# DISASTER PREPAREDNESS PLANNING AND STUDIES

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## ABSTRACT

This paper provides a brief overview of a United States Department of Defense (DoD) initiative to enhance Military Support to Civilian Authorities (MSCA). This project was sponsored by the Space and Strategic Defense Command (USASSDC) under the guidance of Mr. Max Alston, DoD. The targeted user group was the emergency operations centers at U.S. military installations. Our mission was to evaluate current products and technologies and assess their potential in enhancing the capability of U.S. military installations to provide MSCA for All-Hazards disasters. Our team implemented a systems approach to integrating the many commercial and government off-the-shelf products and services which are available to enhance disaster preparedness, emergency response, and reduce human suffering at both a national and international level. We concurrently employed a product oriented approach focused on providing interoperable, user oriented products, not producing another study or developing a new software package. Our products demonstrate the integration of today's technologies and capabilities.

## INTRODUCTION

"The views, opinions and/or findings contained in this presentation are those of the author(s) and should not be construed as an official United States or Department of the Army position, or decision, unless so designated by other official documentation".

Our ability to successfully complete a systems approach to producing an Integrated Disaster Preparedness Package and enhancing installation capabilities to interoperate with their communities was due mostly to the selfless cooperation, contributions, and enthusiasm of installations; county, parish, and state emergency management agencies; Director of Military Support (DOMS), United States Army Forces Command (USAFORSCOM), Continental Armies (CONUSAs), many Disaster Coordinating Officers (DCO) and EPLOs; Federal Emergency Management Agency (FEMA), United States Geological Survey (USGS), and the many offices of the United States Army Corps of Engineers (USACE).

## PROGRAM OVERVIEW

The USASSDC objectives were to support disaster preparedness planning and study technologies and activities which enhance DoD installation disaster preparedness, and which improve planning for disaster relief relating to DoD installations and cooperative planning with local and international civil authorities. Program requirements included:

- Perform research and recommend enhancements for providing MSCA.
- Conduct site visits to determine requirements.
- Conduct special studies for the National Guard, U.S. Atlantic Command (USACOM), Department of Defense Resource Data Base (DODRDB.
- Produce a legal data base on CD-ROM.
- Enhance interfaces between installation and the civilian community.
- Finally, make determinations on what should be done in outlying years.
- Co-develop an international radiological gaming demonstration.

A general program overview is available on request. The general program overview is a concise pictorial representation of how Program Management maintained a product-oriented, first-year effort. Management utilized concurrent engineering principles to ensure proper integration and to keep each product on schedule and fully coordinated with current and future user requirements.

## SCOPE

A general product description from our Integrated Disaster Planning (IDP) Program Package is also available which depicts the USASSDC disaster preparedness planning and study program flow from initial requirements collection and definition to the development and fielding of the IDP Package and the completion and documentation of field exercises. Also documented are lessons learned from actual disaster support; and the final program report to DoD and Congress. As can be seen by the study program flow, this one-year effort focused on the installation and their related requirements for self-recovery and MSCA during all-hazards response. This package and its products are not just for federal or national level disasters. It includes the information and

spatial data necessary for the installation Emergency Operation Center (EOC) to also perform day-to-day emergency and preparedness planning activities. In general terms, DoD defined this effort as a bottoms-up study effort. The product which we will demonstrate today is the Installation and Vicinity Data Base.

## PRODUCT VALIDATION

The design of this spatial data base and its utility for DoD emergency management and installation EOCs use during All-Hazards emergencies was validated and tested during development by participation in scheduled exercises and actual disaster response.

The USASSDC Program Team rapidly set up a base of operations and fielded four quick response teams during the Southeast Floods of July 1994. The products in greatest demand utilized data layers from the installation and vicinity data base fused together with current weather, imagery, and operational information. The data layers from many different and diverse sources were built using current Geographic Information System technologies and innovative techniques which minimized data loss. The products included visual situation and damage assessments, near real-time imagery and photography integrated with decision aids, population demographics, and evacuation and logistics routing maps.

On-site direct support was also provided to assist the Director of Military Support (DOMS) at the Pentagon; the Alabama, Georgia, and Florida National Guards; the National Guard Bureau; and the National Centers for Disease Control and Prevention.

