Minnesota MetroGIS Geospatial Data Collaborative Minneapolis–St. Paul Metropolitan Area (2002—Enterprise System)

System Summary

MetroGIS provides an unprecedented and effective system for collaboration between the geospatial data-producer and user communities to assemble, document, and distribute geospatial data commonly used by the more than 300 local and regional government units serving the seven-county Minneapolis–St. Paul metropolitan area. Its purpose and operations have, from the outset, recognized, refined, and implemented concepts fundamental to the National Spatial Data Infrastructure (NSDI), in particular, the "area integrator" and "skyline" concepts.

MetroGIS, a voluntary organizational system founded in 1996, provides an effective forum to identify common geodata-related needs, collectively define organizational and technical solutions needed to address those needs, and share geodata knowledge. MetroGIS has no legal standing and, as such, cannot own data, hire staff, or finance projects. It relies on its stakeholder organizations to develop and maintain all data, develop and support data-distribution tools, and finance its staff and project needs.

The key to MetroGIS's ability to accomplish institutional changes needed to achieve the vision of both the MetroGIS community and its component of the NSDI is its unconventional organizational structure. The policy board is comprised of 12 elected officials who represent 1 of 5 core local and regional government communities—counties, cities, school districts, watershed districts, and regional government. These members are appointed by their respective communities to the voluntary board, which has no formal legal standing.

The policy board is supported by a 25-member coordinating committee. The committee provides a forum to discuss MetroGIS design, implementation, and operations. It defines goals and issues for strategic work groups, and makes recommendations to the policy board. Its members come from the gamut of public, academic, private, nonprofit, and for-profit stakeholders of MetroGIS.

MetroGIS has been successful because it focuses on both technology and building interorganizational relationships, and it raises issues to a level of public purpose. This structure and all its forums ensure that "all relevant and affected interests are involved, dominated by none." At the outset, participants recognized that conventional hierarchical, command-and-control structures would be capable of neither building and maintaining the trust relationships needed to bring all essential participants to the table nor of overcoming fears of "hidden agendas."

Among MetroGIS's most notable accomplishments are the following:

- Agreement on 13 priority common-information needs and involvement of hundreds of stakeholders in participatory processes that led to collaborative solutions to meet these needs.
- Nine regional data sets and the implementation of accompanying custodial responsibilities. Two of these regional solutions—parcels and planned-land use—are believed to be unprecedented in their complexity and extent (see http://www.metrogis.org/data/index.shtml).
- State-of-the-art, Internet-based data-distribution mechanism, the portal to which—MetroGIS DataFinder (http://www.datafinder.org)—is a registered node of the NSDI (see http://www.metrogis.org/data/datafinder/index.shtml#data_distribution).
- Grand prizewinner of the ESRI/National Geographic 2001 International Geography Network Challenge for use of Web Mapping Service (WMS) technology (http://www.datafinder.org).
- Successfully implemented NSDI's "area integrator" concept at the substate level; the State of Minnesota is following suit using guiding principles developed by MetroGIS.
- Testified before a subcommittee of the U.S. House of Representatives at a special session held in conjunction with the 1999 National Geodata Forum.
- Two exemplary GIS project awards from Minnesota Governor's Council on Geographic Information.
- Three FGDC grants for NSDI-related projects totaling more than $158,000.

Motivation for System Development

Minnesota organizations have a long tradition, dating back to the 1960s, of cooperative development and use of geographic information system (GIS) technology to address issues that significantly affect the quality of life. This legacy aligned with two other key factors in the early 1990s to create a rich environment for the development of an ambitious regional geodata system collaborative now known as MetroGIS.

