Sharing the Costs, Sharing the Benefits: The NYS GIS Cooperative Project

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EXECUTIVE SUMMARY

Nearly all government information has a geographic dimension--a street address, a transportation corridor, a river, a city line. All kinds of descriptive information can be linked to a particular place to present a rich and detailed picture of a neighborhood, a park, a coastline, or an industrial site. Geographic Information Systems (GIS) offer unique opportunities to analyze and compare these disparate types of information, opening up new opportunities to deliver both information and services. The value of GIS and spatial data can be seen most dramatically in applications that promote economic development, public health and safety, and environmental quality. Moreover, these applications share many common information needs.

Experts estimate that up to 80 percent of the cost of GIS is tied to the collection and creation of spatial data. Often, however, data created by one organization can be used by other organizations with similar needs, so sharing can yield considerable efficiencies. Other states are learning how to coordinate GIS resources to become more efficient and more attractive to businesses and residents. While New York State has a rich array of expertise and spatial data, it currently lacks a common focus that could leverage these separate resources to achieve similar statewide objectives.

The New York State GIS Cooperative Project, initiated by the NYS Department of Environmental Conservation, was designed to address some of these issues. The project demonstrated the depth and variety of existing human, technical, and data resources in New York State. It showed the extent to which spatial data needs overlap among key policy and applications areas and examined how data sharing strategies can reduce the cost and increase the value of geographic information systems at every level of government and in the private sector. Existing local and regional coordination efforts were identified, as were the formal coordination activities of the federal government and other states. The project identified and examined existing barriers to data sharing and coordination and developed specific recommendations for overcoming those barriers. Finally, the project created a new spatial data resource for New York State--the NYS Spatial Data Clearinghouse.

The Prototype New York State Spatial Data Clearinghouse

The NYS Spatial Data Clearinghouse was developed in concert with Federal initiatives to facilitate the exchange of spatial data among members of the GIS community. The prototype NYS Clearinghouse, available on the Internet, provides a mechanism for potential users of NYS spatial data to determine what data sets are already available or under development. This means of improving data access and sharing can lower the cost and increase the use of these data throughout New York. Users who access the Clearinghouse may review collections of metadata submitted by many different organizations. Once a data set of interest is identified, information is provided on how to obtain the data files. For some data files, an option for immediate on-line transfer is also available. The NYS Spatial Data Clearinghouse is a new production-quality information resource for New York State and will be among the first state clearinghouses which

offers spatially searchable metadata. It not only provides a vehicle for data sharing, but it also demonstrates the use of the Internet as an effective tool for government-wide communication.

Barriers to Information Sharing and Coordination

The benefits of sharing data are obvious. Sharing reduces the total cost of individual applications and can make GIS affordable for more organizations. Data sharing, however, is not as easy or as pervasive as one might think. Availability, pricing, and ownership are common stumbling blocks. In some cases, data sharing is limited by the use for which the data were originally created. The scale or accuracy of data required by one organization may not be sufficient for use by another. Nevertheless, many data sets could be used by multiple organizations. The project identified seven management and policy factors which hinder the sharing of spatial data:

- Lack of awareness of existing data sets
- Lack of or inadequate metadata
- Lack of uniform policies on access, cost recovery, revenue generation, and pricing
- Lack of uniform policies regarding data ownership, maintenance, and liability
- Lack of incentives for sharing
- Absence of tools and guidelines for sharing
- Absence of state-level leadership

An Action Agenda for a Statewide GIS Coordinating Body

Regional meetings involving more than 450 members of the GIS community enumerated many coordination issues and gathered perceptions of the need for a GIS coordinating body in New York State. They also identified issues to be addressed by a coordinating body and reached a high degree of consensus about what such an organization should do:

- Sponsor a statewide data clearinghouse
- Develop policies for data development including data quality
- Adopt standards for metadata, data transfer, and other purposes
- Develop policies on data access and data security
- Provide for multi-organizational communication and coordination
- Sponsor a formal education program
- Develop and support cooperative funding strategies
- Act as a formal liaison between the state and the federal government
- Provide a contract or proposal review service

Lessons Learned

The project offers several important lessons that should help New York State leverage existing resources and build needed linkages.

- Geographic information systems issues and applications represent a convergence of state, local, public, and private interests. Every government agency and nearly every business enterprise has a stake in the development and management of spatial data resources. All New

Yorkers will benefit from a comprehensive effort to apply GIS data and technology to shared goals for economic development, environmental quality, and community service.

- The information policy, technology, and coordination issues examined in this project are not limited to geographic information systems. They are general, systemic issues that underlie all government operations. The entire information policy framework of state government can be strengthened by the analysis and recommendations that emerged from this project.

- New York State already has a vast array of spatial data, GIS expertise, and localized coordination efforts. The value of these resources could be substantially leveraged by a policy-driven coordination effort at the state level.

PROJECT OVERVIEW

Introduction

The Knickerbocker Regional Planning Commission is a five-county cooperative economic development agency. Commissioner Lee Hudson recently returned from a national conference with exciting news about how a similar commission in a neighboring state is using all kinds of information to create targeted marketing packages aimed at new businesses. By all reports, this effort is generating new business starts, relocations, and almost instant answers to questions from businesses, local governments, and community groups. Hudson is convinced the Knickerbocker Commission can do the same. Of course, information about the location, capacity, and costs associated with water, sewers, energy, and telecommunications will have to be obtained. Transportation information including roads, rail, waterways, and mass transit are needed, too. Tax maps and real property information will be key. So far, two counties in the region have developed digital tax maps. The other three still need to be computerized. The state has some real property information, but people say the state system doesn't keep up with changes in ownership and subdivision. Socio-demographic data will also be important. Census data should help there, as long as the federal government distributes it free. Solid information about the environment--wetlands, rivers, habitats--will be needed as well. This is all government information, however, so Hudson figures it should not be too costly or difficult to pull together.

The Commission dispatched its staff into the field to learn about hardware and software options and to start bringing in all the needed information. Within two weeks, however, Hudson's ideal proved well beyond the Commission's reach. The needed data is scattered among a multitude of different federal, state, and local organizations. Sometimes several information sources exist, but at different levels of accuracy and detail. No one has a list of who has what information. Not even counties or towns have inventories of their own data holdings. Even when the location of a data source is known, very little information is available about its content or characteristics. Hudson was startled to learn that some agencies provide their information on disk, tape, or CD for just a few dollars while other agencies charge several thousand.

These problems seem insurmountable, especially for a regional organization. How in the world did that other group produce those great-looking maps, brochures, and reports?

Geographic Information Systems (GIS) offer unique opportunities to analyze and compare disparate types of information. The ability to integrate traditional databases with geographic or spatially referenced information opens up new opportunities to deliver both information and services. The utility of GIS can be seen in applications which range from protecting our natural resources to identifying trends affecting public health to managing physical infrastructure. A well-designed GIS can help a school district transportation officer, a social services planner, or a local 911 dispatcher. Graphics and maps linked to rich descriptive information can be both powerful and easy to use, but, as our mythical Lee Hudson discovered, they come at a cost.

While precise estimates of total GIS expenditures are difficult to obtain, recent market estimates indicate that the worldwide investment in GIS technologies by government and the private sector ranges between $3.3 and $8 billion with annual growth rates reaching nearly thirty percent (Lopez, 1995). The US federal government itself spends about $4 billion a year on collection, management and dissemination of domestic spatial data. The emerging GIS industry conducts an estimated $2 billion worth of business annually and is expected to grow substantially through the balance of this decade.

Data is a particularly costly element of GIS. While figures vary somewhat, experts commonly attribute about 80 percent of the total costs of a GIS to data collection or data conversion. (Thapa and Bossler, 1992). Often, however, the information needs of different GIS applications overlap. For example, roads, political boundaries, tax parcels, and census data contribute to scores of GIS applications. Consequently, sharing data can yield considerable efficiencies and costs for GIS application development could be lowered if organizations reuse data sets that already exist. Lower costs would not only benefit those already employing GIS, but would also allow more organizations to afford GIS tools and applications.

Most of the spatial data collection efforts within New York State have been conducted in a decentralized and uncoordinated manner. As a result, data creation has been duplicated unnecessarily and opportunities for information sharing both within the State and between the State and the federal government have been hindered. Nevertheless, GIS technology is emerging as a major productivity tool at all levels of government and has immediate utility for many government applications.

The central issue facing New York State is how to organize and sustain a collaborative effort across all levels of government and with the private sector that will harness this powerful tool to improve governmental services, drive down costs, and stimulate economic development. This report outlines why this is a critical policy issue in New York State, and how the State can position itself to take maximum advantage of the potential of geographic information systems to achieve these goals.

The Current Environment

New York is getting a late start in formal coordination of GIS, but already has many models and resources to build on. These existing resources can be put to use in a comprehensive effort to harness spatial data and geographic information systems to achieve critical public policy goals.

The federal government has created a comprehensive national initiative focused on the value of spatial data. The federal government has begun to address GIS issues with the establishment of the National Spatial Data Infrastructure (NSDI). According to FGDC, the NSDI is “a set of policies, standards, materials, technologies, people and procedures, as well as spatial data, that provide a foundation for more efficient collection, management, and use of data. The goal is better access to higher quality spatial data at lower costs to all. The NSDI requires

cooperation and interaction among various levels of government, the private sector, and academia." The major components of the NSDI are:

- Standards to facilitate data collection, documentation, access, and transfer
- A basic framework of digital spatial data that meets the minimum needs of large numbers of data users over any given geographic area
- A clearinghouse to serve, search, query, find, access, and use spatial data
- Education and training in the collection, management, and use of spatial data.

While the NSDI is managed at the federal level under the leadership of the Federal Geographic Data Committee (FGDC), many state and local governments, as well as academic and private sector organizations, have joined the effort to promote better access to spatial information, to increase communication and cooperation within the GIS community, and to eliminate costly data redundancy. The efforts of all of these organizations together form the NSDI.

