BIOGRAPHICAL INFORMATION

David J. Peters
Director, Systems Integration Department
Environmental Systems Research Institute, Inc.

Specific Responsibilities

Mr. Peters is responsible for the definition of Systems Integration programs, specific tasks and costs, and for development of system implementation schedules and integration test plans. He also coordinates installation and training activities, supports hardware and software vendors with system configuration requirements and integration specifications, provides system design and implementation consulting services to clients, and oversees installation and system performance testing activities.

Mr. Peters is author and publisher of the *System Design Strategies* white paper providing a standardized methodology used by ESRI for designing enterprise GIS environments for the ESRI worldwide customer community. He also developed and maintains the System Architecture Design Strategies for GIS class, which is part of the ESRI education curriculum. In addition, Mr. Peters provides key presentations on system design and implementation strategy in support of ESRI user conference workshops and pre-conference seminars.

Past Experience

Mr. Peters has over eighteen years of experience in systems integration management including technical design and system testing experience. In 1990, he joined Environmental Systems Research Institute, Inc. (ESRI), as director of the Systems Integration department for geographic information system (GIS) projects after twenty years of experience with the U.S. Air Force, where he obtained a broad background of technical, managerial, and system engineering experience.

Mr. Peters served in the U.S. Air Force for twenty years, retiring at the rank of major. He spent four years as chief of the Small ICBM System Test Division in the Ballistic Missile Organization, supervising seventeen project officers and directing 150 aerospace engineers. He managed a $1.2 billion system test integration and test hardware development program. He directed missile processing and launch pad operations for the first small ICBM missile flight test—a flawless operation. He reworked the test program, consolidating test objectives and reducing redundancy, as well as significantly reducing system hardware requirements by eliminating six flight tests and optimizing test schedules; he reduced total program development costs by $3 billion. Mr. Peters managed a major missile hardware development and integration support contract, directing a small ICBM project management team of thirty aerospace engineers. He led a technical effort to develop the statement of work, provided a request for proposal, and complete technical evaluation to support negotiation of a $350 million program restart contract.

Mr. Peters was chief of the Small ICBM Survivability Branch in the Ballistic Missile Organization for two years. He supervised six project officers and directed eighty aerospace engineers managing a very technical $400 million strategic survivability component design, system integration, and development test program. He established initial hardness design and development requirements, and he published a system-level program plan. Additionally, Mr. Peters completed numerous blast simulation shock tube tests, evaluating the hard mobile launcher design on schedule and within cost.

As W80 warhead lead project officer at the Air Force Weapons Laboratory, Mr. Peters spent three years directing forty systems integration managers, representing fourteen Air Force, Navy, and Department of Energy development agencies, and three prime aerospace contractors responsible for W80 warhead development and weapon system integration for the Air Force's air-launched and the Navy's sea-launched cruise missile development programs.

Mr. Peters was warhead development project officer at the Air Force Weapons Laboratory for one year. He developed military requirements for the design and deployment of the W80 and W84 warheads. He directed five warhead development sub-groups integrating warhead design, maintenance and logistics, joint test, and interface control requirements into both the Air Force's air-launched and the Navy's sea-launched cruise missile weapon systems. He established proactive integration teams that identified problems and provided solutions well ahead of schedule, precluding program impacts. He also integrated warhead-testing objectives and coordinated asset deliveries, supporting a twelve-flight competitive fly-off to select a prime contractor for full-scale missile development.

Mr. Peters has nine years (3,050 flying hours) of military flying experience as a C-141 aircraft commander/T-38 instructor pilot. For two years he was chief of Wing Airlift Operations at Norton AFB. He directed operations planning and airlift mission tasking for fifty-eight C-141 aircraft and 200 aircrew staff delivering personnel and cargo worldwide. The operations included both rapid deployment force exercises and routine channel airlift missions. Mr. Peters directed development of a computer program to automate several mission-planning tasks, permitting an office manpower reduction of 50 percent and improving operations performance. For seven years, he was a C-141 aircraft commander flying in support of worldwide military operations including combat support operations into Vietnam, and into Israel during its war with Egypt. He spent one year as a T-38 instructor pilot teaching the basic fundamentals of flying high-performance jet aircraft.

