processes available in future disaster management and safeguard applications. Depending on the technical infrastructure available and the user's current situation the set of devices, services and communication opportunities will change. Therefore the architecture of the eMapBoard environment has to be flexible, it is based on open standards and it will support different platforms.

From the users point of view two basic types of workflow have to be supported: (I.) receiving information from the eMapBoard and (II.) entering information to the eMapBoard. How this information flow between the eMapBoard system and the eMapBoard user will be realized depends on the following criteria:

- which type of information is it (request, note, record, task, etc.)?
- which communication channels are

available?

- are there one or many addressees?
- which level of security/confidentiality has to apply?
- what is the relevant spatial relation?
- how time-critical is the information?

## Conclusion

The answers to these questions (or criteria shown in figure 3) determine if-, where-, at what time-, and how a geo-referenced piece of information (called 'geonote') is going to be presented on an eMapBoard's user interface. Although GIS allows for an expert to do his/her analysis visually and quantitatively, it does rarely assist the expert in an intelligent way. In many cases the decisions cannot be reduced to some pre-defined choices. As we know from other applications GIS is increasingly hidden and seamlessly integrated in day to day operations. For disaster management the communication capacity of a collaborative working environment will be a key issue in future developments.

The GIS industry works hard towards interoperability and overcoming 'monolithic' or 'closed' GIS systems. Alongside with its growing importance since the Indian Ocean Tsunami and the devastating hurricanes in the US in 2005 the importance of geoinformation for disaster management is more evident and geo-collaboration is becoming a hot research topic. It is clearly about effective early warning systems which have to be coupled to a continuously updated database of historical disasters, environmental factors and weather situations including forecasts. It is also about coupled hydro-meteorological forecast for floods and storms generating realistic scenarios on which to base exercises and rehearsals for major incidents. But we need to assess the effectiveness of existing early warning systems at regional, national, provincial and local levels with a focus on communication systems in place to reach risk groups. The authors strongly believe that systems such as eMapBoard will catalyze the development of GIS and remote sensing based spatial analysis environments into geo-collaboration systems.

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