

Louisville and Jefferson County Information Consortium (LOJIC) (2003—Enterprise System)

System Summary

The Louisville/Jefferson County Information Consortium (LOJIC) is a multiagency effort, begun in 1985, to build and maintain a comprehensive geographic information system (GIS) to serve all of Louisville and Jefferson County, Kentucky. Present LOJIC partners include Louisville Metro Government, Louisville and Jefferson County Metropolitan Sewer District (MSD), the Jefferson County Property Valuation Administrator (PVA), and the Louisville Water Company. The partner agencies were actively involved in the hardware/software procurement process, system installation, spatial data conversion, training, applications development, and myriad technical issues related to LOJIC implementation. All the partners continue to share the cost and effort involved in the ongoing development and expanded use of LOJIC.

LOJIC has grown to include nearly 400 users across 60 participating agencies throughout the community, but with the continued deployment of interactive Web-based GIS tools, its users now number in the thousands. LOJIC serves as our community's shared repository for approximately 200 layers of locally maintained spatial data. These include detailed plan/topo mapping, high-resolution color orthophoto imagery, land records, site addresses, street centerlines with address ranges, all manner of political/administrative districts, utility infrastructure, floodplains, zoning, watersheds, stream networks, demographics, and a host of other data. In addition, LOJIC has collaborated with our regional planning agency to develop basic spatial databases of surrounding counties, including political boundaries, street centerlines, and address ranges.

Through LOJIC, GIS technology has become an integral component of many local government and utility business processes in the Louisville metro area. Mission-critical custom applications have been deployed for daily updates to addresses, street centerlines, sewer facilities, and land records. LOJIC also serves as the framework for crime reporting/analysis, 24-7 citizen-call center, work-order and asset management, floodplain determina-

tions, rainfall modeling, pavement and street-sign management, and E911 operations. Interactive LOJIC applications via the Internet at <http://www.lojic.org> provide public access to local voter information, geodetic control information, and land records, and for browsing various community map layers.

Motivation for System Development

The motivation for developing a shared, community-wide GIS for Louisville and Jefferson County, Kentucky, came about as a result of responses to a major local disaster and some progressive leadership among local governments and utilities.

In the early morning hours of February 13, 1981, two miles of combined sewer mains exploded in the Old Louisville neighborhood south of downtown. The explosion was traced to a spill of thousands of gallons of hexane into the sewers from a nearby production plant. More than two miles of Louisville streets were pockmarked with huge craters where manholes had been. Miraculously, no one was seriously injured, but homes and businesses were extensively damaged and several families had to be evacuated. Water, electric, gas, sewer, and phone lines in the area were all broken. Emergency response and damage assessment was severely hampered by a total reliance on hard-copy sets of facility maps and plans, most of which were old, hand-drawn, and varied in scale, detail, and completeness.

From that mess emerged a new vision that utilized emerging GIS technology—GIS, where everyone's data laid neatly on top of one another; where all the utilities and government agencies shared a common digital map database; and where facilities and infrastructure could be seen in a truly interrelated context.

Several agencies began meeting to explore this developing technology. The MSD took the lead in contracting for updated aerial photography with an eye on building a plan and topo base map. PlanGraphics, Inc., was hired to conduct a feasibility study and implementation plan. Shortly thereafter, proposals were solicited for system/software and ESRI was selected. Things grew

from there, not exactly as designed but with enough agreement and participation that the system got off the ground. In 1988, a Memorandum of Understanding was signed by the four original partners—the MSD, the City of Louisville, Jefferson County Government, and the PVA. In 1996, the Louisville Water Company joined the consortium and the network of LOJIC user agencies has grown to include numerous suburban cities, fire protection districts, the University of Louisville, Louisville Gas & Electric Company, Jefferson County Schools, and many others. The partners agreed to share in the funding, maintenance, and further development of a shared GIS with the guiding philosophy of “If we build it, others will come.”

System Benefits Achieved

A primary benefit of the LOJIC GIS is the elimination of data redundancy; each agency maintains its own mission-critical data and shares that data via the community’s shared spatial database warehouse. Partner agencies have incorporated GIS into their daily work flows and processes. LOJIC now serves as the authoritative local source for addresses, land records, utility infrastructure, demographics, comprehensive planning, inspections, permits, political/administrative districts, and emergency services, including the community’s E911/CAD system. This has created synergy and focus on system and database integration and quality across user agencies. LOJIC partners have come to understand that relationships such as data custodian, data creator, and users have interdependencies that are part of a continuous work flow across all local agencies. GIS has “forced” agencies to work together in new and creative ways. It is no longer about “my data” or “your data,” but about “our data.”

