Military Installations

Decision Support

Facilities Management

Pavement Management

Utilities Management

Work Order Generation and Tracking

Safety and Security

Environmental Restoration

Hydrology

Hazardous Material Tracking

Asset Management/Tracking

Range Management

Range Control Systems

Natural Resource Management

Hazardous Waste Management

Planning

Disaster Preparedness and Response

Military Installation Management GIS

Introduction

Geospatial information plays a key role in our national defense. Knowing what is where is the key to mastering the battlefield, the installations, and deployed areas that support the warfighter. Military leaders must have a common tool with rapid access to relevant and accurate geospatial information for mission-critical operations. To provide this geospatial information, the base manager's ability to fuse, manage, analyze, and disseminate facilities information is a vital component for command planning and operations. A broad range of challenges, such as dynamic base space requirements, expanding regulations, land use restrictions, aging infrastructure, asset tracking, and regional data calls, require the deployment of flexible and scalable technology to assist the installation manager.

The effective management of the military installation with a complex, dynamic, and sometimes conflicting range of objectives requires comprehensive, up-to-date information and analytical tools to support decision making processes at all levels of operations and command. Geographic information system (GIS) technology provides the information technology (IT) foundation for the capture, management, dissemination, analysis, and visualization of geographic and related information concerning all aspects of military installation management and operations. GIS provides powerful tools for solving problems such as identifying the most cost-effective methods for managing and rehabilitating facilities, environmental compliance and remediation, utility and communications management, physical security, land use planning, range management, and explosive safety siting.

GIS and support of spatial data standards provide the mechanism for interoperability between departments, base commands, and headquarters, thus optimizing coordination and leveraging investment in installation data resources. GIS also provides installation managers with better tools to share data and coordinate land use issues with neighboring government agencies. In an era of smaller work forces and declining staffing, GIS can function as the crucial productivity improvement tool for maintaining a high level of "corporate knowledge" and readiness while coping with changing personnel.

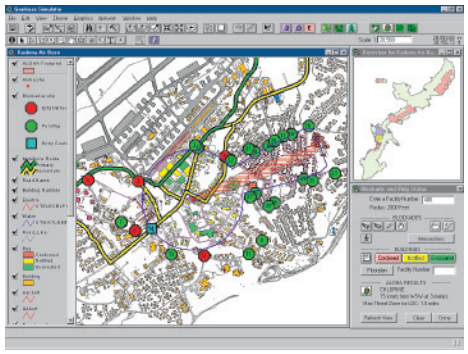
ESRI® software solutions provide commanding officers with access to management information while also providing operational personnel involved in the day-to-day management of base facilities and resources with optimal sets of tools. The ESRI ArcGIS™ family of software provides the tools to fuse and aggregate information for roll up to command and staff levels. The following articles are examples of how ESRI's GIS technology can be used to effectively address the major areas of concern to today's military base managers.

Spatial Data Standards for Facilities, Infrastructure, and Environment

The Computer-Aided Design and Drafting (CADD)/GIS Technology Center for Facilities, Infrastructure, and Environment was established at the Information Technology Laboratory (ITL), U.S. Army Engineer Research & Development Center (Waterways Experiment Station [WES]), Vicksburg, Mississippi, in October 1992 to support the Army, Navy, Air Force, and Corps of Engineers. Since its creation it has expanded its role to support other federal, state, and local government organizations.

One of the major initiatives assigned to the CADD/GIS Technology Center is the development of the Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE). The SDSFIE is the only nonproprietary GIS data content standard designed for use with predominant commercial GIS and relational database software. The SDSFIE focuses on development of data content standards to facilitate shareability and interoperability with the enterprise GIS at Air Force, Army, Navy, and Marine Corps installations; U.S. Army Corps of Engineers Civil Works activities; and other federal government organizations.

This nonproprietary design, in conjunction with its universal coverage, has propelled the SDSFIE into a de facto standard throughout the Department of Defense; other federal, state, and local government organizations; public utilities; and private industries throughout the United States and the world.



The CADD/GIS Technology Center annually updates and expands the SDSFIE. The SDSFIE (along with the Facility Management Standards for Facilities, Infrastructure, and Environment [FMSFIE]) is distributed via CD–ROM and the Internet (http://tsc.wes.army.mil). A user-friendly interactive Microsoft® Windows®-based software application installs the SDSFIE/FMSFIE toolbox of software applications that facilitates the use of the standards and the development of an implementation schema.

The Center recently began an effort to develop a consolidated geospatial data model using object-oriented technology. In conjunction with ESRI, the Center is working to define an SDSFIE geodatabase implementation. In so doing, the Center will be able to move with and help lead the industry in developing a standard object-oriented data model for GIS.

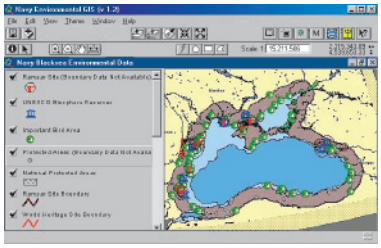
For additional information, contact Bobby G. Carpenter, P.E., CADD/GIS Technology Center, e-mail: carpenb@wes.army.mil.

The Navy Environmental Planner—Providing Environmental Information and GIS Analysis Tools to Support Decision Makers

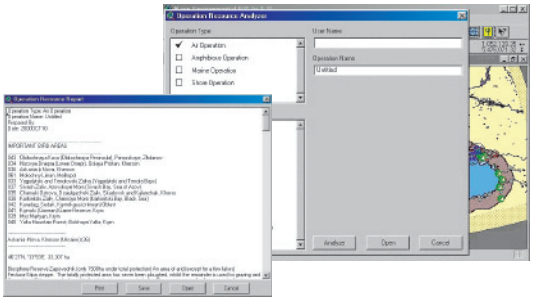
Naval Warfare Publication 4-11 (NWP 4-11) was promulgated in October 1998, and it requires that environmental considerations be included in operational planning. It further provides Navy and Marine Corps commanders and planners with doctrine to accomplish their assigned mission while achieving the highest possible degree of environmental protection and compliance. In addition, NWP 4-11 includes guidance on the preparation of an environmental annex (Annex L) to an operations order or operations plan.

To support fleet commanders and planners, PCCI Inc. of Alexandria, Virginia, with the support of ESRI's Professional Services Division, has created for the Navy an ArcView® application called the Navy Environmental Planner (NEP) to support the creation of an "Annex L." The NEP allows the fleet planner to combine and view many types of data including environmental data, infrastructure data, baseline cartographic data, and oceanographic data. Furthermore, the NEP provides the ability to produce an in-depth analysis of the environment of a user-specified area of interest in an easy-to-use graphic interface.

The Black Sea Example



The collection of environmental information for the Black Sea coastal region was a concern due to a lack of regional harmonized environmental data sets. An abundance of Black Sea environmental data exists; however, it is in different formats, languages, and countries around the Black Sea and the world.