The National Spatial Data Clearinghouse (NSDC), an Internet-based tool to facilitate search and retrieval of spatial data sets, is a key part of the NSDI. A number of federal agencies and state governments have built spatial data clearinghouses on the Internet that can be accessed from the NSDI home page. The URL for the NSDI home page is http://fgdc.er.usgs.gov

Every state has a mechanism in place to support GIS coordination. In order to coordinate GIS activities or to support such specific statewide programmatic issues as water resource management or growth management, other states have developed a diversity of approaches to coordination. A survey conducted by the National States Geographic Information Council (NSGIC) showed that, as of 1994, only five states, Alabama, California, Missouri, South Carolina, and New York State were without a formal or ad-hoc coordinating body for GIS. (NSGIC, 1994). More recent data indicates that these states, too, have begun to address GIS coordination issues (Warnecke, 1995). State government coordination efforts range from small voluntary organizations to those supported by both legislation and executive order. Annual budgets for these coordinating bodies range from zero to $1 million.

The NSGIC survey shows that state coordinating bodies focus mainly on four areas. In order of importance these are: coordination and communication among government organizations, GIS-related policy making, planning and strategies for GIS development, and resolution of technical issues. Their formal mission statements may include such specific goals as the development and management of GIS databases, the development of standards, and oversight of GIS expenditures. Twenty-two of these bodies distribute electronic data as part of their operations.

New York is just beginning a GIS coordination effort at the state level. Recognizing the need for statewide GIS coordination, the Legislature and the Governor created a NYS Temporary GIS Council in July 1994 to examine various technical and public policy issues pertaining to geographic information systems. The Council's charge is to make recommendations to the Governor and the Legislature on the development of geographic information systems and to assess the potential costs and benefits associated with the coordination and integration of geographic information systems within New York State. The NYS Temporary GIS Council is

composed of 57 members, representing state agencies, regional and local governments, universities, the public, and interested federal agencies.

GIS use in local government is also receiving state level attention in New York. Information on methods and procedures for planning a GIS are difficult to locate and may not be suitable for local government use. The State Archives and Records Administration (SARA) has recognized this issue by supporting selected GIS projects through the Local Government Records Management Improvement Fund (LGRMIF). LGRMIF has funded 13 GIS-related projects since 1991 for a total of $450,000.

In an effort to increase the success of GIS efforts in local governments, SARA made a special grant of $300,000 to the Erie County Water Authority in 1995 to develop guidelines and other written material to assist local governments in addressing the records and information management aspects of GIS, and to further the development of GIS standards. The Erie County project will produce guidelines for GIS planning, draft standards for spatial data, and develop software to generate spatial data descriptions and records management guidelines for future use by SARA.

Much GIS expertise already resides in individual government organizations in New York State. The New York State government organizations most experienced in the use of GIS include the NYS Department of Environmental Conservation (DEC), NYS Office of Real Property Services (ORPS), and the NYS Department of Transportation (DOT). Many other state agencies including the NYS Health Department (DOH), the Adirondack Park Agency (APA), and the State Emergency Management Office (SEMO) have also developed considerable GIS expertise. Counties, cities, and other local governments are also benefiting from geographic information systems and spatial data resources. In New York City, for example, 38 agencies use GIS for budgeting, licensing, inspections, procurement, zoning, and taxation, and other uses. The counties of Nassau, Westchester, Suffolk, Madison, Monroe, and Tompkins use GIS for such activities as tax mapping, emergency planning, police operations, and environmental conservation. Other counties have geographic systems in place or in the planning stages. (NYS Forum for IRM, 1994).

Both formal and informal regional and local coordination programs are active within New York State. A number of different models have been developed within New York State to facilitate the sharing of GIS data, knowledge, and applications at the regional and local levels. Nassau County, for example, has implemented a formal partnership agreement under which the County licenses the use of its data to its various partners. At present the program includes 93 partners, including five state agencies (four in New York and one in New Jersey) plus many police and fire districts, villages, towns, and municipalities. Any consultants working for the County's partners may use the County's data free of charge. In addition, the partners may procure hardware and software under the pricing agreement that the County has developed with vendors. As a requirement of the partnership agreement, any changes to the data or value-added products created by the partners are considered the property of the County and participants are prohibited from disseminating the County's data to any other parties.

A smaller, less formal partnership arrangement exists between Saratoga Economic Development Corporation, Niagara Mohawk's Department of Economic Development, the Saratoga County Real Property Office, and the NYS Adirondack Park Agency. These partners pooled resources and expertise to convert Saratoga County tax maps to electronic form. This valuable data layer can now be used by all the partners for a variety of applications. The success of this partnership led the Adirondack Park Agency and Niagara Mohawk to seek similar arrangements in other counties.

Individual GIS professionals in New York are working together in informal user groups and professional associations. As the natural outcome of a desire to work together, 12 informal regional coordinating efforts and user groups have developed across New York State. These regional groups have produced directories of geographic data; they have discussed standards, hardware, and software issues; coordinated base map development; and generally facilitated networking and information sharing.

The Capital Region ArcInfo User Group (CAPARC), for example, provides communication mechanisms and information sharing opportunities for ArcInfo users in the Capital Region. GISMO, a group of GIS professionals from New York City is developing common electronic base maps and facilitates the distribution of data among city agencies. The Multi-County GIS Cooperative, a consortium of local and regional user groups, plays an active role in influencing statewide GIS development to assure coordination, public access, and regulations sensitive to county and local governments.

Professional associations play an important role in the development of GIS expertise as well. These groups may focus on cartographers, planners, or other similar professions. The Urban & Regional Information Systems Association (URISA), for example, is a formal nonprofit educational association of information users, providers, and evaluators. URISA's annual national conference is widely attended and recognized as one of the best sources of information about GIS development, use, and evaluation.

Center for Technology in Government Project

In 1994 the Department of Environmental Conservation (DEC) proposed a project to the Center for Technology in Government (CTG) to help create a framework within which New York State organizations could pursue their individual business objectives within the context of shared spatial information resources. The proposal centered on the idea of a data "cooperative" where many organizations would work together to share data and expertise for individual and mutual needs. A readily accessible spatial data clearinghouse was a key feature of the cooperative concept. The project was selected from a field of 19 proposals. Efforts to define the focus and scope of the project began in December 1994 with a small team of CTG and DEC staff. The project team quickly expanded to include involvement by a number of state, local, and private organizations. The project team included:

- Department of Environmental Conservation

- Faculty experts from the University at Albany
- Faculty and staff from the University at Buffalo's National Center for Geographic Information and Analysis
- The State Archives and Records Administration staff
- NYS Forum for Information Resource Management staff
- Erie County Water Authority staff
- CTG professional staff and graduate students

The project team also included 10 corporate partners. Applied GIS, Inc. was instrumental in the design of the NYS Spatial Data Clearinghouse. Blue Moon Training Systems, Inc. provided the CTG project staff with training in Geographic Information Systems. Xyplex, Aule-Tek, Inc., and Sun Microsystems provided CTG with support for remote access to the Clearinghouse. Harlan Wallach, a graphic artist, designed the logo for the Clearinghouse. Inteligis Corporation, a not-for-profit GIS consulting firm near Buffalo, provided support for some of the research efforts undertaken in the project. Documentation Strategies, Inc. together with Full-Circle Communications provided CTG with technical writing expertise for the Clearinghouse. Digital Equipment Corporation provided consulting services for some of the project activities.

Project participants came from all levels of government, the private sector, the academic community, utilities, and the not-for-profit sector. The project research activities involved approximately 450 participants from across the state and many additional participants from the national GIS community. Presentations and articles in regional user group newsletters were used to inform the GIS community about the project activities and to invite participation, reaching about 3,500 individuals.

Project Objectives

The Center worked with the Department of Environmental Conservation to improve the ability of any individual or organization to identify the existence of relevant data sets, to enhance understanding of the value of geographic information systems, and to explore the need for coordination of efforts to use GIS and spatial data in New York State. The project team identified a set of deliverables that reflected the proposal submitted by DEC, and which, to the extent possible, also addressed some of the charges to the NYS Temporary GIS Council which was getting underway at the same time.

The project activities were focused in two areas. The first was the development of a prototype designed to demonstrate the efficacy of an on-line clearinghouse of metadata and spatial data sets. The clearinghouse would be available to public, private, academic, and non-profit users as a mechanism to share data. The federal metadata standard was adopted for use in the prototype Clearinghouse. In a parallel project activity, the federal standard for metadata was further analyzed for its usability to support data sharing in New York State.

The second focus was to review the literature and work with the GIS community to gather data on the value of GIS as a decision making tool, to identify effective approaches to assessing costs and benefits, to identify barriers to sharing and coordination of GIS activities, and to gather

information and recommendations from the community regarding the future coordination of GIS in New York State.

Within this larger framework, the project team pursued three specific objectives:

1. Demonstrate the value of GIS by examining exemplary applications and existing evaluation approaches.
2. Identify barriers to sharing spatial data and explore potential solutions for overcoming those barriers.
3. Investigate some practical tools to support GIS coordination in New York State.

Project Workplan and Participant Roles

Figure 1 shows the major blocks of work that comprised the project workplan. CTG research staff and faculty fellows conducted the research to identify the value of GIS and barriers to sharing spatial data and GIS expertise. CTG, DEC, and Applied GIS, Inc. all shared the prototype design responsibility. CTG led the prototype Clearinghouse development process. CTG, the University at Buffalo, and SARA shared in the process of analyzing the federal content standards for metadata.