The first of these factors was a large cost reduction for GIS-related hardware and software that occurred in the early 1990s when PC-based GIS emerged. Consequently, a number of local governments began to explore the benefits of GIS technology. State and regional government and six of the seven counties that make up the Minneapolis–St. Paul metropolitan area had already made considerable investments. The result was a plethora of conflicting data-access policies, inconsistent and time-consuming licensing requirements, and duplication of data-development efforts. Where data documentation existed, it varied significantly in quality and format. Small pockets of collaboration began to emerge as the GIS community became increasingly aware of the duplication of effort and expense that was occurring.

The second of the initiating factors came in 1994 when the Metropolitan Council, a regional planning and service agency, recognized that it had a compelling business need for parcel-level data—data produced by others—to accomplish its responsibilities. The council also recognized the need to explore collaboration on a regional scale and, as such, accepted a leadership role and rose to the challenge of providing the primary financial sponsorship for the initiative.

In October of 1995, the council and the Minnesota Land Management Information Center (LMIC) cohosted two informational forums to answer two questions: Should a regional GIS initiative be pursued? and Would the community participate if the council provided financing and staff support? The response was strongly in favor on both counts. In December of 1995, a strategic planning forum was held, which officially launched the regional MetroGIS initiative.

MetroGIS was created to improve the efficiency of, and quality of decisions made by, government in the Twin Cities area through widespread geospatial data sharing.

The guiding vision of MetroGIS is to:

> *Provide an ongoing, stakeholder-governed, metro-wide mechanism through which participants easily and equitably share geographically referenced data that are accurate, current, secure, of common benefit, and readily usable.*

The goal has been to integrate into the day-to-day functions of stakeholder organizations the systems and procedures needed to sustain the desired data-sharing outcomes. The result is that both data users and producers share in the efficiencies of users being able to effortlessly obtain data needed from others, in the form needed, and when it is needed.

MetroGIS's comprehensive solution can be characterized as a distributed system comprised of three interrelated, technology-dependent components:

1. Coordinated production, maintenance, and documentation of regional data solutions for common information needs.
2. A one-stop shop for discovery and distribution of data important to and consistent with stakeholder business functions (MetroGIS DataFinder).
3. Knowledge sharing and fostering use of endorsed best practices through the general-information Web site, special purpose forums, and scheduled meetings of the policy board and committees.

System Benefits Achieved

MetroGIS is clearly having a significant positive impact on improving the efficiency of government operations in the Twin Cities area. The primary reasons for the improved efficiencies include: reduced duplication of effort to find and use data; access to data not previously available; cost avoidance through collaborative solutions; improved data quality; and greater understanding of the community's geospatial data needs and opportunities through increased networking.

Consider the benefits of regional data solutions to common information needs. First, the data solutions are uniform across the seven-county area, notwithstanding that in most cases each regional data set is an assembly of several components or primary data sets. For example, the seven individually produced county parcel data sets have been assembled into a single regional solution with attributes that have been reformatted to have consistent names, character types, and sizes. Second, each regional data solution works (is interoperable) with the others. These characteristics significantly reduce the time and effort needed to manipulate data for use once it is located and obtained.

As a case study, consider the Metropolitan Mosquito Control District. Prior to access to MetroGIS data, the district staff spent thousands of dollars and many hours acquiring, downloading, manipulating, and reconciling parcel data from seven different counties to generate accurate and comparable field maps. Now the data is free and can be downloaded from one spot. Quarterly updates are available at no charge. In just two months after an updated and enhanced parcel data set was released in early 2005, nearly 50 organizations had sought and obtained licenses for access to the data.

About 160 government and academic users are licensed to obtain MetroGIS's regional street centerline data set. Prior to MetroGIS's involvement, government organizations did not have access to this robust and reliable data set, without paying a fee, and thus most did not seek access. The fees ranged from $4,000 for a modest-size community to more than $50,000 for the entire seven-county area for a one-time purchase and no updates. As with the parcel data, these organizations not only have free access, but they also receive quarterly updates at no charge.