PCCI tasked the World Conservation Monitoring Centre (WCMC) in Cambridge, United Kingdom, to use their extensive environmental data resources to compile the first complete harmonized set of environmental data for the Black Sea region on the following subjects:

1. **Important Coastal Wetlands**
2. **Important Bird Areas**
3. **Coastal Protected Areas**
4. **World Heritage Sites**
5. **Ramsar Sites**
6. **Black Sea Fisheries**
7. **Endangered and Rare Animal Species of the Black Sea and Coastal Area**
8. **Endangered and Rare Plant Species of the Black Sea and Coastal Area**
9. **International Conventions and Agreements**

Basemaps were generated from NIMA data products including World Vector Shoreline Plus and Digital Nautical Charts. These maps provide the infrastructure and serve as the basemaps for the NEP Black Sea application.

NEP has an analysis tool that synthesizes the data to produce reports based on the specifications of the planner who is creating an Annex L. First, the planner defines a specific area of interest by either drawing a polygon, circle, or rectangle. The planner then designates the type of operation or operations that they are planning. The operations have been divided into four types including shore, marine, amphibious, and air. Each of the operation types pulls up the appropriate data coverages for the specific operation type and graphically displays them on the screen. Also, in each of the operation types, the user has the capability to turn on and off each of the different coverages under each operation type. The final analysis punches through the data layers and extracts the data and produces a report that can be saved. This allows for multiple analyses to be saved and compared. Eventually, the desired analysis can be printed or saved electronically.

A temporary database file is also saved with the report that recognizes the links to the report's data files. This allows for the automatic integration of the report data into any

other type of program that is capable of reaching out and reading the database including a plan writing software that is being developed to guide the user through the creation of an Annex L.

Including environmental considerations in operational planning is important to ensure mission success. NEP provides the planners and decision makers the ability to determine the environmental concerns of a region, to select an area appropriate for an operation, and finally to document the environmental considerations. NEP is a flexible environmental GIS analysis tool that can be applied to support environmental planning anywhere around the world.

The National Inventory of Dams

The National Inventory of Dams (NID) is the most comprehensive source of information on dams in the United States. The inventory, which currently consists of approximately 77,000 dams, is a congressionally authorized tool for managing dam safety in the United States and its territories. The NID represents a partnership among the U.S. Army Corps of Engineers (USACE), the Federal Emergency Management Agency (FEMA), other federal dam owning and regulating agencies, the Association of State Dam Safety Officials (ASDSO), and the states and territories of the United States. Information includes dam name; official ID number; dam type, height, storage capacity, latitude, and longitude; and other data pertaining to characteristics of the dam. The NID was originally commissioned by Congress in 1972 and consisted of 49,329 dams. Subsequent updates by USACE in 1980 and in partnership with FEMA in 1992, 1994, and 1996 have verified existing data, added missing information, expanded the criteria to include structures under 25 feet in height, and implemented electronic methods for data collection and publication.

Prior to 1998, the NID was available on CDs as dBASE® and Paradox® databases. Therefore, retrieval of information could be a tedious process of scrolling through thousands of dam names and corresponding database columns. Since the database of 77,000 dams is geographic in nature, GIS tools were added to the 1998 update and publication of the inventory. ESRI's MapObjects® application was used to develop a GIS interface and display of the NID for users without GIS knowledge or experience. Dams are displayed on a map of the United States, which can be displayed at scales from national level down to county level. The dams can be color-coded according to size or hazard potential. Additional features displayed are state and county boundaries, rivers and streams, and highways. The user can query dams based on any of the 40 fields of information in the NID and display results in a table and on the map. The Access database, GIS software, and menu routines are all included on a CD, and a user need only have a Pentium® computer with a Windows® 98 operating system and sufficient hard disk space.

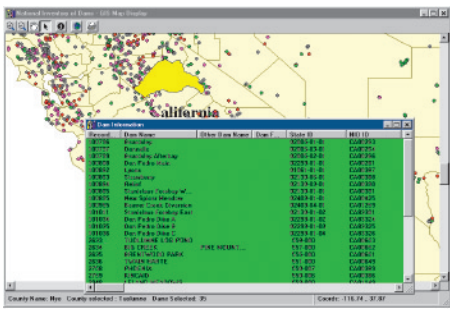


Figure 1: Dams are displayed according to their hazard classification. Query results show all dams in Tuolumne County, California.

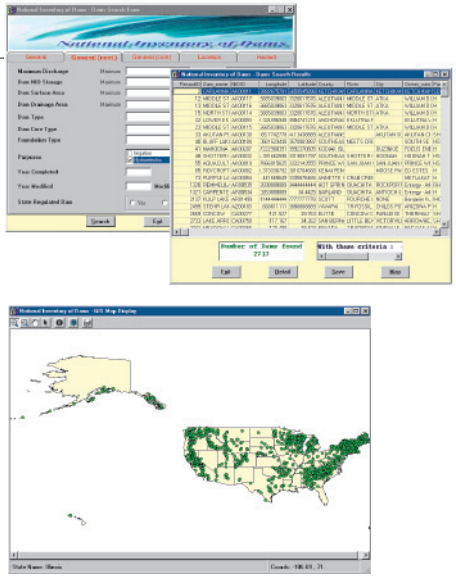


Figure 2: Query of the NID to find all the hydroelectric dams. The results are then shown on a map.

The customized GIS application provides a powerful and valuable interface to the extensive database of dams. Tedious hours that may be spent, for example, finding all earthen high-hazard dams in Texas built since 1980 can be found in less than a minute. The application also introduces the capabilities of GIS to a large number of users without the need for expensive software, specialized training, or any GIS knowledge. A similar GIS application for the NID is also available on a USACE Web site, which eliminates the need for CDs and enables links to various other databases.

GIS Users *Installation Management*

Navy Region Hawaii Uses ESRI Software for Regional Planning, Facilities Management, and Public Works Operations

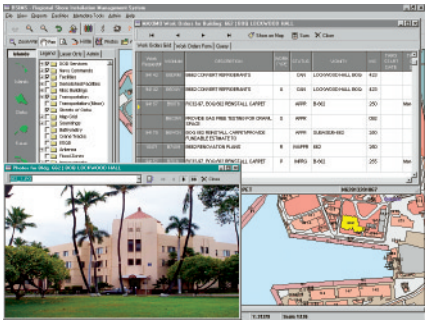
The Commander Navy Region Hawaii (CNRH) required a standardized process to keep track of its shore installation facilities and infrastructure and desired the capability for information retrieval and analysis to support its facilities planning, management, and public works efforts. To accomplish this goal, it created a component-based GIS application called the Regional Shore Installation Management System (RSIMS) using ESRI software.