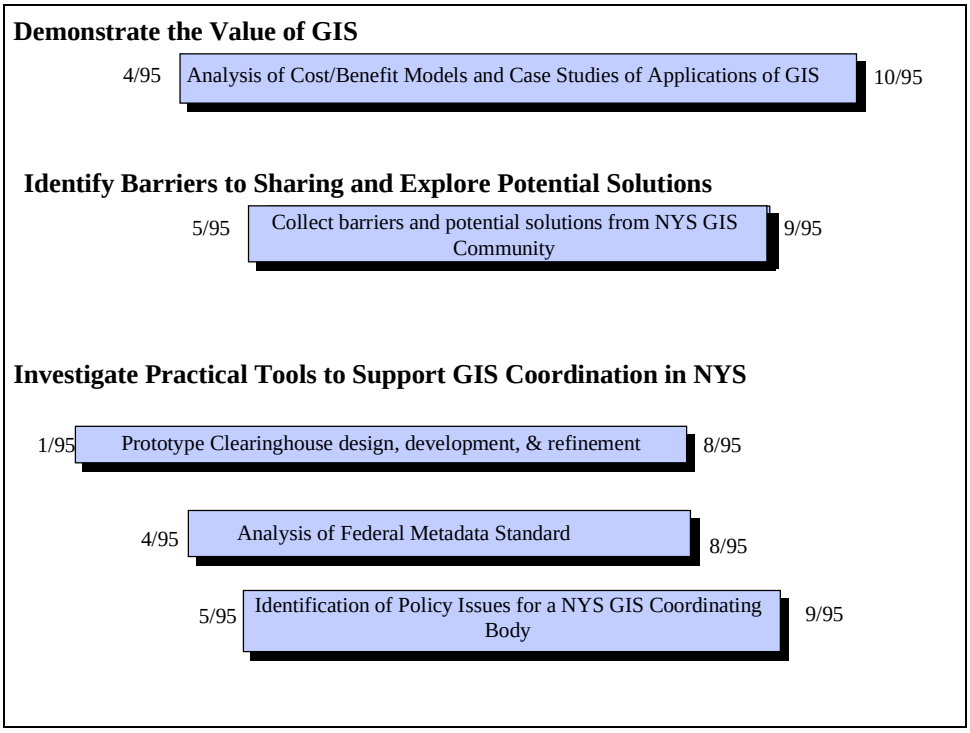


Figure 1. GIS Cooperative Project - Timeline for Major Activities

1. Demonstrate the Value of GIS. In an effort to make a case for the value of GIS we focused on three public policy areas, economic development, public health and safety, and environmental conservation. CTG staff conducted a review of relevant literature and program materials and

identified and analyzed exemplary applications in each area. Additionally, the project team sought to identify mechanisms and measures for assessing the value of GIS through literature reviews and discussions with GIS users in NYS and elsewhere.

2. Identify Barriers to Sharing and Explore Potential Solutions. In order to identify barriers and solutions, CTG conducted six facilitated data collection conferences throughout the state. About 450 members of the NYS GIS community attended these sessions. Participants generated prioritized lists of barriers to sharing GIS information and focused on developing solutions to the top barriers. Various mechanisms to reduce barriers to sharing were identified. CTG also conducted a review of the literature regarding data sharing and GIS coordination.

3. Investigate Practical Tools to Support GIS Coordination in New York State. CTG, Applied GIS, Inc., and the Department of Environmental Conservation led an effort to develop and demonstrate a Prototype Spatial Data Clearinghouse as one mechanism to support data sharing. The Clearinghouse, available to any user over the Internet, was designed to be New York State's node of the National Spatial Data Clearinghouse. In addition, SARA, the University at Buffalo, and CTG initiated an analysis of the federal metadata content standard, a process which will continue in a separately funded project sponsored by SARA.

During the project CTG staff also helped support the work of the NYS Temporary GIS Council. The project team drafted a survey instrument to collect the answers to the detailed questions enumerated in the GIS Council legislation about the extent of state and local investment in spatial data and geographic information systems applications and technologies. The survey is being conducted for the Council by the NYS Forum for Information Resource Management. CTG provided several presentations to inform Council members of the progress and results of the NYS GIS Cooperative Project. These presentations included a description of the project and its participants and goals, and a review of the research into GIS coordination efforts in other states. All Council members were invited to the public demonstration of the CTG project prototype where they heard presentations by state, federal, and local GIS experts. CTG staff acted as group process facilitators for the Council's working groups and provided other more traditional staff and technical support services.

OBJECTIVE 1.
DEMONSTRATE THE VALUE OF GEOGRAPHIC INFORMATION SYSTEMS

One of the underlying assumptions of the NYS GIS Cooperative Project is that GIS is a valuable public sector management tool whose benefits can be enhanced through increased coordination. The value of GIS and spatial data can be seen best in three program areas: economic development, public health and safety, and environmental quality.

Geographic Information Systems in Economic Development

Developing New York State's economy is a key goal of the Pataki Administration. National data show that during the period 1980-1993 New York State ranked 45th in the nation in job growth. Attracting new business to the State and assisting those already here in remaining competitive and growing is therefore of great importance to the state's future.

New York State is currently at a disadvantage when it comes to attracting new industries. Data from 1992 show that total taxes in New York State are the second highest in the nation (Public Policy Institute, 1995). Energy costs in New York State are 1.3 times the national average (New Yor kState Department of Economic Development, 1994). New York's complicated regulatory environment means businesses considering locating here may wait six months or more for the approval of permits needed for business start-up.

Several gubernatorial and legislative initiatives are underway to mitigate these disadvantages. But New York must also take advantage of existing strengths and resources. Information is one vital resource that can be put to work to achieve economic growth. According to the Office for Research and Communications in the South Carolina Department of Commerce: "Economic Development is becoming more of an information business, or information game, where people demand detailed data on a broader range of topics" (Lang, 1994). GIS offers enormous potential to support economic development and planning activities. These systems can support many analyses related to business expansion. An Arkansas study identified many economic development uses for spatial data (Table 1).

Additionally, GIS can be used to develop and evaluate public policy decisions related to business expansion (Drummond, 1995). Specifically, geographic analysis can help:

- Identify current and emerging clusters of globally competitive industries
- Determine the best locations for new investments in public infrastructure
- Develop fair, effective incentive programs to encourage job creation in distressed areas

- Target education and training programs to support vital industries
- Organize networks of small business for joint marketing and purchasing

Table 1. Economic Impact of Land Records on Private Sector Economic Development	
Public Utilities	• Map transmission facilities including data on land ownership, construction configuration, facilities characteristics, etc. • Used to schedule maintenance, respond to emergencies, and for sales and marketing purposes.
Retail	• Target trade areas • Locate new store • Store-specific product stocking plans
Transportation	• Delivery and trucking companies are developing optimal routing systems to minimize travel time and costs and to maximize loading • In-vehicle navigation
Farming, forestry, and agribusiness	• Management of forest lands
Banking	• In response to federal regulations, banks are using GIS to assess the distribution of loans to support community reinvestment analyses and reports. • Target marketing • Strategic planning • Growth and development trends • Deposit structure changes • Identify geographic changes in household finance and composition
Real Estate	• Site selection analyses • Identification of characteristics of properties (e.g. school districts) • Assess neighborhood trends in market prices • Client presentations
Health Care	• Site locations for offices and clinics • Optimal routes for emergency vehicles • Positioning emergency vehicles
Improved ability to respond to federal requirements	• Respond to federal environmental regulations associated with development
Source: Arkansas Mapping and Land Records Modernization Advisory Board	

Industries seeking sites for location or expansion request information on wage rates, work force availability, land costs, building availability and suitability, construction costs, local and state taxes, local and state development incentives, availability and cost of energy, and transportation costs to customers and from suppliers. They also seek information about the quality and availability of medical care in the area, the presence of unionized work forces, the location and

market areas of competitors, the availability of other infrastructure (such as telecommunications, sewer, and water), and factors related to quality of life.

The comprehensive information that businesses need must also be timely. If potential sites in New York are unable to provide information within a required time frame, or if the permitting and approval process takes longer than a business is willing to tolerate, then New York loses growth to other places that are able to meet these demands. Without the tools and information infrastructure to support these requests, New York State is at a further disadvantage in attracting new business to the State.

The absence of a geographically-oriented information infrastructure also precludes the state from adopting a proactive approach to development. Such an approach would include an inventory of existing businesses in the State, their locations, and their inputs and outputs; maintaining an inventory of existing sites for development, including the work force characteristics of these areas, other associated socio-demographic factors, resource availability, and infrastructure limitations. This kind of data resource would allow economic development agencies to identify those industry types that would be most competitive in a given region and help them carry out targeted marketing to those business types. While other states, such as South Carolina, have comprehensive statewide GIS systems containing the information that businesses demand, New York State continues to lag behind, reacting to specific requests rather than aggressively mining that information for strategic opportunities.

Cases: Regional Economic Development Initiatives

Several geographic regions within New York have recognized the value of this technology in supporting economic development and have begun to develop systems to support GIS activities. Regional organizations are becoming better able to provide comprehensive information to businesses considering locating in these regions of New York State. They will have the strategic planning tools to adopt initiatives that benefit their respective regions through increased economic activity and revenue, and these may also benefit the State as a whole. However, while regional activity is increasing, no statewide plan has emerged to serve as a strategic umbrella for these local efforts. As a result, regional efforts compete not only with other states, but with one another. New York will not become competitive as a state without developing a comprehensive ability to use this information strategically.

> **Saratoga Region.** Saratoga Economic Development Corporation, (SEDC) in cooperation with Niagara Mohawk, Saratoga County, and the NYS Adirondack Park Agency, has initiated a GIS to support regional economic development. SEDC's strategic approach includes the development of a GIS containing digital tax maps for Saratoga and surrounding counties, socio-demographic data, available sites for industrial development, and an inventory of existing businesses so that economies can be realized in new business development. With this system SEDC will also be better able to analyze the benefits of potential infrastructure improvements on the regional economy.

Greater Buffalo Region. In the western region of the State, the Greater Buffalo Partnership, a not-for-profit corporation, is developing a comprehensive GIS as part of its broader economic information infrastructure initiative. This system will support economic development activities such as relocation assistance to both firms and relocating executives.

Capital Region. The Capital District Regional Planning Commission (CDRPC) serves as a regional data bank and information center, offering technical assistance to member communities and compiling information requested by businesses considering locating in the region. CDRPC uses its GIS to compile demographic information in support of marketing activities of several industrial parks in the region. The system has also been used to conduct a Groundwater/Wellhead Protection Program for Southern Saratoga County which integrates environmental considerations into regional economic development activities.

New York City. Several economic development activities in New York City are supported through the use of GIS. The Environmental Simulation Center at the New School for Social Research has developed a three-dimensional database for neighborhood planning and development in various parts of New York City. The Staten Island Economic Development Corporation, aligned with the Borough President's Office, has released an RFP for a GIS for use to support economic development for Staten Island.