A hallmark effort to eliminate redundant data came as a result of the development of a master address file maintained in LOJIC and shared by all agencies. In 1994, LOJIC began a project to establish and maintain an authoritative spatial database of all addresses among the 300,000 land parcels and 3,500 miles of streets in Jefferson County. Procedures have been established through local ordinances for the assignment and maintenance of official addresses, both as site addresses and street block ranges, by Louisville Metro’s public works and planning agencies using the LOJIC GIS.

Other successes include development of spatial data and applications for:

- Comprehensive land-records management and public access
- Sewer record/facilities maintenance
- Asset and work-order management
- FEMA floodplain management and insurance-needs determination
- MetroCall citizen response and reporting
- Crime reporting, statistics, and analysis
- Custom cartography and spatial data products
- Web-based GIS and public access tools

Above all, the real success of LOJIC has been the viability and durability of the consortium approach with local government partners bound together toward the common mission of building, funding, and sharing a GIS enterprise. More than the common warehouse of spatial data, system components, software, and applications, this is what other communities want to learn more about when they come for site visits. They want to hear more about how our local agencies have pulled together with a common vision for nearly 20 years.

System Design Issues Encountered and Overcome

Aside from the “normal” challenges caused by rapid changes in core hardware/network/software technology, system design “problems” can be categorized into three groups:

- System growth management;
- Developing and maintaining an enterprise design; and
- Overcoming a “GIS-centric” structure/methodology.

As the LOJIC system has grown increasingly integrated and complex in terms of the amount and kind of data stored, the number of dependent applications, and the growing number of users, it has become increasingly difficult to manage the timing and requirements of overall system growth, migration, and upgrades. It has become more difficult to stay on top of the many and varied uses of the system and data. These uses create dependencies because of data structure, application programming, or system design. As flexible as one tries to make the design, conflicts always seem to exist—sometimes minor, but, more often than not, increasingly major and complex.

Similarly, as our overall system design becomes more complex, and grows to respond to many more integrated uses, it is often difficult to balance the needs of specific applications and the commitment to making LOJIC a true enterprise system. Balancing priorities of use with what might become the “flavor of the moment” in terms of technology choices is challenging. While LOJIC users rely on a single spatial database warehouse, the actual enterprise consists of five separately maintained networks. Keeping servers communicating, firewalls open, and data streaming is an ongoing challenge that requires much collaboration. The complexity of system design issues and their solutions is hard for nominal users to grasp. Sometimes this makes the larger enterprise systems intimidating or not well fitted for a specific use. It is extremely challenging to balance enterprise vision with particular end user application requirements. Many times it is simply easier or more expeditious to build an independent database, but then something always comes along and puts that specific use into a broader context.

LOJIC grew as a totally ESRI-based GIS. LOJIC staff members were schooled as geographers, cartographers, photogrammetrists, or programmers. As the proprietary separation between GIS and conventional IS technology blurred, support staff had to develop new skills in SQL, RDBMS, Object Models,

VB, JavaScript, .NET, and many others, while keeping the existing system, data, and applications up and running. Technical support staff must be as comfortable with ORACLE/SDE geodatabases as with coverages and shapefiles, with VB and JavaScript as with AML or Avenue, and Web-based GIS was another totally new realm. Staff had to see beyond a question to a solution that might only come partly from the GIS—where a map is not all that is the desired outcome, but where the GIS is just one element of the analysis.

What Differentiates This System from Other Similar Systems?

Three things fundamentally differentiate LOJIC from other similar systems:

- It's a successful consortium;
- Agencies are responsible for maintaining their own data, and do so as a part of daily work; and
- LOJIC has a core full-time staff dedicated to the support of all user agencies.

As other municipalities have tried and failed to organize cooperative, multiagency systems, the LOJIC consortium has succeeded. It has been guided by a stable policy committee that, until the past two years, has had a consistent membership since its inception. This core group of executive managers has guided decision making about project priorities, balancing the expenditure of a set budget, and made the tough decisions when something needed to be accomplished for the community good.