RSIMS combines spatial data with tabular information to provide its users with a visual tool that allows them to intuitively perform reporting and analysis functions for regional planning and facilities management. RSIMS links the Region's spatial data to databases such as Naval Facilities Assets (NFA), which contains real property inventory for land, buildings, structures, and utilities owned or leased by the Department of the Navy. RSIMS is also linked to MAXIMO, an Oracle®-based maintenance management system that tracks and manages repair, maintenance, and service work orders for many military activities in Hawaii. The integration of GIS technology with operations databases results in an easy-to-use, interactive graphical interface allowing users to navigate and retrieve information via a map. It also provides reporting and analysis functionality for work orders, equipment inventory, preventive maintenance inspections, and job plans for recurring work.

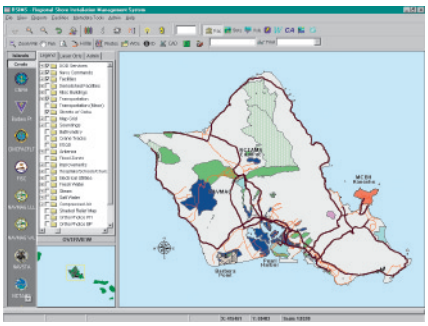
Through RSIMS, multiple users can instantly access spatial data from their desks in real time and are able to overlay various data types onto each other. RSIMS has increased worker efficiency and improved response time. Users are now able to do data analyses and see relationships between different data sets—tasks that were difficult or impossible to do when the data existed as paper maps and stand-alone databases. Another benefit RSIMS has provided is the ability to share data among various departments, thus eliminating data redundancy and fragmentation as well as streamlining data maintenance by making it easier, faster, and more cost-effective to update the maps.

RSIMS utilizes a spectrum of spatial data required for facilities and installation management.

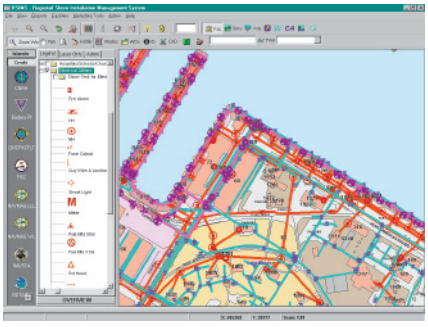
- **General Installation Maps: Military facilities and dwelling units, roads with geocoded street centerlines, naval vessels, piers, cadastre, bathymetry, and hypsography**
- **Utilities: Electrical, wastewater, potable water, steam, compressed air, and saltwater**



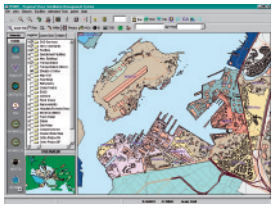
Buildings are hot linked to inventory databases and CAD and photo libraries.



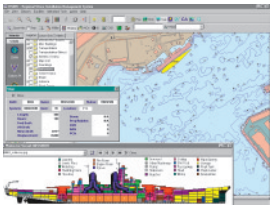
Standard RSIMS interface showing the extent of military properties in Hawaii



Detailed map showing facilities, piers, and utilities distribution systems



Display of maps in the Pearl Harbor area, showing buildings and roads



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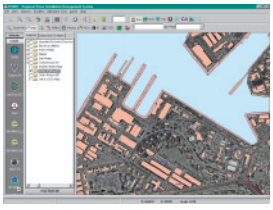


Spatial data superimposed over aerial orthophotography

• Environmental Constraints: Wetlands, shoreline sensitivities, refuges, endangered species, electromagnetic radiation arcs, explosive safe distance arcs, hazardous materials storage, and remediation zones

• Public Safety: Tsunami and flood inundation zones, emergency services locations, and oil spill contingencies

RSIMS also includes raster imagery such as orthorectified aerial photography and USGS topographic line maps. The vector spatial data served by RSIMS is stored either as ArcInfo shapefiles or in ESRI's ArcSDE geodatabase, and the data is maintained using ESRI's ArcGIS Desktop (ArcMap™, ArcCatalog™, ArcToolbox™) and ArcInfo™ Workstation. The raster images in RSIMS are compressed using LizardTech's MrSID™ program and displayed as MrSID files.

RSIMS is accessed via one of two platforms: an Intranet application powered by ESRI's MapObjects within a Delphi™ interface or an Internet version based on ESRI's ArcIMS®. The Intranet application is more fully featured and robust. It resides within the Navy's firewall and is used to serve up the entire medley of data. The Internet platform is designed for the more casual user who does not need access to the more robust analysis tools and data.

Both versions are fully component based and data driven, allowing for rapid development of customized applications for specific user needs. All configuration data is stored in an extensive Oracle schema that is maintained through an administrative module.

The standardization of the ESRI file formats allows the same set of spatial data to be used by the Navy for complementary purposes. The RSIMS spatial data is therefore accessible in a mobile environment for on-site investigations using ESRI's ArcPad™ and a pocket PC handheld device. Accessing the data through ESRI's ArcScene™ and ERDAS IMAGINE® allows the Navy three-dimensional visualization capabilities to verify view channels between buildings, study height regulations, and model harbor depths for ship passage.

Three-dimensional rendering of
the Pearl Harbor Naval Base using ArcScene

• Point of contact Navy Public Works Center
400 Marshall Road, Code 410
Pearl Harbor, HI 96860
Attention: Paul Andrew Pollock, AIA
Director, Engineering System Division
Phone: 808-471-4546
Fax: 808-474-3813
E-mail: pollockpa@pwcpearl.navy.mil

Bird Avoidance Model

A problem often faced by both military and commercial pilots is loss or damage to equipment when an aircraft collides with birds in the air. A bird strike at any point during a flight can cause serious equipment problems and even result in the loss of human life. Since 1985 there have been more than 30,000 bird–aircraft strikes recorded by the U.S. Air Force alone. These strikes have caused 33 fatalities, 30 lost aircraft, and more than $450 million in equipment damage. Nearly one quarter of all bird strikes occurred on low-level training routes or over military operation areas, and nearly two-thirds of total equipment damage occurred on those same training routes and operation areas.

Thus, knowing bird strike probability on any particular mission can help prepare pilots, planners, and schedulers in the selection of flight paths and schedules. Geo InSight created the Bird Avoidance Model (BAM) using GIS technology to analyze and correlate bird habitat, migration, and breeding characteristics with key environmental and human-made geospatial data. The original BAM is an intuitively designed desktop application for the Bird Air Strike Hazard (BASH) team of the U.S. Air Force. The BAM application includes interfaces for specific users such as aircrews, planners, and schedulers. Geo InSight then transferred the original BAM application to the Internet. The BAM Internet application allows the user to identify, zoom, pan, and view on the Web various models of bird strike information within specific time spans.

Using technology from ESRI's ArcIMS and Allaire ColdFusion®, the BAM Web site not only provides users with information, but it also provides them with access to frequently asked questions and instructions for using the models. The user can create and interact with maps that display the models and other geospatial themes.