Geographic Information Systems in Environmental Conservation

In order to effectively and responsibly expand the business sector in New York State, it is necessary to examine growth and development in light of associated environmental impacts. While increasing employment opportunities and tax revenues are vital to the State, maintaining the quality of our natural resources is equally important. In short, geographic information analysis allows planners and policy makers to understand the environmental effects of their policy choices. Since environmental concerns do not stop at the county line, the information needed to assess them must be shared among different jurisdictions and agencies. In New York State, GIS is being widely used to support such activities.

Case: Understanding and Managing Flood Plains

The DEC Division of Water is currently developing a three dimensional color infrared electronic map for the entire state which will support many activities related to flooding. The first digital coverage is hydrography which includes the streams, lakes, ponds, and wetlands of the State. This coverage has been completed. The second is the Digital Elevation Model (DEM) of the State's terrain which describes the contours of the land. The hydrography and the DEM are used along with geodetic control to correct color infrared aerial photography that was flown under the National Aerial Photography Program of the US Geological Survey. This will produce the third

layer of information which is a Digital Orthophoto Quarter (DOQ) Quad at 1:12,000 scale. The DOQ Quad will provide information on land use and land cover for the state.

This set of electronic data will be used to create flood insurance maps, assess potential flood and beach erosion impacts, as well as design mitigation programs to minimize the risks associated with these events. These maps are the ideal tool for real-time flood control and prevention. Using Army Corps of Engineers models, areas vulnerable to flooding will be more easily and efficiently identifiable. DEC plans to submit these computer-generated flood plain maps to the Federal Emergency Management Agency (FEMA) in lieu of paper maps to allow flood insurance premium rates to be established for the structures in the flood plain. Because the DEM is sensitive to as little as four inches of elevation, more precise flood plain zones can be defined, thus creating savings for home owners and insurance underwriters. The ability to produce electronic maps will generate both time and cost savings for the agency and its clients.

In addition to the modeling of floods, these tools will provide a mechanism for identifying and enacting pollution prevention measures for New York State's waters. They will also allow DEC and other agencies to conduct analyses related to natural resource management and environmental impact. The data and associated maps will be of great use to other state agencies as well as local governments and private organizations. For example, they will assist the State, County, and Local Emergency Management Offices in both mitigation and real-time response to flooding and tracking of hazardous materials. Further, these maps and the accompanying attribute data can be used by insurance companies for risk analysis.

Case: The New York City Watershed Agreement

A landmark conservation agreement bringing together upstate and urban interests to protect New York City's drinking water was announced in November 1995. The plan is intended to avert the need to build a multi-billion dollar filtration plant and to promote nonpolluting economic development in those areas surrounding New York City's 19 upstate reservoirs. Under this agreement, New York City will increase by three-fold its land holdings within the drainage basins that feed its reservoirs and will spend $350 million on projects that support environmental protection projects for the communities in these basins. Additionally, the agreement will institute the first revisions in water protection since 1953. This agreement, saving New York City residents millions of dollars, exemplifies the need for comprehensive information which will ensure that the development of economies around the basin areas will not imperil the quality of New York City's water sources. It also furthers the case for comprehensive data collection and coordinated efforts between economic development and environmental protection activities in New York State.

Geographic Information Systems in Public Health and Safety

GIS supports a number of activities related to the health and safety of the state's citizens. For example, GISs are the foundation for Emergency 911 Plus systems that first locate and then

efficiently route response services to an emergency situation. Additionally, GIS systems have been used in epidemiological studies, health care planning efforts, the siting of residential treatment programs and emergency outreach facilities, and the development of emergency evacuation plans.

Case: The State Emergency Management Office

The value of GIS as well as the need for coordination is readily apparent when viewed from the perspective of the New York State Emergency Management Office (SEMO). Located within the Division of Military Affairs, SEMO is the staff arm of the State Disaster Preparedness Commission whose mission is to prevent, counteract, defend against, and recover from disasters which result in loss of life, property, and income and disrupt the normal functions of government, communities, and families.

SEMO's role is to help local governments avoid and respond to disasters of all kinds. To do this, SEMO relies on many information sources. In order to respond to disasters, SEMO must have current and accurate information about the areas affected by a disaster. It must also have comprehensive information on the resources available for response. Effective disaster response requires that a variety of state and local agencies work together, using the same base of information.

SEMO has been using GIS for a number of years. Its data holdings are extensive and include point coverages for such entities as ambulance and rescue organizations, dams, bridges, shelters, schools, historic sites, soils, hazardous waste sites, and correctional facilities. Additionally, the agency holds a number of polygon coverages such as State Parks, New York State agency regional boundaries, aquifers, utility franchise areas, and municipal, area code, and district boundaries. Line coverages include roads, railroads, hydrography, power lines, and erosion areas. Much of the data used by SEMO was converted from tabular data provided by federal, state, and local agencies. The degree of detail varies widely across geographic location depending in part on local data collection efforts and projects conducted in each area. SEMO has worked cooperatively with a number of agencies in conducting analyses and developing digital data sets.

A resolution creating a State Hazard Mitigation Policy Committee was approved by the New York State Disaster Preparedness Commission in June 1995. A Risk Management Subcommittee is responsible for identifying and assessing the state's vulnerability to hazards. The work of the Risk Management Subcommittee will be supported by SEMO's GIS and its effectiveness will depend partly on the availability of needed information. The Subcommittee must:

- identify hazards that affect people and property, both locally and statewide
- assess vulnerability to those hazards
- prioritize hazards to be mitigated

The purpose of conducting such analyses is to examine specific hazards facing a community, jurisdiction, facility, property, or organization to gain a greater understanding of each hazard and to rate and rank each hazard to determine its significance for mitigation and planning purposes.

Given that resources are scarce, it is important that priority is assigned to those hazards which pose the most risk to people and property. Probability models that integrate diverse types of information assess the likelihood of an event and the potential damage that it may pose to the community.

Table 2 presents the many different types of information that must be integrated in order to effectively conduct vulnerability assessment. It is also important to note that assessment information is dynamic. The likelihood of events, community characteristics, and availability and location of resources to react to events all shift over time. It is imperative that risk assessment activities be dynamic as well. These types of analyses cannot be conducted comprehensively and dynamically using manual processes. Only a comprehensive information system, with geographic components, can ensure that accurate and timely information is available to protect the people and property of New York State.

Table 2. Data Needs for Vulnerability Assessment

Vulnerability Factors			**Hazard Surfaces**
People of the Community	**The Built Environment**	**Community Organization**	
Total population and density Language spoken at home Annual household income Households without cars Unemployment Educational level Age by Gender Persons with disabilities	Land use density Sensitive facilities Individual structures: Ground height Number of stories Floor Height Building material Building age Building size	Formal or informal organizational networks Level of protection and service boundaries: Fire Police Ambulances Medical care	Flood plains Storm tide maps Earthquake maps
Source: Ken Granger, URISA Proceedings, 1995			

Overlapping Information Needs

The important programmatic areas described above (the economy, the environment, and community safety) share many common information needs. While some information requirements are specific to one program area, there is an extraordinary amount of overlap among them. Much of the data needed for economic development are the same data needed for environmental conservation activities and for disaster preparedness and mitigation. Table 3 provides several examples of data types which support all three areas. The list of data types is not meant to be exhaustive, nor does it include the many other application areas that these same data types can support. Rather, the table is designed to illustrate the great economies of scale and scope that could be achieved by a coordinated effort to create, manage, and share spatial data.

Table 3. Overlapping Information Needs for Economic Development, Environmental Conservation, Public Health and Safety			
	Program Area		
Data Types	**Economic Development**	**Environmental Conservation**	**Public Health and Safety**
Digital tax maps (parcel boundaries)	X	X	X
Land ownership (real property)	X	X	X
Zoning (land use planning)	X	X	X
Transportation networks	X	X	X
Infrastructure (water, power, sewer, telecommunications)	X	X	X
Socio-demographic characteristics	X	X	X
Hydrography	X	X	X
Natural resources	X	X	X
Environmental hazards	X	X	X

The effective creation, maintenance, and sharing of spatial data across government will serve a variety of vital public purposes. These overlapping information needs demand increased coordination among information users and information creators.

Measuring the Value of GIS

While the need to evaluate GIS is clear, the process for doing so is not obvious. Much of the preceding discussion of the value of GIS is anecdotal or qualitative. For example:

- GIS can support new services that were not feasible under manual processes.
- GIS allows for the integration of information from diverse sources in order to strategically develop the economy.
- It allows for the ready provision of information to businesses considering locating within the State and allows for more effective development and evaluation of policies to support economic growth.
- The use of GIS will enable emergency response to more effectively reach those in need and will allow for more effective distribution of resources needed in response to disasters. The technology will also allow for an increased ability to assess potential disasters and create mechanisms to alleviate their effects on the people and property of the State.

While the qualitative value of geographic information systems is apparent from the above discussion, quantitative measures of cost and benefit must also be developed. These measures are needed for several purposes:

- to assess the resources needed to implement a GIS project

- to make a case for investment in a single project or to evaluate the relative merits of several alternative projects
- to provide a benchmark for assessing the success of a project

The most appropriate and commonly used mechanism for assessing the value of public sector projects in general, is cost-benefit analysis. However, "from a review of the literature, it would appear that the task of cost-justifying investment in GIS in local government has proved difficult and that some GIS implementations are more an act of faith than the result of critical evaluation" (Worrall, 1994).

While the costs associated with the development of a GIS are relatively straightforward (hardware, software, data collection or conversion, data management, system administration, training), it is often difficult to determine the benefit side of the equation. The benefits of GIS can be described and measured in terms of the cost, timeliness, and quality of services. Cost measures center around increases in productivity--performing the same tasks with fewer resources or delivering more services at the same cost. Increases in productivity can be seen in the example of the submission of flood plain maps to FEMA, where there is less cost associated with the provision of electronic maps than with paper ones. Some of the economic development projects illustrate measures of timeliness where improvements can be measured in terms of responding comprehensively to site location requests in a fraction of the time it takes under a manual process. Quality improvements may involve new or enhanced services that were not possible without a GIS in place. E-911 emergency response systems are a case in point.