Testing and validation also included several large-scale hurricane and earthquake exercises including the Joint Warrior Interoperability Demonstration (JWID), Hurricane Polly, and a Central U.S. earthquake exercise with Fort Campbell, KY. The program team also developed and conducted a major radiological disaster exercise in Romania, which was hosted jointly by Romania and Bulgaria. Twenty-two countries attended and actively participated in this international event.

All emergency management data sets and capabilities contained in the Installation and Vicinity Spatial Data Base provide an initial approach to enhancing disaster preparedness. There is still much to be done in the future to mitigate destruction and human suffering. The USASSDC, as a center of technical expertise, stands ready to play a continuing role.

## FLOOD SUPPORT

The USASSDC Program Team prepared slide situational assessment and planning documents in support of MSCA agents while planning national level MSCA support during the Southeast Floods of July 1994. The top-level MSCA agent desired to see, on a single graphic, the hydrography of each of six major river systems as flood waters were rising. On this same graphic, they required key cities and military installations which either might be affected or which might be needed to assist should the flooding worsen. Our spatial data base design allowed us to quickly change viewing of the hydrology data to show the Southeastern Flood area with the specific hydrology enhanced. Examples of our spatial database and product samples are available upon request.

Our government-contractor team also deployed quick response teams to support state level flood response planning. The team provided maps depicting requested state and county level situational assessments and planning aids for Decatur and Seminole Counties in Georgia during the Southeast Floods of July 1994. The request was for a single planning tool which would depict the area(s) flooded should the waters be at various flood stages. The normal water level (hydrography) and outline of the Flint River were shown in conjunction with the area and roads which would be covered when the water level rises.

## INSTALLATION AND VICINITY DATA BASE

The installation and vicinity data base design focused on producing usable products at the installation EOC for their related requirements for self-recovery and MSCA during preparedness planning and all-hazards response. As such, this data base design is not just for federalized disasters. At the request of installation EOCs, it also includes the design for the spatial data necessary for the day-to-day emergency and preparedness planning activities.

The installation and vicinity data base provide standardized digital spatial data and associated attributes for the production of digital and hard-copy maps in a format and scale consistent with the level of automation at each respective installation EOC. The data base was delivered to each installation EOC free of cost and any licensing or distribution constraints.

## INTEGRATION OF KEY SPATIAL INFORMATION TECHNOLOGIES

Several key off-the-shelf digital spatial information technologies were identified during on-site visits and from surveys completed.

- Geographic Information Systems (GIS)
- Computer Aided Drafting and Design (CADD)
- Emergency Management Software (EMS)
- Global Positioning System (GPS)
- Imaging
- Scanning

## REQUIREMENTS IDENTIFIED FROM THE FIELD

Spatial data and information requirements were identified from:

- On-site visits to 38 military installations in CONUS and our territories. An additional 83 installations

were sent questionnaires to collect emergency planning data.
- Concurrent visits or interviews with more than 50 communities surrounding the 38 installations.
- Visits and interviews with over 100 other civil and government offices and agencies involved with MSCA.

The following general mission-related requirements which were deemed essential for supporting the installation's response mission:

- Enhance self-recovery operations
- Respond to requirements in the immediate vicinity
- Deploy response forces to remote locations
- Provide logistics support
- Provide related planning and training.
- Meet reporting requirements:
  - ⇒ Warning information (activation of EOC, evacuation of facilities, early dismissal of employees, coordination initiatives)
  - ⇒ Response activities (installation missions, missions from others [number, scope, status], state/local requests, general description of damages and reconnaissance/survey data, initial status of facilities, coordination/liaison activities, personnel status, funds status)
  - ⇒ Recovery activities (mission requests from FEMA, status of FEMA missions, requests for state/local, status of state/local requests, personnel status, contract status, funding status)
  - ⇒ Type of event, e.g., flood (by type), drought, HTW spill, earthquake, hurricane, war, terrorism, water contamination (by cause)
  - ⇒ Economic impact (dollar value of damages, number of people affected, type of area affected).
- Provide Presidential and Dignitary Visit Management:
  - ⇒ Damage surveys, planning route and means of transportation.
  - ⇒ Security activities.
  - ⇒ Change-of-command security activities.
  - ⇒ Crowd control.
  - ⇒ Clean-up.

It was clearly evident from the installation visits that not all installations perform all of the above mission requirements to the same degree. In many cases, they are event specific. Additionally, the installations, the CONUSAs, and all agencies visited stressed key requirements, including continuous data base maintenance, data interoperability, connectivity, and standardization of geographic data bases within the national-level disaster preparedness infrastructure.