Education Information

- M.B.A. (Business Administration) Southern Illinois University, Edwardsville, Illinois, 1979
- M.S. (Physics) Air Force Institute of Technology, Wright Patterson Air Force Base, Dayton, Ohio, 1978
- B.S. (Math/Physics) Wisconsin State University, Whitewater, Wisconsin, 1970

SYSTEM ARCHITECTURE ALTERNATIVES FOR ENTERPRISE AM/FM OPERATIONS

Dave Peters

Environmental Systems Research Institute, INC

380 New York St. Redlands, CA 92373 USA

Over the last 13 years GIS technology has evolved from a desktop application to supporting operations on a global scale. This paper provides a brief overview of the GIS technology evolution, and highlights the challenges faced by customers today in implementing enterprise GIS operations.

GIS is a remarkable technology. This technology has carried the traditional science of Geography into the digital world, enabling organizations to represent business data and manage geographic resources through a powerful user-friendly geographic perspective.

The utility of a Geographic Information Systems should be measured in terms of what value you get out of the system. This value is determined by the information products that can be generated by the GIS, and the value of these products in supporting business needs. These information products provide the primary basis for establishing data and application design requirements. Information products cannot be generated without the required GIS data and the appropriate applications.

Most GIS operations were initially developed to support specific department level information product or workflow needs. The cost of generating and maintaining GIS data was high, thus GIS implementations focused on specific high value business requirements.

Department GIS. Once operational GIS data were available, departments found a variety of opportunities to leverage these resources to address an expanded range of business needs. GIS data became a core business resource, and organizations started consolidating and maintaining shared GIS data resources on Department level file servers. This enabled GIS users throughout each department to have direct access to shared data resources, enhancing their ability to produce quality GIS information products and more effectively support business operations.

Organizational GIS. Departments throughout larger organizations continued to improve their GIS data repositories, and GIS information product needs expanded beyond the department level. It is the nature of GIS technology, or geographic analysis in general; that the quality and value of the information products (maps) improve with the increase of available GIS data resources. For this reason, data resources would be shared across department boundaries to improve the quality and value of their information products.

Data sharing was initially supported through informal exchanges between departments. WAN communications supported network connections between departments, enabling on-line file exchange between department level data resources to support business needs.

Over time, GIS committees were established to develop common data standards and data sharing agreements between departments, and organizations started consolidating their GIS data resources at the Organizational level to better leverage their investments. Departments could then access required GIS data resources from a common Organizational data warehouse.

IT technology has played a big role in supporting the evolution of enterprise GIS operations. Business organizations do what they can afford, and technology costs money. If organizations find a more cost effective way of supporting their business needs, financial resources can be applied to generate other business opportunities. Many organizations found they can significantly reduce their GIS total cost of ownership by consolidating GIS operations (applications and data resources) in a central computer center. Most GIS operations can be supported from a central computer center (ArcGIS desktop supported through Citrix terminal access to Windows Terminal Server farm).

Community GIS. In more recent times, GIS operations have expanded to include Internet data resources. This again is driven by technology, both from the IT community and from evolution of the GIS software technology. GIS users can integrate their GIS data resources with additional Internet data resources to further enhance the value of their information products.

GIS business opportunities are expanding. Several State and National organizations provide consolidated data clearing houses for their user communities. Organizations are starting to outsource their GIS data management and IT system operations to application service providers, reducing IT staffing requirements and finding more efficient ways to support their technology needs. GIS data is shared throughout business communities, with a multitude of alternatives for supporting organizational level Enterprise GIS needs.

GIS Technology. GIS has kept pace with the IT technology revolution, supporting sophisticated professional GIS user needs with workstation desktop applications; and at the same time the most practical mobile field operations over wireless connections. GIS data resources are expanding exponentially, from 10-20 GB of GIS data a few years ago to multiple Terabyte of GIS data supporting typical customer operations.

GIS technology throughout the years has consistently placed high demands on the IT infrastructure. GIS users require the highest performance workstations, and the latest and highest performance data and application servers. GIS operations consume a relatively high percentage of the available network communications. Even with the rapid increase in IT infrastructure technology, the typical customer infrastructure has not kept pace with the expanding capabilities and demands of the GIS operational evolution.

Much of the Enterprise GIS evolution today is about providing user access to a rapidly growing volume of GIS data resources. Most users are quite satisfied with the functionality provided by GIS technology, and just want to get it to work in their operational environment. The biggest challenge in supporting many Enterprise GIS operations is providing the appropriate system architecture to support existing operational deployment needs. Just give users access to all the data resources and provide productive performance at the desktop.

System Performance Sizing. There are a large number of factors that contribute to overall GIS performance in an Enterprise IT environment. These factors include several critical considerations in deploying and maintaining appropriate GIS and database software, applications, and data resources; and also a variety of critical considerations in establishing an appropriate IT hardware infrastructure to support GIS Enterprise operations.