Other benefits:
- Visits to the MetroGIS DataFinder Web site averaged 1,272 monthly in fiscal year (FY) 2004; data downloads from the site averaged 617 monthly during that period. The Web site has about 170 metadata records and 132 downloadable

data sets. Popular data sets include county and municipal boundaries; census demographic profiles; planned-land use; parcels, street centerlines, and zip code boundaries. The site offers the user the ability to "clip and ship" only the data he or she wants for a specified geographic extent.

- MetroGIS's general-information Web site received an average of more than 800 user sessions per month in FY 2004, an increase of one-third over the previous year.
- Many stakeholders use DataFinder to support their internal data discovery and distribution needs as well as to make their data available to others.

Efforts to document effects on productivity have included asking participants to offer short statements of benefits realized by their organizations to include in each annual report, conducting formal interviews with stakeholders for "user testimonials," a formal benefits study in 1999, and annual performance measures studies since 2002. These can all be viewed at http://www.metrogis.org, the organization's Web site.

System Design Issues Encountered and Overcome

For the most part, the problems of the most substance have been organizational in nature. Once the organizational differences have been resolved, the technical solutions have emerged. Initially, differences in GIS program maturity and level of investment between the seven counties were an obstacle to achieving MetroGIS's vision. The MetroGIS Interim GIS Data and Cost Sharing Agreement initiative was implemented to address these inconsistencies. (See http://www.metrogis.org/about/history/sharing.shtml for more information.)

An ongoing topic of discussion for some of the organizations with a long-standing GIS presence in this area is MetroGIS's unconventional organizational structure and the amount of meetings, particularly in the early phases, held to collectively define solutions to common geodata needs and opportunities. Some would prefer to "just do it," but the majority have sided with the need to maintain a trusted, effective organizational structure capable of engaging all essential and affected stakeholders, and dominated by none.

Data-access policies and procedures and the time and effort required to participate in the forums and meetings continue to receive attention. Significant progress has been made to streamline licensing procedures for parcel data. The policy advisory team was dissolved in July of 2001, reducing the number of meetings for the team members.

What Differentiates This System from Other Similar Systems?

To MetroGIS's knowledge, no other geospatial data collaborative involves:

- The diversity or number of local and regional stakeholders;
- The number of effective and comprehensive solutions to common information needs;

- An Internet-based data-search-and-delivery mechanism that is as robust and state of the art;
- An organizational structure that actively involves locally elected officials, and by its very nature is able to raise issues to a public-policy level;
- The incorporation at a substate level of core principals, and refined and operationalized philosophies, which are fundamental to achieving the NSDI vision.

These characteristics are the hallmarks of the collaborative innovations that have helped MetroGIS achieve its vision. Ultimately, the purpose is to position government interests in the Twin Cities area to be measurably more effective in their efforts to protect the environment, achieve livable community goals, improve economic competitiveness, and reach other goals.

System Hardware, Software, and Data

The components of MetroGIS's multifaceted, distributed system are owned and operated by several of MetroGIS's stakeholder organizations. Custodial roles and responsibilities are defined by the community for each regional data solution and for the data-distribution mechanism. MetroGIS seeks out organizations with internal business needs and appropriate expertise for each of the community's commonly needed data sets to voluntarily accept the custodial responsibilities on behalf of the broader community. If any opportunities arise for one-time projects to improve data quality, documentation, availability, or consistency, MetroGIS attempts to support them if the custodians are willing to participate.

Hardware:

The hardware system that supports MetroGIS's regional data solutions, Internet-based data distribution tool (MetroGIS DataFinder), and knowledge-sharing Web site (http://www.metrogis.org) are owned, operated, and distributed among several organizations. Data producers, designated by MetroGIS, develop and maintain data that are components of regional solutions in accordance with MetroGIS-endorsed regional data specifications using hardware and software appropriate to their respective internal business needs. They provide the metadata and, in some cases, the actual data via a variety of manual and semiautomated procedures to the Metropolitan Council, which serves as custodian for MetroGIS DataFinder. The DataFinder Web site, which is a registered node of the National Geospatial Data Clearinghouse, runs on a 4 CPU Pentium server-class machine. The metrogis.org Web site, which provides information on the development, organizational structure, and current activities of MetroGIS, is updated by the staff at the Metropolitan Council but is hosted on a server owned and operated by the State of Minnesota.