This strong partnership created an operational stability that enabled agencies to see beyond their own needs and respond to the broader needs of the community. The policy committee was supplemented by a committed technical committee that struggled with the various systems growth, data development, and application projects throughout their representative user agencies. The technical committee members often break into subgroups to explore process work flows, doing this long before "reengineering" became a buzzword.

Early in the organization's development, mainly prompted by the PVA assuming responsibility for maintaining the parcel layer, other agencies stepped up and took responsibility for data creation and maintenance efforts for specific data sets. All partner agencies have assumed these responsibilities and openly share databases without charging one another for use, or without expecting cost recovery for those efforts. To do this, work flows had to be developed that integrated data maintenance into everyday activity at the very front lines of staff interaction.

Since its inception, LOJIC has maintained a core technical staff that supports all end user functions related to GIS data and applications development and analysis across all user agencies. Beginning with 1 overall coordinator and 3 college interns, LOJIC staff has grown to 11 full-time GIS specialists to keep pace with a much expanded and diverse user base and the increased needs for products, services, and user support.

System Hardware, Software, Data

Hardware:

- Network of 43 SUN Workstations
- Citrix farm of 12 servers for ArcGIS
- Ethernet, TCP/IP, fiber optic net

Software:

- ARC/INFO workstation 8.0.1 and ArcInfo Desktop 9.0 software
- ArcView3.3 (PC and UNIX)
- Network Analyst, Spatial Analyst, 3-D Analyst, ArcPublisher, GRID, TIN, ArcPress
- ArcIMS 9.0
- Oracle 9i
- SUN SOLARIS 9
- ArcSDE 9.0
- ERDAS Imagine and OrthoBase software for in-house production of digital orthoimagery
- MrSid Professional for production and publishing of compressed digital orthoimagery

Spatial Data:

- Note: All spatial databases exist as coverages, shapefiles, and Oracle/SDE layers.

LOJIC has built a detailed county-wide photogrammetrically compiled planimetric and topographic (PTD) base map that contains more than 100 features in 22 different data layers, and meets National Map Accuracy Standards for 1" = 100' mapping (+/-2.5 feet horizontal; +/-1 foot vertical). The PTD, originally compiled in 1988–1990 and updated in 1993, 1998, and 2001, serves as a reference database for many other data-conversion efforts.

A county-wide property layer containing more than 300,000 parcels, detailed annotation, and tax block boundaries is maintained daily by the PVA. Property data has recently been converted to a robust land parcel geodatabase model in Oracle/SDE.

MSD completed the first major data conversion project supported solely by a participant agency. More than 2,500 miles of sanitary and combined sewers, an accompanying master inventory of these facilities, and a point coverage of service connections that links parcels to the sewer main that serves them was completed in 1997. The project is the first effort to integrate an external RDBMS for attribute-data storage. Using Hansen's Infrastructure Management System (IMS), the system links an Oracle database housed on SUN servers on the MSD network, with the graphic facilities data located on the LOJIC network. No annotation is maintained in the graphic data. All attributes are pulled live, through a dynamic, real-time link between the two systems. Users can click on the graphic symbology and attribute inventory data describing the facility displayed on the screen.

Soils and floodplains were both developed under joint initiatives with NRCS and FEMA, respectively. The soils conversion project involved scanning existing soils maps, edgematching

the data into a seamless coverage, and extensive quality-control checking.

Development of the flood limits and the Flood Insurance Rate Mapping (FIRM) data in conjunction with the Corps of Engineers and FEMA was the first successful joint effort of its kind in the country. MSD, as the entity responsible for stormwater management services in Jefferson County, uses LOJIC as the official FIRM repository. MSD staff is working with FEMA on FIRM modernization using national DFIRM specifications.

Since 1996, LOJIC has produced high-resolution ortho-photo imagery from annual aerial photography of Jefferson County rectified to the PTD mapping. The digital orthophoto

imagery was originally created from 1" = 660' panchromatic photos acquired in the spring of 1996 and 1997. Imagery was again updated using 1" = 800' color aerial photography acquired in the spring of 1998, again in 2000, and most recently from the spring of 2003 aerial photography. Digital imagery is accessible online via the LOJIC GIS and serves as background data to support a wide range of internal projects and as a future source for updating PTD mapping.