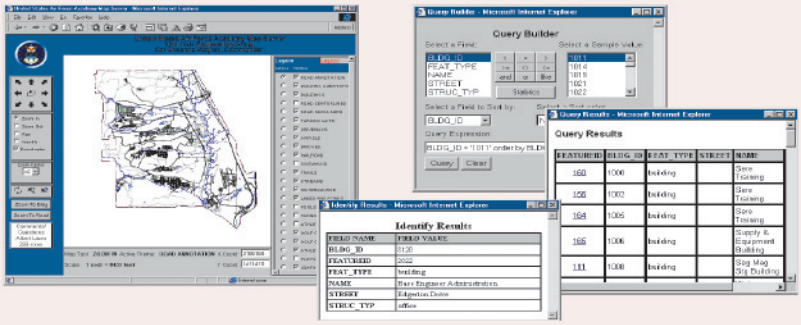
U.S. Army Training and Doctrine Command Delivers Integrated Corporate Solutions to Installation Management

Mission

The U.S. Army Training and Doctrine Command (TRADOC) trains the Army, develops the war-fighting doctrine, and commands assigned activities and installations. The Deputy Chief of Staff for Base Operations Support (DCSBOS), Headquarters (HQ), TRADOC, Fort Monroe, Virginia, provides mission support and facilities installation management and accesses, trains, sustains, and deploys the forces. DCSBOS supports 16 installations, or "cities," where more than 150,000 people work, live, and train on two million acres of land and in almost 170 million square feet of facilities. Organizationally, DCSBOS is organized into functional directorates that include military and civilian personnel management, resources management, logistics, acquisition, engineering, community activities, and other processes to manage the infrastructure, services, and environmental issues for the TRADOC installations. Substantial information resources used in decision making are spatial data or directly related attribute data. Unfortunately, DCSBOS had no structured "information library" for integrating, viewing, and analyzing current or historical information for various sources. All of the various DCSBOS functional IT systems manage, store, and summarize data in "stovepipe" hierarchies. Also, there was no repository of time-based, summary information to help make decisions.

As a result of an intensive, interactive planning process involving all 11 directorates, DCSBOS created an implementation plan to guide the development of a corporate database (CorpDb). With its purpose to "Achieve Information Dominance—The Right Information at the Right Time" (one DCSBOS strategic goal), the CorpDb system is a framework to plan, design, create, and dispense geo-

10th Civil Engineering Group



Defense organizations are frequently being asked to make their operations more efficient using new technologies. To increase efficiency, data management needs have become a priority in defense organizations around the world. Recently, the 10th Civil Engineering Group (CEG) located at the U.S. Air Force Academy (USAFA) enlisted the services of Geo InSight's Web development team to create an Intranet GIS for their existing planimetric and orthophotographic data. The Web development team customized ESRI's ArcExplorer™ using HTML and JavaScript™. Powered by ESRI's MapObjects Internet Map Server (IMS), the resultant application gives users the ability to query, identify, zoom, pan, and view various layers of mapping information via the Web.

It is also important that any Intranet/Internet GIS solution be easy to use and have a high level of functionality. Therefore, Geo InSight's Intranet GIS solution for the 10th CEG features a cursor display with live geographic coordinates and a zoom to building or road function. The application also allows the user to query and identify functions. With this Intranet GIS application, the 10th CEG implemented a comprehensive, integrated, basewide GIS that aids in the management of their natural lands/assets and human-made infrastructure.

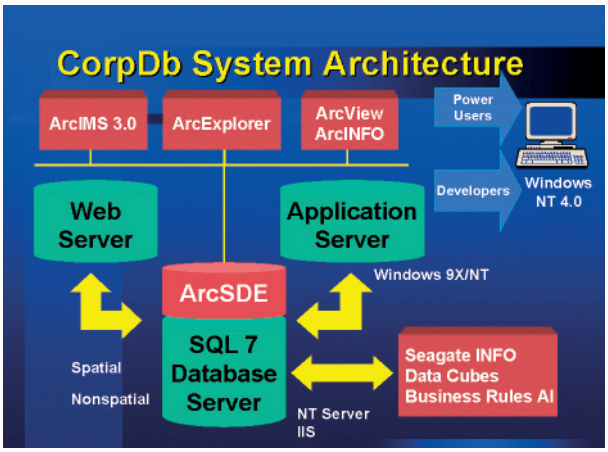
based information technology to support decision making throughout the DCSBOS base operations organization. The following fundamental principles guided the development of the CorpDb.

- **Use existing, proven, off-the-shelf GIS and database management technology.**
- **Establish a "corporate memory" for tracking history.**
- **Integrate spatial and nonspatial data that is useful across functional directorate boundaries.**
- **Integrate key information from BASOPS databases, as well as other outside information sources.**
- **Reduce the time needed to make decisions.**
- **Improve the accuracy of decisions.**
- **Support the installations.**
- **Allow directorate users to "own" and "maintain" their data.**
- **Develop and maintain additional software tools, as required, to acquire, view, edit, analyze, share, and present information.**
- **Make information available to all potential users.**

CorpDb Overview

DCSBOS, supported by its contractor, Systems Management Engineering, Incorporated, developed an enterprise-level, GIS-based decision support system (DSS) known as the BASOPS Corporate Database. Using the CorpDb approach effectively breaks down the "stovepipe" decision making of the past. The system is a relational database model integrating spatial data (data that references a location on a map), attribute data (descriptive information about the spatial entities), and regular tabular data. The system employs ESRI's GIS technology to enable the linking of text data to the appropriate corresponding location on the earth. The GIS technology allows massive amounts of information to be stored, accessed, managed, and analyzed on the computer, then viewed geographically on the screen in map form. Data is shared across these functional domains. Both spatial and nonspatial data can be directly exchanged with the Army's other major commands, Department of the Army, and other military services.

Facing a wide range of potential users, the CorpDb's designers created a system for the entire user community. The CorpDb's capabilities are accessed by system developers and certain designated "power users" in each directorate through ArcView GIS loaded on individual PCs. By having

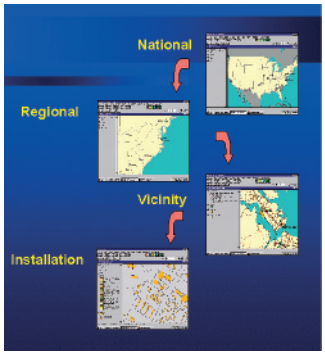


direct access to ArcView GIS, users can create and add new data layers and perform advanced analyses. The remaining DCSBOS users, whether on-site or in the field, reach the system through CorpDb Web application (CorpDb Web), now under development. The Garrison Commanders and Directors of Public Works (DPWs) in the 16 installations have been provided copies of their installations' version of the CorpDb. The next phase of installation support will allow installation users to reach the CorpDb Web site. Also, an installation version of the CorpDb LAN system, with direct links to the DCSBOS CorpDb, is in the planning and design stage.