Software:

As with the hardware components, the software components are determined by the internal business needs of the various organiza-

tions that have accepted custodian responsibilities for creation and maintenance of commonly needed data on behalf of the broader community. Several GIS software platforms are involved, with ESRI's being the most common. The seven counties use ESRI or a combination of Autocad and ESRI software. The data-user community, like the data-producer community, is dominated by ESRI products; however, GIS software developed by Intergraph, SmallWorld, and MapInfo are also used.

Complementing the systems and efforts of the organizations that serve custodian roles is the MetroGIS DataFinder Web site, first introduced in 1998. It is supported by the Metropolitan Council on behalf of the MetroGIS community and provides a central portal for discovery and access to the commonly needed geospatial data. In 2001, it was awarded the Grand Prize in ESRI's Geography Network Challenge. The Internet-based functions that make up DataFinder combine to offer a data-discovery and data-distribution system that improves efficiencies for data producers and data users.

The core components of MetroGIS's DataFinder Web site are the catalog, which uses FTP utility, the ISITE product distributed by the FGDC, and ESRI's ArcIMS. The software components that make up MetroGIS DataCafé, the state-of-the-art data distribution component of DataFinder, are ESRI's ArcIMS, Safe Software's SpatialDirect/FME, and Java Web Start. The data users interact with the system via a customized Java client application. The users can subset data by ad-hoc geographic areas of interest or by a predefined geographic area such as a city boundary. In addition, users may select among data themes produced by multiple organizations, and when downloading them, they can further refine their downloaded requests by indicating which individual attributes or fields they wish to include. The application then allows the users to choose from a list of different geospatial data formats to indicate the preferred format for their downloaded data.

From a data-producer perspective, MetroGIS's data-discovery and data-delivery mechanism is very flexible; data may be hosted on the MetroGIS DataFinder server or remotely served by the custodian organization. A robust security interface protects data that have access limitations (e.g., parcel data). The remotely hosted option for data producers was important to implement because many counties and larger cities were already using GIS Web-based technology. The ability to integrate these existing sites seamlessly reduces the work for the data producers, but, equally important, it also reduces data redundancy and ensures that the data offered via the DataCafé client are the most up-to-date. The system works because DataCafé can connect to both ArcIMS Web map services and OGC-compliant Web map services.

Data:

Users of MetroGIS DataFinder have the ability to browse vector and raster metadata and download vector data. As mentioned previously, the data that are available may be distributed on servers owned by several different organizations. These data may be stored in a variety of different geospatial formats and/or databases. DataCafé uses the data via Web map services. These map services may adhere to either the ArcIMS or the OGC's WMS protocol. This provides a very flexible interface between the DataCafé system and data producers while providing one seamless client view for the data user. In addition to using WMS, DataCafé also outputs all nonsecure data sets in WMS, which means that any WMS-compliant client can input and use these data sources directly.

Where Are We Now?/Future Directions

Since earning the ESIG award in 2002, MetroGIS has solidified and enhanced its core capacities as well as moved in new directions. MetroGIS has formed additional alliances with other organizations to marshal the capabilities of GIS to address critical issues facing the Twin Cities area and Minnesota. For example:

- MetroGIS teamed up with the Minnesota Governor's Council on Geographic Information to help the region and state better respond to emergency events. The initiative has resulted in a password-protected test Web site that features an interactive map with emergency-management data. The alliance fosters relationships between emergency management and GIS professionals, and in 2005 held a workshop to educate GIS professionals about emergency-management issues.
- MetroGIS is assisting the Metropolitan 911 Board to integrate GIS technology into the day-to-day work of the 7-county metropolitan region's 27 emergency dispatching facilities. The goal is to instantly provide dispatchers with accurate maps of the locations of callers from wired and wireless telephones.