Investment in the IT hardware infrastructure must be properly distributed across platform and network resources to avoid system performance bottlenecks. For GIS operations, operational constraints should be limited by platform CPU performance capacity technology limitations (the rest of the system environment can be designed to avoid performance bottlenecks). System architecture design requirements should be established based on peak user workflow requirements.

The system architecture design and hardware deployment establishes the IT infrastructure for supporting the GIS operations. GIS technology must support user performance requirements within the technology limitations of the established IT infrastructure. Too little investment in hardware will require lots of system tuning and careful workflow management to maintain user performance. Too much hardware will waste money and reduce return on investment.

GIS Business Planning. Understanding existing business processes and where GIS will best support user workflows is an important first step in developing Enterprise GIS operations. Data requirements and application needs should be derived from understanding the information products required to support normal business processes. The GIS implementation schedule is established based on an understanding of the time required to develop or collect required GIS data resources and deploy appropriate GIS applications to support user workflows. Estimated peak user loads are established based on the operations deployment schedules (when the system is ready to support user operations and the users are deployed).

ArcGIS User Requirements. Understanding the required GIS technology and the steps required to support system migration to full production levels, is critical in understanding what it will take to deploy required Enterprise GIS operations. In some cases, organizations are already using GIS applications and are looking for ways to improve access to available data resources. In other cases, organizations are moving from legacy GIS operations or deploying GIS operations for the first time. In either case,

understanding user requirements and GIS technology options is a first step in establishing a strategic deployment strategy.

Most Enterprise deployments involve consolidating GIS data resources in a central GIS database environment and deploying the associated user application environments. Initial planning typically includes completing a user application needs assessment; and completing a requirements analysis to establish application technology and data resource needs to support user workflow requirements. This planning is followed by tasks to develop the database design and initial GIS prototype applications, and to support prototype testing to validate the initial production design. These efforts are then followed by hardware delivery, data migration/loading, and application deployment. Establishing appropriate timelines and dependencies for these activities is important in order to properly estimate user deployment schedules.

System Architecture Design. System architecture design should be established based on specific peak user workflow requirements. The results of the design should provide specific hardware performance capacity sizing specifications, based on peak user loads. System infrastructure limitations should be considered when selecting a hardware configuration strategy to avoid performance bottlenecks during the GIS operational deployment.

Several factors must be taken into consideration during the system architecture design. User workflow requirements should be managed to optimize utilization of available system infrastructure resources. Hardware configuration strategy and specifications (servers, networks, storage) must be established to support peak user workflow requirements. Location of the database environment, geodatabase design, selection of the database technology, and maintenance and tuning of the database environment are all critical to support GIS operational performance goals. The weakest link in this performance chain can establish system performance limitations. System architecture design strategic planning provides the framework for productive operations.

IT technology is changing very rapidly. Platform processing performance has doubled over the past year, and hardware vendors expect this rate of performance change to continue. Hardware is also getting less expensive each year, which translates to large productivity and cost benefit gains by purchasing the right technology at the right time. Technology life cycles are getting shorter; server platform life cycles are 3-4 years with today's technology. It is getting very important to purchase hardware only when you need it, and plan to use over 50% of the hardware performance capacity within the first year to get proper return on investment.

Managing technology change. GIS customers are faced with the challenge of keeping pace with rapidly changing technology. Enterprise GIS implementations typically take several years. A complete design is completed and approved before the project begins. Projects try to implement the most current new release technology (or try to force vendors to implement future technology), and even then the production system is outdated before the project reaches full deployment. Once the system is deployed,

traditional projects would want to operate in production for several years to recover their deployment costs before starting another upgrade. By that time, their system is far behind current technology trends (5 years is forever) and the upgrade effort requires a complete refresh of their operational environment.

Many GIS customers today are changing to an incremental GIS implementation strategy. Projects are established on an annual basis, and implementation is focused on deploying proven technology that supports their long-term Enterprise deployment objectives. This allows customers to evaluate their implementation strategy on an annual basis, and avoid trying to implement technology that is not ready for deployment. This also helps customers manage technology change, and keep their business on course with technology improvements. The primary objective in supporting these customers is keeping them moving in the right direction. During the first year, normally these customers just want to do what they are doing today in the new technology. Future years will incorporate new technology to enhance their Enterprise GIS operations.

Once GIS operations are deployed, they must be supported and maintained by qualified staff. Initial testing and tuning should start during the initial deployment and continue through full operations. Critical system components must be tuned on a regular basis to support optimum system performance. Understanding the factors that impact system performance, maintaining qualified maintenance staff, and supporting periodic administrative maintenance requirements can ensure successful GIS operations.