The CorpDb now has more than 450 map and aerial photographic data layers, incorporating GIS and CAD layers from the 16 installations; data layers from other federal, state, and local agencies; and data from commercial sources. The CorpDb incorporates Tri-Service's Spatial Data Standards (SDS) for installations and tracks metadata for all spatial data layers. DCSBOS directorates currently use more than 130 databases. The CorpDb currently has direct data links to several major Army standard systems including Installation Facilities System Management (IFSM), Installation Status Reports (ISR), Table of Distribution and Allowances (TDA), and Army Stationing and Installation Plan (ASIP). CorpDb also links to several DCSBOS systems including the facilities maintenance and repair (MAR) and the base operations financial management (BOSFM)

databases. Most of these databases are linked to map layers. All of the CorpDb databases are accessible through the maps and/or through user interfaces employing online analytical processing (OLAP) and business rules modeling technologies. A variety of nonmap interfaces that tap the databases are currently under development. Successful in using ESRI's ArcView GIS software in a LAN environment, the expanding system size and complexity have prompted DCSBOS to add ArcSDE™ and ArcInfo for improved data management. To meet the CorpDb's broad user community requirements, DCSBOS initially developed a Web-based application using ArcView Internet Map Server (IMS) and is updating the Web application using ArcIMS 3.

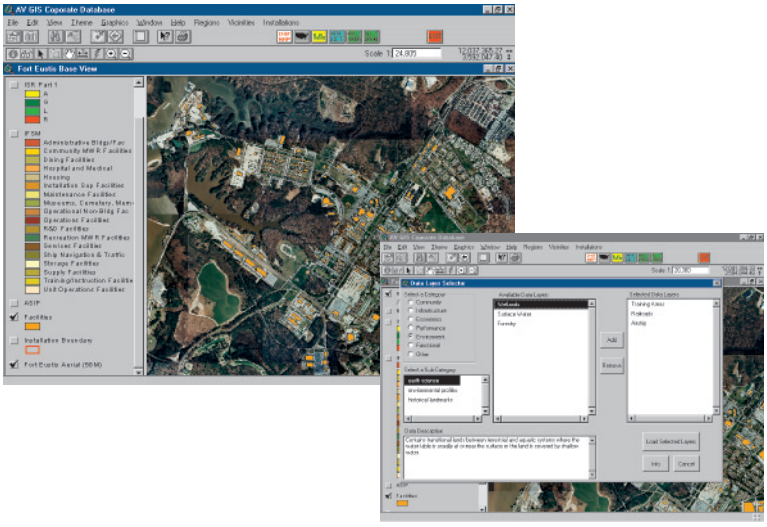
The CorpDb system has three major parts that are accessed from a main system screen.



Maps—In the CorpDb LAN application, Maps opens a customized ArcView GIS software engine, allowing the user to view, create, edit, query, analyze, and present spatial and related nonspatial data. In the CorpDb Web application, Maps opens a customized ArcIMS 3 Web interface, providing the user with many of the same tools as the ArcView GIS application. CorpDb spatial data layers are linked to nonspatial SQL data tables that provide specific physical, geographically based information about TRADOC's 16 installations, their surrounding communities and vicinities, regions of the nation, and the continental United States. Presently, the CorpDb user begins using the system with a view of all TRADOC installations at a national level. From here, a regional view can be selected at a scale that shows several installations and their surrounding states and counties. If the user wants to look more closely at the vicinity surrounding an installation, the view is changed to show the counties, cities, and towns surrounding the installation. The vicinity view offers the CorpDb user an opportunity to inspect, analyze, and present relationships between the installation and its surrounding community.

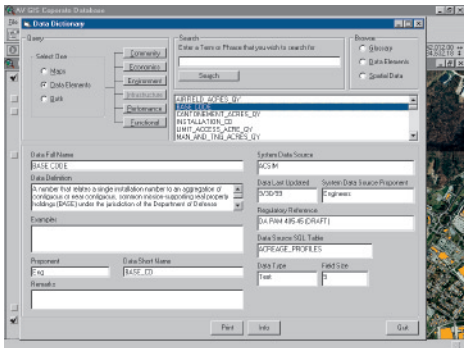
By selecting one of the 16 installations, the user can view an installation's roads and streets, buildings, other facilities, water features, property boundary, environmental features, and aerial photo imagery. The buildings and other facilities are directly linked to the installation's facilities systems and Installation Status Reports (ISR) databases, allowing the user to investigate facilities' relationships inside, between, and among the facilities. For example, the user may locate dining facilities, review their current mess capacity, current budget, utilization rate, or unit meal cost, then determine how far the mess halls are from living quarters, training areas, or work locations and make decisions on relocation or closure as warranted.

Both the CorpDb LAN and Web applications include a growing set of customized software tools that expand the off-the-shelf capabilities of ArcView GIS and ArcIMS. The ArcView GIS tools are developed in Avenue™ language and packaged as extensions for distribution to power users. CorpDb Web incorporates Java, JavaScript, and ArcXML languages for all Web-based system users. One useful tool is the Data Layer Selector, opened by a button on the ArcView GIS toolbar. This tool allows the user to browse, select, and add or delete data layers and other software tools to the current map view. With an ever-increasing number of data layers in the CorpDb, the Data Layer Selector also effectively manages the data layers, allowing the user to view and work with only those required. Examples of other useful tools in the CorpDb include a



flexible Overview Map, an advanced Query Manager, and an improved Find tool. The advanced Query Manager incorporates features of the original ArcView GIS Query tool with the capability to save queries with a date, name, location, and description.

Data Dictionary—During the CorpDb's planning stages, future system users requested a tool for finding information about the data being used—metadata. Since the CorpDb incorporates data from many directorates and makes it available to others, those outside users must be able to understand the data they are using, its source, date last updated, constraints, etc. The information must also be understandable to a user who does not know the terminology. The CorpDb system included a custom-built Visual Basic application, the Data Dictionary, that is linked to a set of SQL data tables, allowing the user to query, search, and browse both spatial and nonspatial data (e.g., maps, data tables, and data elements) within tables. A glossary offers access to a searchable database that includes definitions of terms and acronyms.

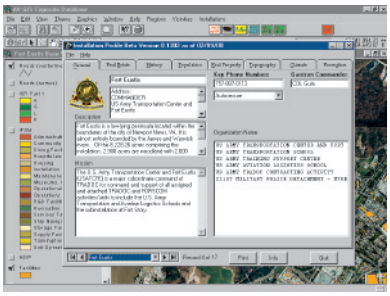


Profile—The Profile is an example of an easy-to-use interface that links multiple databases to get an integrated solution. DCSBOS and installation users have instant access to summary information often needed for briefings, information requests, and research. The interface, created in Visual Basic, presents an overview of base operation facts and figures for HQ TRADOC and the 16 installations. The Profile links to 10 SQL databases, summarizing general facts, real estate, history, population, real property, topography, climate, and recreation. The interface includes capabilities to graphically display three-dimensional pie and bar charts for real estate and population tables. Using the Profile as a model, other CorpDb interfaces are under development to allow users to integrate multiple databases and GIS maps.