In a landmark achievement, MetroGIS in early 2005 successfully completed negotiations with all seven metropolitan area counties for a new GIS parcel data-sharing agreement. The agreement means that government and academic GIS users nationwide need obtain only one license for free access to parcel data from all seven Twin Cities area counties. The third-generation regional parcel data set features parcel polygons, parcel points, and 55 associated attributes in standardized format enabling apples-to-apples comparisons across the Twin Cities metro area.

In 2004, MetroGIS implemented its first regional geospatial data application—mailing labels. An advantage of the new regional GIS application is that it allows users to quickly and easily create mailing label sets for user-defined geographic areas that cross jurisdictional boundaries.

MetroGIS is investigating design options for a regional existing-land-use data set. This data set would join the existing regional solutions: 1990 and 2000 census boundaries, land cover, municipal and county boundaries, parcels, planned-land use, socioeconomic characteristics of areas, and street addresses and locations (centerlines).

MetroGIS continues to play a role in several national and international geospatial data projects, including the federal I-Team Geospatial Information Initiative, the National Map Project, and efforts by the Open Geographic Consortium to document effective regional geospatial data-distribution architectures.

An ongoing challenge for MetroGIS is to continue to document the benefits of regional data sharing as policy, administrative, and political priorities change. While measuring financial contributions is easy, assigning specific value to contributions of data and support of related shared roles and responsibilities is much more difficult. Measuring direct and indirect benefits is even more complex. Nurturing champions at the policymaker level for support of collaboration to address common geospatial needs is critical to securing ongoing support for data-sharing collaboratives like MetroGIS.

Examples of System Images and Screen Shots

Following are images of extracted samples of regional data sets as well as the home page for MetroGIS DataFinder. Visit http://www.datafinder.org for more information.
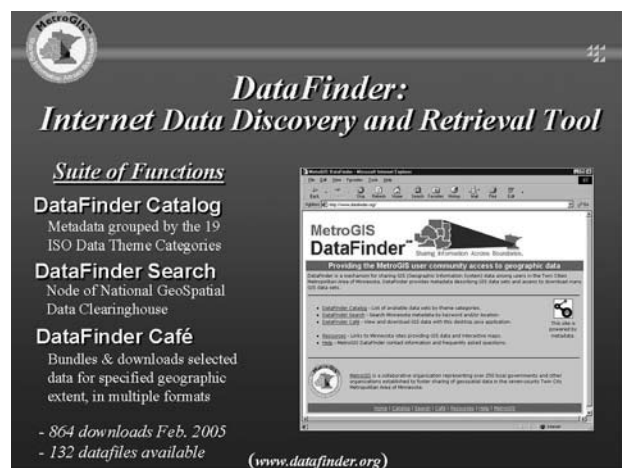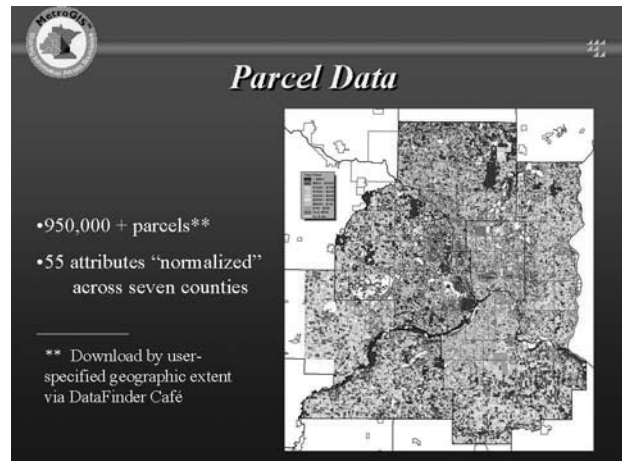
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