One of our most challenging steps was to collect information concerning spatial digital data formats. They had to foremost be available in a timely manner so that we could immediately start scheduling the delivery of products. Secondly, as directed by DoD, the products had to be free of any costs and licensing constraints.

The four-month data collection time schedule allowed time to gather data in its resident format from each source. Almost every data source utilized different data base formats. This project recognizes the value of a standard or at least interoperable spatial data formats. One is needed that will accommodate both government and commercial data fusion for emergency management applications both at a national and international level. Our research found significant duplication of spatial data collection efforts in separate offices and agencies at almost every location visited. USASSDC project will continue to work to support the standardization and interoperability of digital formats for emergency planning.

The installation and other agency coordination trips resulted in numerous and sometimes differing ideas and interests in the installation and vicinity data base. From the ideas collected during these trips, implied requirements were synthesized. These fact-finding trips revealed that the level of automation at installation EOCs ranged from none to fairly sophisticated with map viewing and emergency operations and management software packages with geographically referenced attribute data. The typical source of high resolution installation data--the installation Public Works (PW) or Facility Engineers (FE) office, had complex hard-copy and digital data sets available from a wide range of high end Commercial-Off-The-Shelf (COTS) Software formats. These formats were usually incompatible with those required in the installation EOC. These findings are significant as they help define both a key source of higher resolution data covering the installation, as well as the scope of the effort required to produce diverse and enhanced data sets for the installation EOCs.

The requirement was subsequently defined to establish a single spatial data base to support the IDP Project using the COTS ARC/INFO GIS software which was already on-hand at USASSDC. This requirement significantly minimized project startup time and costs.

Additionally, visits conducted on the representative sample of 38 military bases, revealed that most installation EOCs had little or no automation to view digital data or to manage emergency response activities. Those that did have automation usually required a source agency or contractor with a GIS or CADD capability to prepare the spatial data in certain digital mapping formats in order for their emergency management software to view the spatial data efficiently. Therefore, a data loss problem was identified with creating a single data base due to the many input/output spatial data formats.

This data loss problem is exacerbated when relatively few data layers are used with each layer having many attributes. This is normally the case with the many very high resolution data sets generated by engineers as they compile facility data

(which is the primary source of existing installation data). For example, the facility engineers may have one data layer for all buildings or structures on the installation. All uses, owners, names, dimensions, etc., would be accounted for as attributes. This method is efficient and makes sense for engineers; however, this is not how the EOC personnel or many of their COTS emergency management software manipulate and use spatial data sets. Typically, layers which are not as detailed were more usable to the EOC, e.g., certain key buildings such as designated shelters or buildings with weapons and ammunition storage, etc.

All the emergency management software packages identified during the installation visits, all installation plans reviewed or discussed, and the EOCs interviewed have the common need to track and manage specific subsets of general building and resource data. However, the EOCs do not require all of the detailed engineering drawing-level data, as the EOC manages, not directs, emergency response. High resolution, detailed maps and dimensions of buildings may be required for use by the on-scene fire chief, military police, bomb disposal teams, utility crews, etc., who actually respond with their resources. If so, they will already have them on hand or in their information system. According to EOC managers who have automation or have seriously been researching the problem, it is unnecessary and too resource intensive for the EOC to try and maintain the extra detailed data. These extraneous data are simply more information to keep updated, and many EOCs are already understaffed to perform the updates required for their current data.

The surveys, additional research, and installation visits also identified the following All-Hazard Disasters and other events as representative of those required of installation EOC managers for MSCA and installation self-recovery. These may also be initiating events and/or contributing hazards due to material, technical disasters, overt actions, planned events and visits, and any number of possible combinations.