Air Force Academy

Metadata management and data storage are crucial to efficient work within defense organizations. In the process of increasing data management efficiency, Geo InSight became involved with another project for the U.S. Air Force Academy. Their GIS team created a relational database management system (RDBMS) solution for metadata management and a data model for storage of vast amounts of geospatial and tabular data for USAFA. The RDBMS solution provides users with Web-based access to browse, search, view, and download metadata information. In addition, Geo InSight created a custom application that allows USAFA students and instructors to load data into ArcExplorer. In building this Intranet/Internet application, the Geo InSight development team used Allaire ColdFusion, ESRI ArcExplorer, Microsoft Access, and CASE tools.

Future Directions

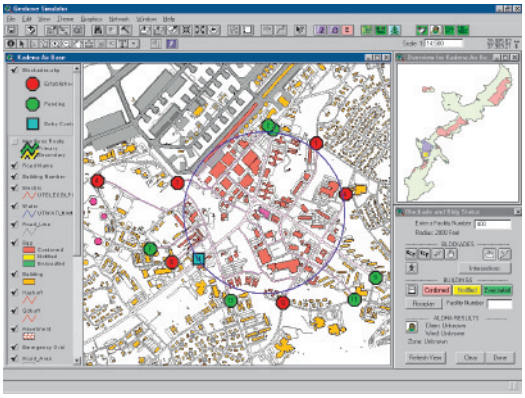


DCSBOS continues to expand and improve the CorpDb system, meeting decision support requirements of TRADOC's installation management community. Future versions of the CorpDb will incorporate new user interfaces and other tools such as those that better manage and analyze data and use business rules to improve decision making processes. Expanding the CorpDb system approach to each of the 16 installations will allow base operations personnel to manage people and facilities at the local level, seamlessly transferring information directly to HQ TRADOC. The results will improve the efficiency of information used to allocate installation management resources and reduce, if not eliminate, the need for periodic "data calls" to the installation and reporting. Also, DCSBOS's vision is that the CorpDb will be the information nucleus for day-to-day installation management operations that can be accessed by other Department of Defense (DoD) activities.

GIS Users

The United States Air Force GeoBase Simulator

Geospatial information plays a key role in our national defense. Knowing what is where is the key to mastering the battlefield, installations, and deployed areas that support the warfighter. The United States Air Force Vision 2020—"Global Vigilance, Reach, and Power" recognizes information superiority as one of six Air Force core competencies required to "defend the United States and protect its interests through aerospace power."



Given the global area of responsibility of the Air Force, it is paramount that leaders in all organizations have rapid access to relevant, accurate digital geospatial information for mission-critical decision support. The Air Force is implementing geospatial information technologies to support mission processes at each installation in accordance with Air Force GeoBase foundations and principles.

GeoBase is an Air Force initiative to develop enterprise geospatial information cooperatives to support mission objectives at Air Force installations. The GeoBase initiative prescribes a set of principles, policy, and guidance to govern the process of geospatial information management at USAF installations. The GeoBase vision is an installation where all mission elements gain situational awareness via easy access to a single georeferenced common installation picture.

Working with the Air Force Academy's Institute for Information Technology Application (IITA), CH2M HILL has developed a GeoBase Simulator, based on ArcView GIS 3.2, to demonstrate how network-based geospatial information technologies could be used to support real-world crisis and daily mission decision making at Air Force installations, ranges, and forward mission locations.

Focusing on the application of data, system, and communication standards, and the customization of commercial off-the-shelf (COTS) software tools, CH2M HILL was successful in meeting several objectives.

1. **Develop a scenario-driven capability to demonstrate the value of mission-based, shared use of geospatial information.**
2. **Demonstrate the effective use of geospatial information analysis tools to solve key installation crisis management work flows.**
3. **Provide a technological framework for the advancement of mission geospatial information solutions.**
4. **Demonstrate the benefits of GeoBase as a decision support foundation for Air Force leaders.**

To meet the objectives stated above, the Air Force exercised two crisis scenarios—a bomb threat and an aircraft accident. In the first scenario the Wing Operations Center (WOC) is notified by Security Forces that there is a bomb threat to a key building on base. To address the requirements of the first scenario, CH2M HILL developed a Blockade and Building Status tool that can be used by security personnel in situations where a controlled area must be cordoned and traffic control is necessary. The tool automatically centers the view to a selected structure, adds a user-defined cordon area, generates traffic control points (TCPs) for road intersections immediately outside the cordon, and creates a formatted report of the intersections available to the WOC as well as the on-scene commander via a wireless network and mobile computing.

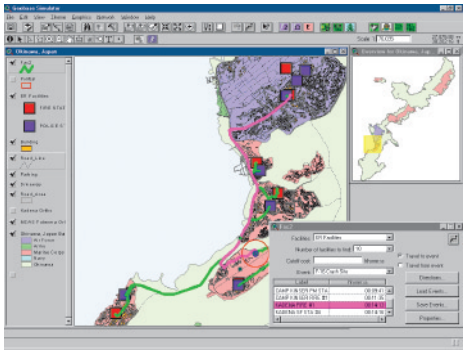
In support of evacuation of the cordoned area, the tool enables the user to modify TCP status and location, display building evacuation status, view structure floor plans, and report which buildings fall inside the specified cordon. The formatted building list is also available to the on-scene commander. In the event of an airborne toxic material release, the tool is integrated with the ALOHA aerial plume generation application codeveloped by NOAA and the EPA. The specified cordon area, traffic control points, and selected buildings and roads can be modified to account for both the plume footprint and a 95 percent confidence area (established to account for sudden weather changes).

The Blockade and Building Status tool is designed to support a primary seat (at the WOC) and multiple secondary seats via ArcView RPC Client/Server requests. This approach allows the primary seat to control the display of building and TCP status, intersection, and building status reports and the display of potential plume footprints for the entire support

team. Using RPC, the views on secondary seats at remote locations can be refreshed with real-time updates.

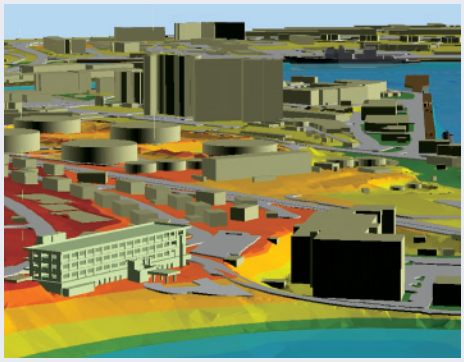
As part of the bomb threat scenario, a call is received at the WOC indicating that a munitions convoy is en route from a munitions igloo to the airfield. Established munitions convoy routes intersect the cordoned bomb threat hazard area. CH2M HILL used ArcView Network Analyst to calculate a new route for the convoy to avoid the cordoned area.

In the second scenario, an aircraft accident unfolds as the Marine Corps contact the WOC to report an Air Force F-16 has crash-landed on their air station. The key crisis response objectives are to mitigate any hazards associated with the site and route emergency responders to the scene of the accident. CH2M HILL employed applications of ArcView Network Analyst to determine drive time to route first responders and HazMat teams to the accident site.