Theoretically, the steps involved in conducting cost-benefit analysis are relatively straightforward, (specify objectives or desired outcomes, define costs and benefits and give them dollar values for a base year, assess the benefits and costs over time, and compare costs and benefits against defined decision criteria). In practice, this is much more difficult. First, since many GIS applications represent new service types, their impacts are difficult to specify and baseline data may not exist. Second, assigning monetary values to all of the associated costs and benefits often poses some difficulty. Dickinson and Calkins (1988) suggest that the detailed information needed to support traditional cost-benefit analysis is not always readily available for three reasons. First, it is often difficult to identify and describe the level of demand for those products the GIS is designed to support. Second, it may be difficult to estimate the economic or dollar value for all of the system products. Lastly, some of the objectives or goals of a GIS implementation may not be readily expressed in terms of discrete products.

For the most part, the literature indicates that the cost-benefit framework is an appropriate tool for evaluating GIS implementations. However, it is also evident that system benefits are often difficult to quantify. Some of this difficulty can be alleviated by comprehensive needs analysis during the system design phase. However, processes and methodologies for benefit estimation are lacking. Much additional work is needed before GIS systems are routinely measured in quantitative terms.

OBJECTIVE 2.
IDENTIFY BARRIERS AND SOLUTIONS FOR SHARING SPATIAL DATA

Spatial data sets have potential for use across many program areas. Digital tax map data, for example, can be used in a local assessor's office, at the state Office of Real Property Services, by State and local emergency planning offices, by economic development agencies, insurance companies, real estate brokers, and local and regional planners. The benefits of sharing digital data are obvious. Sharing data reduces the total cost of individual applications. Using data created by others allows some organizations to embark on GIS applications for the first time, because the major cost element, data creation, has been made affordable. Data sharing, however, is not as easy or as pervasive as one might think. Availability, pricing, and ownership are common stumbling blocks. In some cases, data sharing is limited by the use for which the data were originally created. The scale or accuracy of data required by one organization may not be sufficient for use by another. The CTG project team sought to identify those factors which hinder the sharing of valuable spatial data and to identify mechanisms that might minimize or reduce these barriers. Much of the information reported here was obtained through facilitated group meetings involving both information holders and information seekers in New York State. Seven management and policy barriers emerged from this analysis (Table 4). In each case, possible solutions were offered.

Table 4. Barriers to Information Sharing in New York State
Lack of awareness of existing data sets
Lack of or inadequate metadata
Lack of uniform policies on access, cost recovery, revenue generation, and pricing
Lack of uniform policies regarding data ownership, maintenance, and liability
Lack of incentives for sharing
Absence of tools and guidelines for sharing
Absence of state-level leadership

Lack of Awareness of Existing Data Sets

Perhaps the most obvious barrier to the sharing of digital spatial data is a lack of awareness of the existence of specific data sets. For example, the State Emergency Management Office has geographically referenced all of the nursing facilities in New York State based on data provided by the New York State Department of Health. This data is of obvious value to a number of state and local government agencies, some of which may have conducted this same geocoding process. Lack of awareness may also preclude an organization from implementing a system or an application because the costs associated with spatial data creation may make the project seem infeasible. Unnecessary data duplication means scarce resources are spent multiple times on the same activity, while other needed work goes undone for lack of funds.

While this barrier was noted most often in the context of inter-organizational data sharing, it exists even within single organizations. A bureau or division within an agency may create a specific data set to support its particular programmatic need and neglect to identify and inform others within the organization who may also benefit from the use of that data. In many cases, units within an organization are completely unaware of the data holdings of their entire agency. If this lack of communication is evident within organizations, it is even more problematic across government agencies. Currently, there is no statewide mechanism in place which identifies either data sets already held by state and local agencies or those in the process of being created.

Those individuals or organizations which have been active in GIS for some time are often familiar with the other players and their activities within the State. For these users, awareness may be less of a barrier. However, for most, the identification of existing data holdings is a difficult and costly undertaking which is often abandoned without achieving success.

Recommended mechanisms for increasing awareness of existing spatial data include a statewide data clearinghouse and policies and procedures to ensure that this clearinghouse is comprehensive and well-maintained. Within organizations or agencies, mechanisms must also be put in place to ensure awareness of and access to information across divisions or bureaus. While some agencies in other states use their statewide clearinghouse for this purpose, executive leadership is necessary to assure that this awareness is pervasive among agency staff. Additionally, the project found that integrating GIS and spatial data policies within an organization's overall information strategy will maximize the benefits of GIS and spatial data

Lack of or Inadequate Metadata

Even when people know a certain data set exists, sharing is not simple or easy. In order to use another's data, a potential user must have specific descriptive details about its characteristics. These details, called metadata, help determine the suitability for use in a specific application. Metadata is often called "information about information." It helps a prospective user decide if a particular data set will be suitable in a new application. For example, a particular scale or level

of accuracy may be important for the intended use of the data. For a time-sensitive application, the potential user may need to know precisely when the data was created and how often it is updated. If details like these are unavailable, both the data seeker and the data holder need to spend time communicating these specific characteristics. Worse, if the creator of a data set should leave the organization, critical descriptive information about the data set may leave as well.

This issue, like lack of awareness, occurs both within single organizations and between organizations. The absence of metadata, failure to understand the need for metadata, and inadequate metadata all hinder information sharing. Moreover, since metadata can be difficult and time consuming to create and maintain, data holders need tools to help them create the metadata associated with their data resources.

In order for users to have sufficient information to determine the potential and appropriateness of a data set for a specified use, they need a minimum level of data description. This description must contain defined fields which all potential users understand, in other words, a metadata content standard. Software tools that generate metadata and educational programs that demonstrate their value and use must also be developed.

Lack of Uniform Policies on Access, Cost Recovery, Revenue Generation, and Pricing

Another barrier to the sharing of spatial data is the lack of clear statewide policies related to data dissemination. Since the creation or conversion of spatial data is costly, some organizations want to recover these costs by charging requesters for their use. Others prefer to disseminate their data at no charge or, at most, for the marginal cost of reproduction. In some cases the same agency will provide data free of charge to one requester while charging another a fee for the same data.

The State's Freedom of Information Law (FOIL) was noted as a particular barrier to the sharing of spatial information. The legislative declaration which introduces the law bases the statute on the people's right to know about government processes and right to review the information on which policies or determinations are made. Many agencies believe that requesters seek spatial data sets solely for their commercial value, and not for any open government or policy review purposes. These requests can be time consuming to process. Yet, under the generally accepted interpretation of FOIL, public organizations are unable to charge more than the actual cost of reproduction for any government "record." Moreover, the definition of a "record" is somewhat unclear in the case of digital spatial data. According to FOIL,

> "Record" means any information kept, held, filed, produced or reproduced by, with or for an agency or the state legislature, in any physical form whatsoever including, but not limited to, reports, statements, examinations, memoranda, opinions, folders, files, books, manuals, pamphlets, forms, papers, designs, drawings, maps, photos, letters, microfilms, computer tapes, or discs, rules, regulations or codes. (Public Officers Law, Article 6 p. 251)

If information needs to be extracted, reformatted, or reconstituted in order for it to be useful to the information seeker, a new "record" would need to be created and charging for its creation may be permissible under the law. However, no clear guidelines exist for determining when these costs can be recovered and how they should be calculated.

For many government agencies, particularly local governments, requests for spatial data can be expensive to process. There is overhead associated with responding to requests for data. Staff time must be allocated for communicating with data seekers, answering questions, and physically reproducing and disseminating the data. These overhead costs are not recoverable under FOIL and again represent an expenditure of resources with relatively little, if any, benefit accruing to the data creator.

This absence of clear policies and practice guidelines has resulted in confusion about what agencies can and cannot charge for and has left many of the decisions about data dissemination policies to the individual interpretations of different agencies and individuals. In order to ensure consistent and equitable sharing of digital spatial data, statewide spatial data access policies must be developed. These policies must include consideration of privacy and confidentiality issues and mechanisms for enforcement. They must also recognize that resources to support the dissemination of spatial data may be insufficient, particularly at the local level, and therefore, technical tools and other forms of support may be necessary to achieve desired levels of access to spatial data across all levels of government.

Lack of Uniform Policies on Data Ownership, Maintenance, and Liability

Another barrier to sharing is the lack of clear policies on the transfer of data and what happens to it after it leaves the hands of the original creator. For example, if one organization creates a data set and distributes it to another which then modifies or adds value to the data, it is no longer clear who is the "owner" of the modified data set. Nor is it clear whether the modifier should be able to disseminate that modified data set since it also contains information created by the originator.

Any modification of an original data set raises the additional issue of whether the modified data should be automatically transferred back to the original creator, and further, which party should maintain that modified data set. In some cases, a data requester sells the data (with or without adding value). In these cases, should the original data supplier share in the revenue?

The issue of liability was also identified as a barrier to information sharing. There are several important questions in this area. If an original data set is modified or updated by the originator, what obligations exist to ensure that outside users are apprised of the changes? Is the creator of shared data liable for uses or misuses of the data? Are policies and procedures needed to assign responsibility when an individual or organization uses a data set created by another and is somehow harmed or harms others because of the accuracy or the currency of that data? Since

there are no clear policies within that State which address these issues, many agencies are reluctant to transfer or share their data.

In order to reduce this barrier, policies must be developed within the State which address the issues of data ownership and data transfer. These policies must be developed in concert with data access policies. Responsibility for the development and maintenance of specified, commonly used data sets (such as political boundaries) should be assigned to appropriate organizations or agencies within the State. Additionally, policies and mechanisms for the transfer of value-added data sets must be developed. Issues of liability for mishaps that may result from various uses of data must also be examined. All of these policies must be developed with consideration of the potential for competition between the public and private sectors.