The following chart details some of the data layers and the agency that maintains it. The reference grid systems and some of the less significant thematic layers are not detailed here.

Planimetric and Topographic Base Map	LOJIC
Property Database	PVA
Sewer Facilities	MSD
Street Centerline/Address Ranges	Public Works and Planning
Site Addresses	Planning
Flood Insurance Rate Maps	MSD
Precincts	Board of Elections
Municipal Boundaries	Planning
Digital Ortho Imagery	LOJIC
Political Districts, including commissioner, aldermanic, and legislative districts	Board of Elections
Police Districts	Metro Police
Neighborhoods	Public Works
Emergency Management Service Districts	Emergency Management
Parks and Greenways	Metro Parks
Historic Districts	Public Works
Census Tracts/Block Groups	LOJIC
MSD Service Areas	MSD
Watersheds	MSD
Combined Sewer Lines and Outfall Points	MSD
Soils	LOJIC
Zoning	Planning
Land Use	Planning
Sanitation Districts	Waste Mgmt.
Snow-Removal Routes	Public Works
Empowerment Zone	Planning
Water Facilities	Louisville Water
Floodwall	MSD
Subdivisions	Planning
Urban-Renewal Areas	Public Works
Olmsted Parks	Metro Parks

Metadata and system documentation are available online in PDF format to all LOJIC users. This documentation is patterned after FGDC Metadata Content Standard, and provides consistent and highly detailed information about the standards and database design used to create and maintain each data set, as well as who to contact for additional information. The documentation provides a summary of the data set and the data template, and has hypertext links to sample graphics for a visual example. Legacy metadata is in the process of being converted to FGDC using ArcGIS.

Where Are We Now?/Future Directions

LOJIC is in a period of major transition and evolution on all fronts. With the merger of the old city of Louisville and Jefferson County (both original LOJIC partners) into a singular county-wide Louisville Metro government came expectations for more efficiency in operations and service. Numerous duplicate agencies and departments—along with their relative responsibilities and staff—were merged and dramatically streamlined. The political/administrative landscape and leadership changed completely. Amid this transition in 2003, the original 15-year LOJIC partnership agreements expired and, as fortune would have it, the LOJIC was awarded the URISA Exemplary System in Government award that same year. Building on the new Metro mayor's formal announcement of the ESIG award, new Metro representatives were named to the LOJIC policy committee, and along with MSD, PVA, and the Louisville Water Company, meetings began with a consensus goal negotiating a new agreement and funding to ensure the continuation of the consortium.

LOJIC system architecture, software, databases, and applications have also undergone significant transition in recent years

as a result of ongoing efforts to migrate the enterprise to ArcGIS technology. LOJIC spatial databases have been converted to Oracle/SDE layers with libraries of associated layer files and efforts to build FGDC metadata in ArcGIS have begun. LOJIC's land-parcel database has been converted to a robust geodatabase model integrated with PVA's CAMA system. Geodatabase conversion efforts are also planned for site addresses, street centerlines, and sewer network data. LOJIC has collaborated with state government, regional planning agencies, and sister counties toward building regional spatial databases of topo mapping, political jurisdictions, street centerlines, orthoimagery, and in some cases parcels and addresses.

Approximately 30 LOJIC "power users" have been trained in ArcGIS and work is under way on designing sets of ArcIMS tools as a precursor to moving hundreds of browse/query users away from ArcView 3.3. LOJIC provides access to ArcGIS software, custom applications, and ArcSDE data through a secure intranet connection to a farm of 12 Citrix servers. Core spatial data will continue to be made available to LOJIC users in the familiar coverage and shapefile format for a while longer as work continues toward migrating legacy ArcInfo 7.2 and ArcView 3.3 applications to ArcGIS.

LOJIC partners and technical staff are diligently working toward building a stronger, more viable GIS enterprise. Successful integration of a local pavement/street-sign-tracking system, a permit-tracking system, asset/work-order system, computer-aided dispatch, land-records management/CAMA system, and numerous front-counter and Internet public-access applications have demonstrated the value of spatial data and GIS to the Louisville metro community. All recognize that even after nearly 20 years of work and progress, there is much more to be accomplished.

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