In October 2000, the GeoBase Simulator was successfully demonstrated to the combined leadership of the Air Force (the Secretary of the Air Force and more than 50 Generals) at the CORONA Conference. The recommendations to Air Force leadership as a result of the demonstration are "continue building on GeoBase/GeoReach capabilities viewed at CORONA Fall '00" and "GeoBase/GeoReach must be fielded across the Air Force."

U.S. Navy Public Works Centers



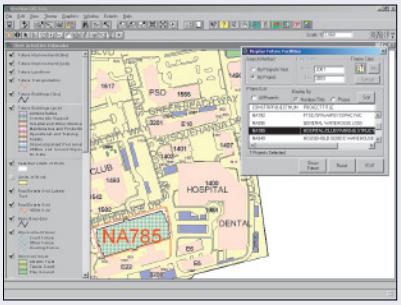
Geographic Information Services, Inc. (G/I/S), is providing GIS implementation support to the United States Navy in Yokosuka, Japan; Pearl Harbor, Hawaii; and San Diego, California. The project includes migrating the primary mapping platform from AutoCAD® to ArcGIS 8.1. The associated data conversion, staff training, and application development are also encompassed in this effort.

Work Flow Automation

The primary goal is to improve the overall work flow processes of the Public Works Center (PWC) staff. Applications include ArcIMS 3 for casual users and custom tools for comprehensive document integration of floor plans, photos, and cultural and natural resource surveys from multiple departments. Custom tools developed for long-range capital improvement planning and three-dimensional visualization of project plans allow personnel the ability to see how their base will look years down the road. The integration of these applications creates more efficient work flow processes. Consequently, this allows the staff to make better-informed decisions.

Success Spreads

When news of the system spread, other Navy Commands came to the GIS group to solve facility management problems. In Pearl Harbor, GIS is used to support regionalization efforts including footprint reduction: the demolition of inefficient structures to reduce operating costs. At the request of the Commander of Navy Forces, Japan, tools were developed to analyze and correct chronic parking problems when the Fleet is in port. A tool has also been developed for the Environmental Department of Commander Fleet Activities, Yokosuka, which links existing water sample databases to the GIS basemap.



In October 1998 Ayman El-Swaify, CADD/GIS manager, PWC Yokosuka, embarked on an ambitious project. "As the lead Public Works Agency for the U.S. Navy in Japan, we recognized the need for accurate basemapping of our facilities. As the project developed, the U.S. Air Force saw the financial benefits of pooling our efforts and reducing costs." Under the direction of PWC Yokosuka, many DOD installations in Japan are developing planimetric maps, digital orthophotos, and three-dimensional models.

Geodatabase Implementation Project

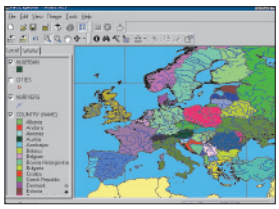
One of the most exciting elements of this project is its groundbreaking work with the Geodatabase. According to Denise Martin of the CADD/GIS Technology Center located in Vicksburg, Mississippi, "The purpose of this effort is to develop a physical implementation of Spatial Data Standards (SDS) that preserves the investment our customers have made in SDS-compliant systems while supporting our long-term goal of developing an object-oriented standard."

Expanding on that, Dale Dunham of G/I/S explains, "The Geodatabase provides us with an excellent opportunity to extend SDS to include the natural behaviors of the objects it represents. The SDS provides a tremendous framework for implementing the Geodatabase since its hierarchical model is ideally suited to be migrated to object technology. The challenge is that it forces us to examine the business process relationships in SDS to be sure they accurately reflect the real world."

ArcGIS

The ArcGIS software family embraces IT standards. Featuring an intuitive Windows user interface for desktop software, ArcGIS integrates with many databases and the open architecture allows the creation of applications that can be deployed in a "loosely coupled" distributed environment using XML protocol. As a result, ArcGIS is easily integrated into an organization.

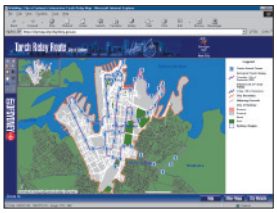
ArcGIS features an array of Internet-aware solutions including the ArcGIS Desktop products, browsers, mobile devices, and embedded solutions. ArcView, ArcEditor™, and ArcInfo software products share a consistent user experience, common code base, common extension model, and single development environment. This dramatically increases usability and interoperability while retaining flexible deployment options.



ArcExplorer
is a free geographic data browser that lets you display, query, and retrieve GIS data.

ArcView, ArcEditor, and ArcInfo
are collectively known as the ArcGIS Desktop products and are a scalable suite of software for geographic data creation, integration, and analysis.

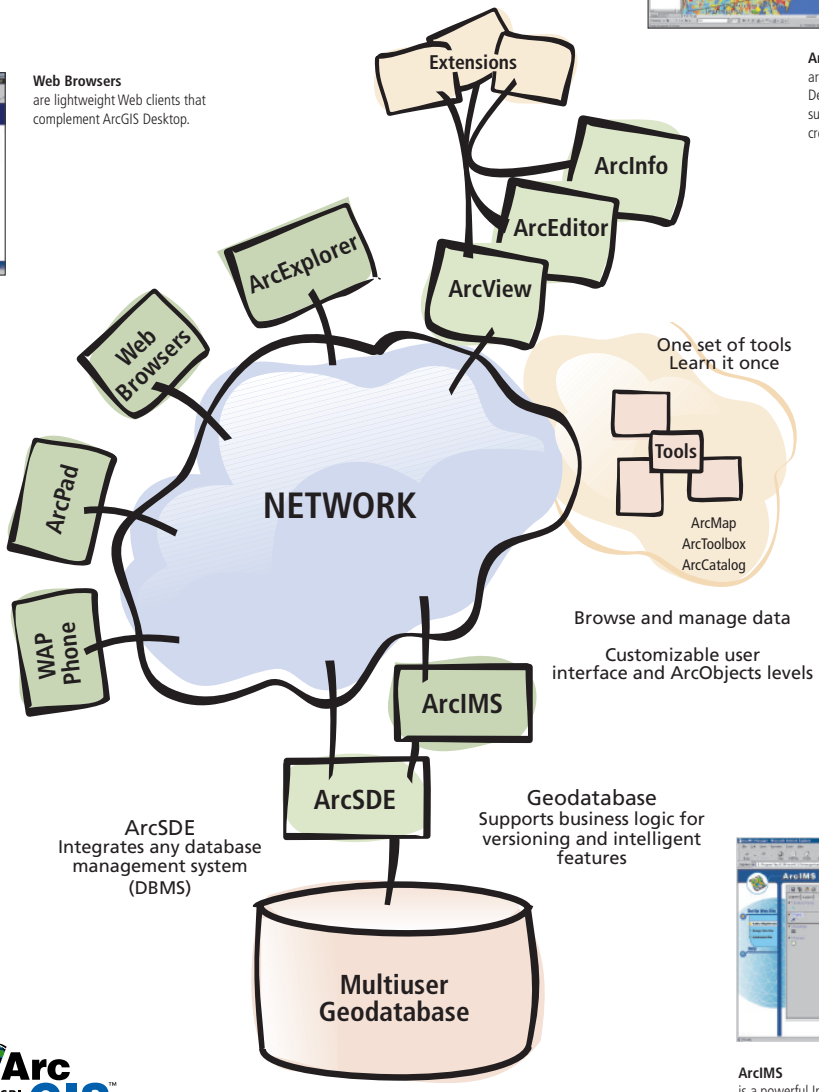
Featuring Microsoft® VisualBasic® for Applications

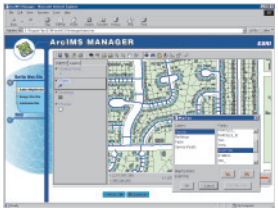


Web Browsers
are lightweight Web clients that complement ArcGIS Desktop.