Lack of Incentives for Sharing

Sharing data both within an organization and across organizations requires an expenditure of resources. The resources devoted to data dissemination activities are seldom an explicit budget item. Instead, they generally come at the expense of an organization's ongoing programmatic responsibilities. Further, little or no benefit accrues to an agency as a result of information dissemination activities. Given the potential for liability for misuses of data, the lack of polices to encourage or support sharing, and the scarcity of agency resources to pay for dissemination, it follows that agencies have little to gain from publicizing their data holdings and thereby increasing external demand for their data. In order to foster data dissemination or sharing activities, mechanisms must be put in place to both minimize the cost and increase the tangible and intangible rewards for those efforts. Agencies that produce data products for use by others, or invest in projects which have multi-agency or statewide import should have budget lines that support these activities. Agencies that generate revenue or contribute to projects with measurable savings should be allowed to retain some of those funds to operate or improve their programs.

Absence of Tools and Guidelines for Sharing

Many states have created mechanisms, policies, and processes which facilitate the sharing of spatial data--mechanisms that are absent in New York State. For example, many agencies have investigated the benefits of aerial photography, but few have the resources to support this method of data collection as their individual needs represent only a small part of the full data set that could be generated from a statewide database. At present, no one organization has the authority or the funds to organize a statewide effort of this kind. Tax maps are another example where partnership arrangements would produce a data layer of immense value to many public and private organizations. However, since the tax maps "belong" to the counties, only those counties with enough money can create them on their own.

Increased coordination and communication would be fostered by formal education programs, technical assistance, well-defined information management tools, or formal processes or structures to support intra- and inter-organizational collaboration. For example, changes in the way funds are allocated for data creation activities may be necessary. Traditional budgetary mechanisms allocate resources for data creation to one organization. However, the benefits of a particular data set could accrue to many organizations if the data is shared. New York needs to develop budgets or accounting procedures that allow for sharing the costs as well as the benefits of data creation. Agencies are unsure about the rules and processes for data sharing. Standard data sharing agreements that agencies could use as templates for specific projects might help overcome confusion and reluctance. Similar agreements to govern joint data development efforts, specifying which agency is responsible for which activities and how they share the ownership or use of the results, would also be very helpful.

Absence of State-Level Leadership

Many of the barriers to sharing discussed above are the result of the state's past failure to provide effective leadership or guidance with respect to GIS activities. Costly data creation and system development activities continue to be conducted in an uncoordinated manner. To date, data creation and application development have continued without central oversight and in the absence of a statewide strategy. This situation is not only costly, it puts New York at a distinct disadvantage when compared with other states.

Policy-makers must be made aware of the importance of these issues. Executive and legislative leaders need to set and prioritize policy goals with some understanding of how GIS systems can support their attainment. Leaders then need to assign responsibility for the creation and maintenance of valuable statewide data sets. This would help ensure quality and consistency of the most widely used spatial data. Resources should be allocated to critical data creation needs and to coordination functions that will build and reinforce expertise.

OBJECTIVE 3.
INVESTIGATE PRACTICAL TOOLS FOR GIS COORDINATION IN NEW YORK STATE

As outlined in the preceding sections, there are many potential solutions that would help New York overcome the barriers to sharing. The NYS GIS Cooperative Project examined three specific solutions that illustrate the issues and how they might be resolved:

- An action agenda for a NYS GIS coordinating body
- A prototype NYS Spatial Data Clearinghouse
- Analysis of the Federal Content Standard for Digital Geospatial Metadata

An Action Agenda for a NYS GIS Coordinating Body

The project examined the need for a New York State GIS Coordinating Body and further sought to identify those issues that such a body should address. As noted earlier, nearly every state in the nation has a body that addresses issues related to the coordination of GIS activities. These structures vary greatly in structure, size, and level of formalization but their priority concerns (communication and coordination, policy making, planning, and technical issues) are quite similar. There are also commonly recognized critical success factors that New York should take into account. The successful coordination efforts in other states are characterized by (NSGIC, 1994):

- Executive or Legislative authority
- Active member participation
- Unity of purpose
- Adequate financing
- A champion for the cause
- Demonstrable cost savings
- Sufficient staff support

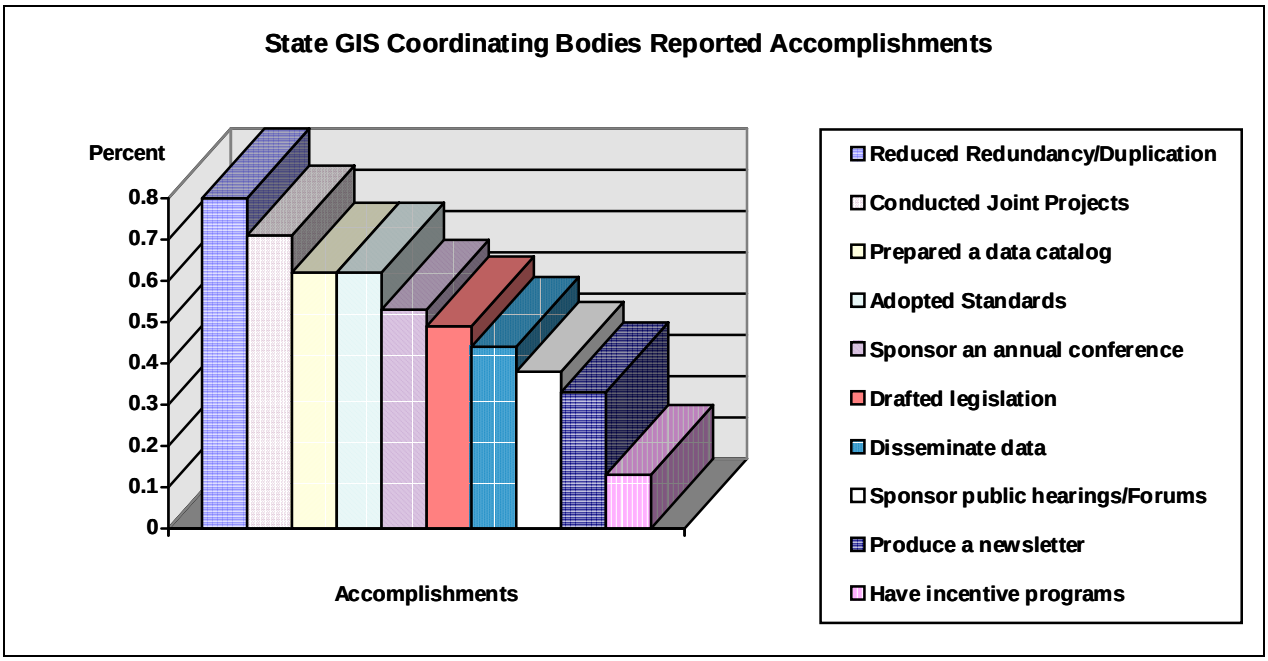


Figure 2

Coordinating bodies in other states report a variety of achievements that would also be of great benefit to New York State (Figure 2). Eighty percent report a reduction in duplication and a majority report sponsorship of joint projects, preparation of a data catalog and direct dissemination of spatial data.

In order to decide what kind of coordinating body would be most appropriate for New York State, it is first necessary to identify what it should do. The facilitated meetings gathered community perceptions of the need for a GIS coordinating body in New York State. In three of the meetings, the question "Does New York State need a GIS coordinating body?" was posed to the group. The response was unanimously affirmative. Issues to be addressed by a coordinating body were also elicited from the groups and then prioritized. There was much overlap among the groups, indicating a high degree of consensus about the issues that most need attention. These issues are essentially the same as those being addressed by the coordinating bodies in other states. They are summarized in Table 5 and discussed below:

Table 5. An Action Agenda for a Statewide GIS Coordinating Body
Sponsor a statewide data clearinghouse
Develop policies for data development including data quality
Adopt standards
Develop polices on data access and data security
Provide for multi-organizational communication and coordination
Sponsor a formal education program
Develop and support cooperative funding strategies
Act as a formal liaison with the federal government
Provide a contract or proposal review service

Sponsor a statewide data clearinghouse

One of the most significant barriers to the sharing of spatial data was a lack of awareness about what data is available and from whom. As indicated, the process of determining whether a data set already exists is very costly, particularly for those new to GIS use. Many valuable and useful coverages already exist in state and local government agencies. In addition, a number of useful data sets such as TIGER line data and census data have been developed by the Federal government. Useful data sets are also available commercially.

Further development of a spatial data clearinghouse is an important role for a coordinating body for GIS in New York State. A statewide clearinghouse would reduce the cost of identifying the existence and location of needed data. The cost to data holders could also potentially be lowered by reducing the number of direct queries from data seekers. A clearinghouse might take several forms. Some states, such as Vermont, have created paper directories of available information while other states such as Florida, California, and North Carolina have developed Web-based spatial data clearinghouses. Additionally, while some of these clearinghouses contain only metadata, others provide for on-line access to the data sets themselves. On-line access to data sets further decreases the cost to the data provider as they must no longer expend resources on data dissemination activities.

In addition to information about existing data sets, users wanted information about ongoing application and data creation activities. This information would support data development partnerships and would reach into isolated pockets of GIS expertise within the State. Participants also asked for a guide, electronic or otherwise, of "Who's Who in GIS in New York State." This

would provide a reference, particularly for those new to the GIS field, to the activities and responsibilities of the various entities involved in GIS across the State.

Overall, a statewide spatial data clearinghouse would reduce costly data duplication efforts, and reduce the time required for data searches. Costs to data providers could also be reduced through decreased time spent responding to inquires and, if on-line access to data sets was provided, the costs of disseminating data would also be reduced. Agencies in other states have found these clearinghouses useful for obtaining information about their own information holdings. They provide a valuable resource for intra- as well as inter-organizational information management activities.

Develop policies for data development including data quality

Much of the data creation activities across the State are conducted without the benefit of a comprehensive plan or strategy. Resources are allocated for these activities on a project-by-project basis with little attention paid to the long term or big picture. As a result, overlapping or redundant projects take place and the potential for shared use goes unrecognized. A NYS GIS coordinating body should develop policies to coordinate these data creation activities. The coordinating body should examine the role of various state agencies in the creation of various data sets to determine which agencies should be responsible for particular data layers that have broad applicability (e.g., roads, political boundaries). In order to facilitate the use of these data sets by others, standards for data accuracy should also be determined by a coordinating body.