- Severe weather
- Flooding
- Earthquakes, slides
- Volcanic activities
- Oil, chemical spills
- Nuclear spills or melt-downs
- Weapons mishaps
- Plant accidents
- Air, marine accidents
- Transportation mishaps
- Hurricanes, tornadoes
- Crime
- Environmental
- War
- Toxic gas release
- Terrorist actions
- Building fires, collapse
- Riots, disturbances
- Massive disruptions
  - Power
  - Water
  - Communications
  - Food supplies
- Contamination
- Dam failures
- Forest, grass fires
- Dignitary visits (President, Pope, large concerts etc.)
- Demonstrations, and major civic events

The requirement was further defined to interface the digital and hard-copy mapping products with the installation EOC, consistent with their respective level of automation and skills. Additionally, the EOC needs to interface with the surrounding vicinity using compatible maps. The EOC and facility engineers may have maps with Military Grid Reference System coordinates, latitudes and longitudes, or no coordinate system. The vicinity will usually have maps with State Planar and latitudes and longitudes, or no coordinates. Very few of the major commercial emergency management software products reviewed thus far can convert to each of these coordinate systems. However, any high end GIS and most CADD software can convert between these coordinate systems.

Due to the various formats and qualities of source data received, the requirement was also derived to make a distinction between a core set of data sources and others. The core set of data sources are those which are, or are expected to be, used by key disaster management agencies that directly influence DoD participation. These are first and foremost FEMA and the DOMS. These include Census data, interstates, primary roads, flood data, nuclear plants, airports, fault lines, hydrology, and federal, state, and county boundaries.

The list below identifies the emergency management software media formats identified for IDP production at selected installations during this one-year effort.

- Hard copy
- Emergency Information Systems (EIS)
- ARC/INFO

These same format requirements were also identified at the CONUSA and DCO levels, at FEMA offices, and at some vicinity locations.

The installation visits all identified the requirements that any data sets and capabilities provided be:

- Usable on a day-to-day basis for other installation requirements so that all installation offices are working from the same data sets.
- Simple and easy to use for EOC operators.
- Focused on standardization, and interoperability with higher headquarters and vicinities.
- Kept up-to-date.

Many installation EOC personnel also work mobilization issues and training area usage during mobilization and need to minimize the number and use of specialized software and data bases.

The number of spatial data layers are being maximized and the number of attributes on each layer minimized. The rationale is that this minimizes data loss and data base export problems during translation from and to the many data formats and platforms involved. Additionally, time and resource savings are expected.

The team reviewed the list of 83 data layers, and established associated work priorities for the 16 thematic groupings considered for the installation and vicinity data bases during this first year effort. See **Table 4-2**. A more extensive review of feedback from installation EOCs and all MSCA agencies after they have exercised the installation and vicinity data base is recommended in future years.

TABLE 4.-2 THEMATIC GROUPS OF DATA LAYERS

| THEME | DATA LAYERS | | |
|---|---|---|---|
| Hydrology | FEMA Flood Maps<br>Hydrography<br>Ice (Glaciers) | Wetlands<br>USACE Flood plains<br>Hydrologic Units | Snow<br>Coastal Hydrology |
| Land Ownership | Federal Land Ownership<br>County Land Ownership | State Land Ownership<br>Private Land Ownership | Cadastral |
| Utilities | Communications<br>Instrumentation<br>Doppler Radar)<br>Sewer Systems | Fresh Water Systems<br>Fuel Facilities<br>Waste Disposal Sites<br>Electrical Power Grids | Transmission Lines<br>Power Grid)<br>Water/Sewer<br>Treatment Plants |
| Geology | Surface Geology | Elevation Contours | Wells |
| Atmospheric | Climate (Historical)<br>Temperature (Historical) | Weather (Historical)<br>Radiation | |
| Boundaries | Installation<br>Census Geography<br>County<br>International | Local Government<br>State Administrative<br>Federal Administrative | Facility<br>Leased Lands<br>Restricted Areas |
| Socioeconomic | Demographics (Population)<br>Economic | Natality<br>Demographics (Ethnic) | Mortality |
| Geodetic | USGS Control Points | | |
| Geophysics | Magnetics | Gravity | Seismic |
| Hazards/ Environmental | Hazardous/Toxic/ Radioactive Wastes<br>Remedial Activities | Medical Wastes<br>Material Safety<br>Data Sheets | Air Pollution<br>Hazardous Materials |
| Man-Made Features and Structures | Nuclear Plants<br>Fire Departments<br>Base/Unit EOCs<br>Roads<br>Maritime Ports<br>Bridges | Fire Hydrants<br>Man-Made Structures<br>Hospitals<br>Police Departments<br>Designated Shelters<br>Airports | Pipelines<br>Railroads<br>Power Plants<br>Man-Hole Covers |
| Photogrammetric | Photos and Imagery | | |
| Cultural Resources | Historical Standing Sites<br>Native American Sites | Historical Maritime Sites | Prehistoric, Archaeological Sites |
| Land Use/Land Cover (LULC) | Land Cover | Land Use | |
| Emergency Planning Enhancements | Evacuation Routes | Disabled | Troop Support Agency |
| Subsurface | Bathymetry | Soils | Minerals |