ArcPad
is a lightweight mobile mapping solution that can retrieve maps using wireless technology.

WAP Phone
can receive maps via the wireless application protocol (WAP) and other open protocols.





ArcIMS
is a powerful Internet mapping system that works with standard Internet server technology.

www.esri.com/arcgis

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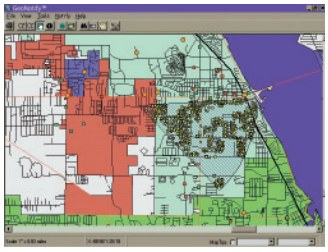


Over the years, manual notification procedures for battle staff recalls, special team mobilizations, and Guard/Reserve unit alerts have proven to be both time-consuming and personnel intensive. That is why so many U.S. military branches and intelligence units have come to rely on the power, security, and flexibility of The Communicator!®—a high-speed notification system from Dialogic Communications Corporation (DCC). Proven to provide fast and total automation of any quick-response checklist, The Communicator! contacts base and civilian personnel by phone, pager, cellular, and e-mail systems; delivers accurate, up-to-the-minute information or instruction; and confirms message receipt through Touch-Tone response.

To complement The Communicator!'s rapid notification and deployment capabilities, DCC also offers an optional ESRI-based GIS interface—GeoNotify™. GeoNotify enables personnel to navigate basemaps for the immediate selection of impact areas, processing data at the rate of up to 18,000 names/phone numbers per minute and initiating communications within 60 to 90 seconds from incident identification. Moreover, GeoNotify provides exclusive directional calling capabilities for proximity-based notifications (e.g., base housing evacuations beginning with personnel and dependents closest to the incident and working outward or vice versa). Together, The Communicator! and GeoNotify also aid military bases, intelligence units, and response teams in delivering critical information for such situations as squadron announcements, roster notifications, HazMat incidents, weather alerts, drills, exercises, and inspections.

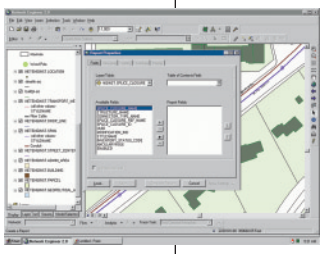
DCC is an ESRI Technology Authorized Developer.

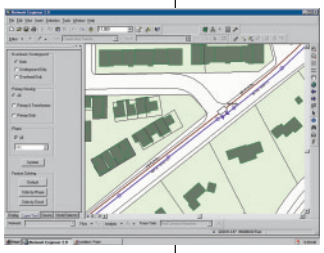
DIALOGIC COMMUNICATIONS CORPORATION

Network Engineer

Defense organizations have both unique and specific requirements for communications network and facilities management functions. During times of peace the training, administrative, and storage facilities require the ability to remain in constant communication with defense management personnel. The documentation, management, and maintenance of this voice and data communications network can be a complex and difficult task.

Likewise, during times of crisis, the communications requirements are even more difficult. Communications networks must be accurately maintained and monitored from the HQ to the field to ensure successful deployment and information exchange. In the aftermath of conflict, the situational analysis and rebuilding process must be done quickly and efficiently—especially the basic communications infrastructure of the region.





All of these areas present a unique problem—they require not only engineering and telecommunications expertise but also a firm understanding of GIS principles to effectively complete the required missions.

Telcordia Technologies and its subsidiary, MESA Solutions, offer a unique combination of communications and GIS experience.

Telcordia™ Network Engineer offers sophisticated network documentation and design capabilities from the experts in the telecommunications industry. This powerful software package combined with MESA Solutions' GIS implementation expertise give defense organizations the tools they need to successfully manage their communications networks.

For more information, visit Telcordia's Web site at **www.telcordia.com/networkengineer**.

MESA Solutions

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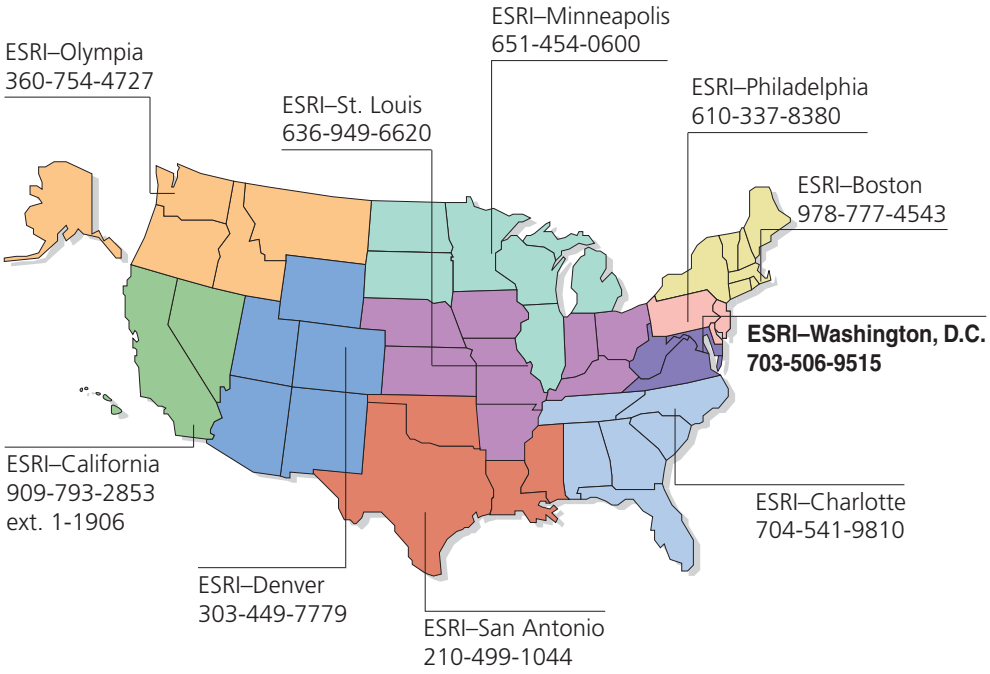

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