Adopt standards

In order to facilitate the sharing of digital spatial data and therefore maximize the value of a given data set, a number of different types of standards must be developed and used. For example, standards for metadata must be adopted and followed in order for a data clearinghouse to be effective. The Standards Working Group (SWG) of the FGDC provides guidance and facilitates the coordination activities among seven subcommittees charged with developing standards such as the National Spatial Data Accuracy Standard, Clearinghouse Metadata Profile, Soils Data Transfer Standard, and Standards for Digital Orthoimagery. The subcommittees of the FGDC are each charged with producing standards for data content and data exchange, encouraging data sharing, and organizing data collection to minimize duplication within a specific theme of spatial data.

The development and promotion of such standards is a logical function for a NYS GIS coordinating body. This function should include identification of the types of standards that are needed, the development or adoption of specific standards, and the development of mechanisms and tools to encourage their use. Additionally, a coordinating body for GIS in New York State should determine whether these standards should be mandated and if so, for whom.

Develop policies on data access and data security

A significant barrier to the sharing of spatial data is the lack of policies on data access. The current situation is characterized by inequitable and inconsistent policies across agencies. Access to data and the pricing of data sets has for the most part, been left to individual agency determination. A coordinating body for GIS should formulate and enforce policies to ensure that data dissemination activities are consistent across state and local government. Data access policies must support consistent and fair access to information resources and protect the confidentially of personal records and the security of sensitive information. For example, health-related data must be provided at a level of aggregation that will ensure that individual privacy rights are protected. Information about the location of vital infrastructure components needs to be protected from unauthorized use.

Provide for multi-organizational communication and coordination

Pockets of GIS expertise exist across the State. Varying levels of awareness exist about roles, responsibilities, and activities of the various organizations involved in GIS. While a number of regional coordinating efforts exist across the State, no formal statewide linkage exists to foster communication and coordination of activities. Across local governments in particular many application needs are the same or very similar. In many cases, each local government is 'reinventing the wheel' in system implementation and data conversion activities. These activities are conducted at great cost to the citizens of the State as they represent multiple, disconnected learning curves across levels of government and areas of functionality. More awareness of ongoing and proposed projects would facilitate the formation of partnerships in data and application development. This might be another use for the statewide clearinghouse. A coordinating body might also sponsor a newsletter, conferences, or workshops where GIS activities are described and widely shared.

Sponsor a formal education program

The project identified the need for an active program of education to ensure that the valuable knowledge and expertise present in New York State is fully leveraged. Much of the learning about GIS system and data development has occurred in a vacuum, diminishing opportunities for the formation of a shareable knowledge base. At the local level, in particular, resources and expertise are lacking which would aid effective and efficient system development and use. As standards are developed and adopted to facilitate the sharing of spatial data, related educational programs will be needed to ensure that these standards are adopted and used appropriately. Additionally, as mechanisms and tools are developed to support communication and coordinated activities, a NYS GIS coordinating body should promote increased awareness and use of such tools. The project also identified the need to educate policy makers about the value of GIS for decision making and service delivery.

Develop and support cooperative funding strategies

Cooperative funding strategies to support creation and dissemination of data sets, mechanisms for coordination and communication, and education regarding guidelines and standards should be developed by a NYS GIS coordinating body. It should be possible for agencies to pool their funds to create data sets for their joint use. Some data sets have statewide importance and should be supported with sufficient funding for statewide coverage and management. Throughout the project, participants emphasized the cost of system and data development, data dissemination, and creation of metadata. Some of the most valuable and detailed information is created at the local level where the least resources are available to support these activities. Project participants repeatedly stressed "no unfunded" mandates and indicated that in order for guidelines and standards to be followed, funding must also be put in place.

Act as a formal liaison with the federal government

A GIS coordinating body for New York State should develop a mechanism for identifying the needs and concerns of the State's GIS community as they pertain to federal initiatives, and present a single face to the federal government as it continues to develop policies and guidelines that affect GIS activities both within and across that states. In order for the needs and concerns of the State to be effectively communicated to the federal government, New York must speak with one voice. The federal government is increasingly turning to state GIS coordinating bodies for input and feedback on federal initiatives. Without a coordinating body for GIS, New York State has no effective voice in the development of policies and initiatives that could have a substantial impact on the State.

Provide a contract or proposal review service

A NYS GIS coordinating body should help agencies make system and data acquisition decisions based on informed unbiased judgment. Many organizations new to the field of GIS rely heavily or solely on vendors or consultants for advice on system configuration, hardware and software purchases, and data needs. While vendors are a recognized source of expertise, many agencies want more objective guidance and advice. In response to this need, coordinating bodies in other states have taken on the role of approving or advising on contracts and proposals. These activities are conducted in many cases in an advisory capacity while in some cases coordinating bodies have the authority to approve GIS-related expenditures.

The Prototype New York State Spatial Data Clearinghouse

The NYS Spatial Data Clearinghouse was developed in concert with federal initiatives to facilitate the exchange of spatial data among members of the GIS community. The National Spatial Data Clearinghouse is a virtual and physical repository of clearinghouses operating to increase the value of spatial data through sharing. The Prototype NYS Clearinghouse provides a mechanism for potential users of NYS spatial data to determine whether data sets are available or

under development. This means of improving access and sharing has the potential to lower the cost and greatly increase the use of these data throughout New York. Clearinghouse users may review collections of metadata. Once a data set of interest is identified, information is provided on how to obtain the data files. For some files, an option for immediate on-line transfer of the files using standard file transfer protocol (ftp) is also available. Figure 3 shows the Internet home page for the prototype clearinghouse.

Describing Data Sets with Standard Metadata

Standard metadata is an essential prerequisite to effective information sharing. The Federal Metadata Standard was adopted as the standard for the prototype. Therefore, contributors described their data sets using the FGDC Content Standard for Digital Geospatial Metadata. The FGDC standard specifies what should be contained in a metadata record for spatial data sets. It includes such information as who produced the data, the geographic area covered, the data set category or theme, scale, accuracy information, and instructions for how to obtain the data set. While the FGDC standard may be further refined for New York State, it proved to be adequate in demonstrating the functionality of the GIS prototype. Results from the prototype also demonstrate that the standard could be used as-is in a production environment until further refinement takes place.

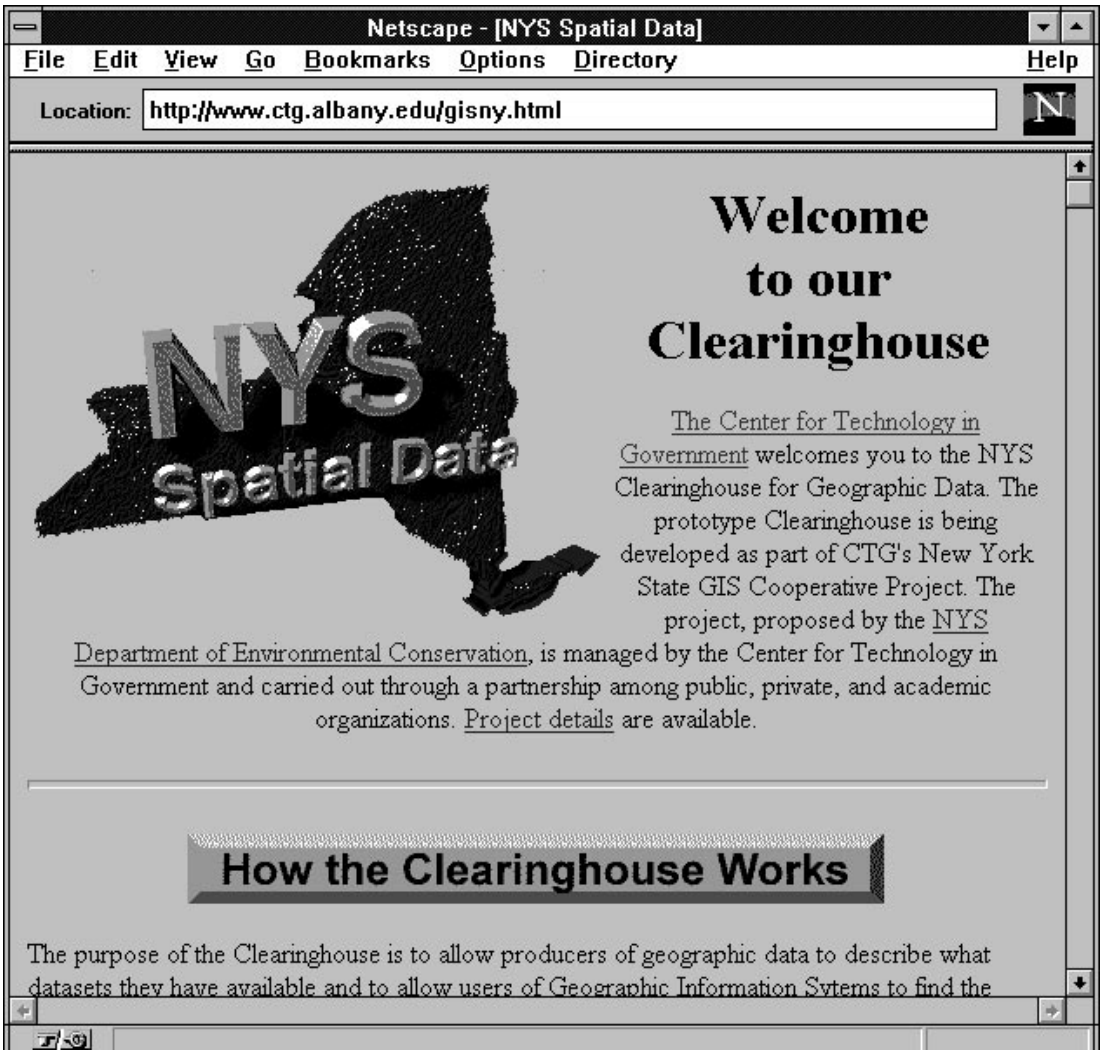
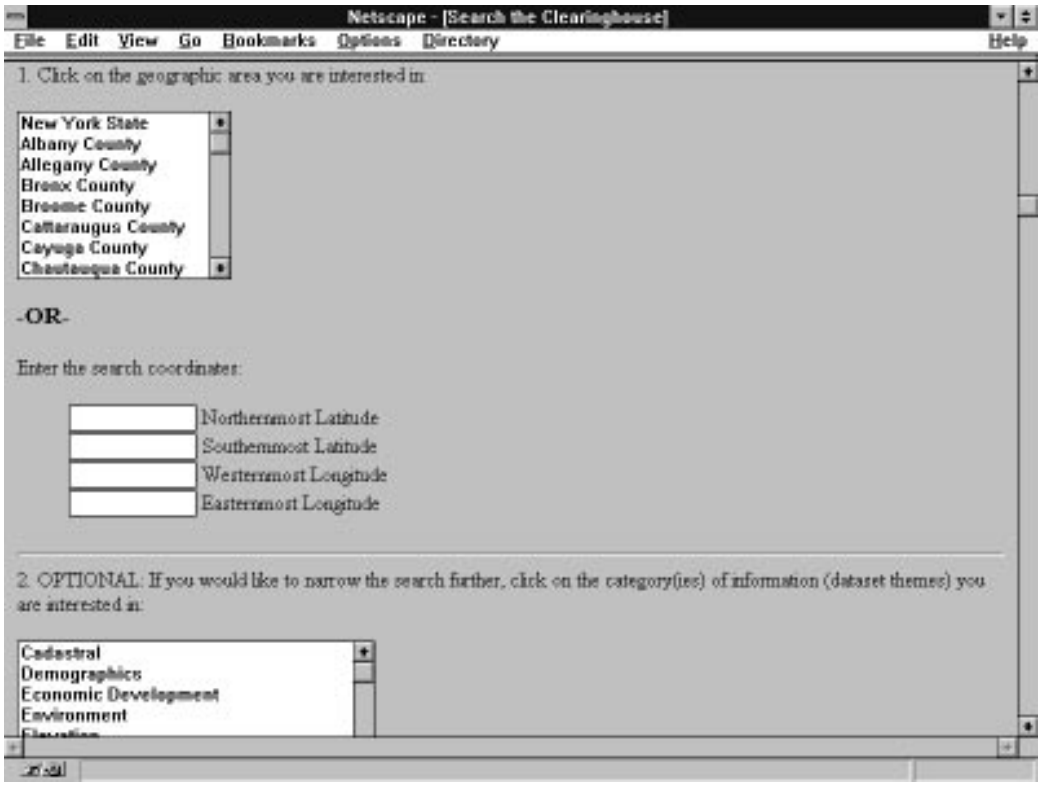