Emergency Planning Enhancements were defined as information that provides value-added capabilities for the installation EOC's self-recovery missions and MSCA-related missions. The installation and vicinity data base was designed to eventually contain enhancements that are essential for emergency response. Enhancements will be implemented as time and resources permit. They may appear as data layers or attributes in the installation and vicinity spatial data base, or special map augmentations, such as color coding and symbols.

Enhancements which have been identified for consideration and evaluation include:

- Evacuation routes. Primary and secondary routes identified by disaster type.
- Troop Support Agency (emergency food supply) location.
- Locations of concentrations of disabled and elderly persons.

- Low-lying flood-prone areas next to bodies of water. These areas are prone to flood, but are not identified on regular maps.
- Symbology. Using special symbology on a map to identify important buildings, locations, information, etc.

  Special emergency operation equipment (location and point of contact). Equipment includes jaws of life, chain saws, cutting torches, welding equipment, come-a-longs, shovels (including snow), rakes, Reverse Osmosis, Purification Units (ROPUs), cargo trucks, wreckers, petroleum, oil, and lubricants (POL) trucks, extra ambulances, and helicopters.
- Special emergency operation crews. Operators and crews for search and rescue, fire fighting, Emergency Ordnance Disposal (EOD), bus drivers, helicopter pilots, truck drivers, POL handlers, generator operators, ROPU operators, and mechanics.

The following recommendations are made for future enhancements:

- Maintain in-depth evaluations of off-the-shelf data services.
- Maintain updated evaluations of off-the-shelf spatial analysis and viewing software.
- Perform a long-range analysis of hard-copy mapping scale requirements.
- Define spatial data requirements for emergency management and MSCA agents above DoD installation level.
- Finish populating the installation and vicinity data base with all data layers required by DoD installation EOCs.
- Produce emergency planning enhancements for the installation and vicinity data base.
- Further assess the utility of the Albers equal area and other projections.
- Define additional themes for selected regions and special disaster threats.

## CONCLUSION

All emergency management products, data sets, and capabilities contained in the installation and vicinity data base provide an initial approach to enhancing disaster preparedness for military installations. There is still much to be done in the future to mitigate destruction and human suffering. The USASSDC as a center for technological expertise stands ready to play a continuing role. This project was funded through October 1994. However, several initiatives have been funded to include an innovative technology exchange with more than eleven countries under "Partnership for Peace" initiatives. We look forward to participating in other additional national and international emergency planning activities.

## BIBLIOGRAPHIES

### FRED A. ROBERTS

**EDUCATION:**

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**SUMMARY:** Mr. Roberts is currently employed by Science Applications International Corporation in Huntsville, Alabama. Hands-on experience providing national level quick emergency response, disaster relief planning, spatial analyses, terrain modeling, and data base management using state-of-the-art Geographic Information System (GIS), emergency management software, and imagery analysis technologies. He is proficient conducting weapons system performance evaluations and analyses; developing and fielding Standard Army Management Information Systems; determining manpower and materiel requirements for systems in Integrated Logistics Support (ILS) analyses, material acquisition, and Force Structure Development processes. His systems integration experience includes modeling and simulation, environmental impacts and assessments, integrated system performance testing for national defense and force modernization systems. Mr. Roberts has on-the-ground military experience conducting total system fielding, logistics, and operations on the M109 family of 155mm Howitzers, M107 175mm gun, and PERSHING 1a missile systems for the U.S Army and foreign countries.

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**SUMMARY:** Ms. Jones is currently employed by Science Applications International Coporation in Huntsville, Alabama. She has hands-on experience providing national level quick emergency response, disaster relief planning, spatial analyses, terrain modeling, and data base management using state-of-the-art Geographic Information System (GIS), emergency management software, and imagery analysis technologies. Ms. Jones was previously employed the the U.S. Army Space & Strategic Defense Command managing the Spatial Weapons System Analysis Center which incorparated GIS technologies into various aspects of weapon system analyses. In addition to experience in a broad range of GIS and emergency management applications she has served as hardware/software systems administration for several federal computer centers.