Figure 3 - NYS Spatial Data Clearinghouse Home Page

Search and Retrieval

The Clearinghouse offers two methods for data set identification. The first method is a directory which lists all available data sets, organized by category and distributor. Users can browse through the directory to find the data sets they need. The second method uses a search form (Figure 4) to enter the specific criteria required. The search form is an html forms document which allows users to enter their criteria for locating data sets. Three options are available for searching:

- Geographic Area
- Data set Category or Theme
- General Query



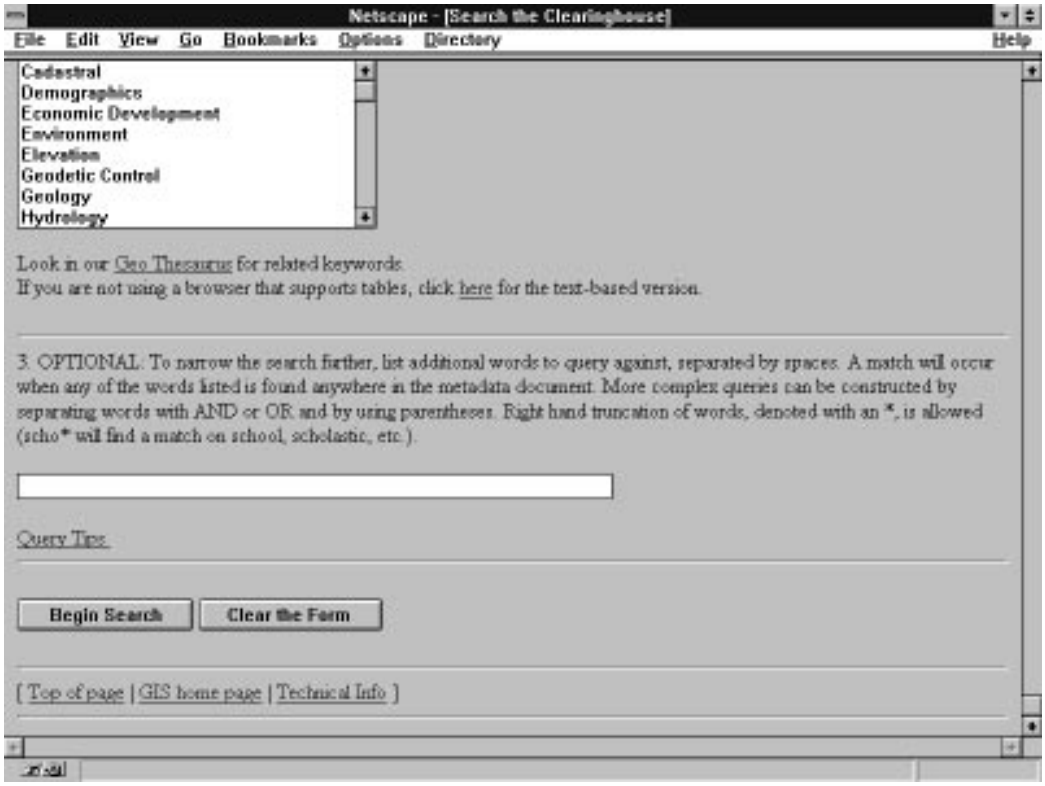


Figure 4 - Search Form

The metadata records are then searched, and those with matching criteria are listed. Both the directory list and the search results list contain links to the full metadata record. When a data set is of interest, the full metadata document can then be reviewed in order to obtain a fuller understanding of its properties. In some cases, the metadata document also contains an image which reflects the geographic region and features that the data set encompasses. The distribution section of the metadata contains instructions for obtaining the data set. Those instructions, supplied by the metadata provider may include on-line file transfers, electronic order forms or instructions for ordering by phone or mail.

The NYS Clearinghouse went on line in August 1995. By late December, about 2,500 visits were made to the Clearinghouse. The Clearinghouse is also included in a number of general Internet directories and search sites such as Lycos and Yahoo.

User reaction has been uniformly positive. Representatives of the Federal Geographic Data Committee Secretariat were particularly complimentary about the search feature. The FGDC created a link to the NYS Clearinghouse under its State and University listings. Response from inside NYS has been equally positive. An on-line survey gathering both general user information and specific feedback on the Clearinghouse was included in the prototype. The survey questions were designed to collect information about users and about their reaction to the Clearinghouse. User questions sought information about each visitor's level of Internet and GIS experience, search methods, and primary interest in visiting the Clearinghouse. Other questions asked how the search form, instructions, and results listings could be improved and what additional information could be included in the Clearinghouse. Few suggestions were made for improvement.

Experience with the Clearinghouse has motivated some new efforts to provide metadata. After attending a demonstration of the Clearinghouse, the Orange County Water Authority provided metadata for six data sets. Orange County Water Authority staff then demonstrated the Clearinghouse to other county officials to build support for providing full access to the County's data resources via a clearinghouse mechanism. As a result, Orange County is implementing a local server connected to the NYS Spatial Data Clearinghouse to provide no-cost on-line access to metadata and spatial data sets. Rockland County is considering a similar program.

Despite, these early successes, much remains to be learned about repository management and about willingness and ability to use a web-based repository to support data sharing. As the prototype Clearinghouse contains only a few dozen metadata descriptions, the full range and volume of use could not be tested. These and other user acceptance and performance issues will need further analysis as the Clearinghouse develops and grows.

Recommendations for Implementation

The prototype Clearinghouse is a central site for storing metadata and some spatial data sets. A centrally managed site can offer savings, but we also believe that data management must remain in the hands of the data owners. Although it may be appropriate for a central site to contain metadata, the data sets themselves do not need to be stored at the same site. The size and

quantity of the data sets may preclude central site storage. Experience with the prototype NYS Spatial Data Clearinghouse yields the following recommendations.

- Fully automate as many aspects of the process as practical including metadata creation, editing, and collection; updating of all Clearinghouse web pages as metadata is added or changed; and data set transfer through the use of ftp and on-line order forms.

- Centralize the home page and technical support for the Clearinghouse. The Clearinghouse application and its technical administration can be managed most efficiently from a single site, avoiding the need for duplicative development and maintenance by multiple organizations. A central site also ensures a uniform presentation of the metadata and provides a principal forum for information exchange.

- Data set owners, who know the data best, should create and manage their own metadata. Metadata creation, update, and deletion needs to be the responsibility of each independent organization. The development of automated tools will make the independent management of metadata possible.

- Organizations should house their own data sets and create their own ftp sites. The metadata can contain a link to the corresponding ftp site so that a simple click of the transfer option initiates the downloading of the file. Because the data location makes no difference to the user, several organizations can work together to form a cooperative ftp site.

The Internet-based Clearinghouse has proven to be a practical tool for fostering cooperation and achieving its benefits. It is being used today with the tools currently available and will almost certainly evolve into a more powerful instrument. Discussions are underway to transfer the Clearinghouse to a state agency, such as the State Library, for permanent operations. The URL for the prototype NYS Spatial Data Clearinghouse is: http://www.ctg.albany.edu/gisny.html

Analysis of the Federal Content Standard for Geospatial Metadata

Metadata, or "information about information" describes the content, quality, condition, and other characteristics of data. Metadata standards enable us to describe data in a common language, locate sources of data, and use data created by others.

In June 1994, the Federal Geographic Data Committee (FGDC) adopted the Federal Content Standards for Digital Geospatial Metadata. The FGDC invited and encouraged others to use the standard to document their spatial data. The purpose of the standard is to provide a common set of terminology and definitions related to these metadata that helps prospective users determine what data exists, the fitness of these data for their applications, and the conditions for accessing

the data. Metadata also aid the transfer of data to other users. The FGDC developed the standard based on the four characteristics that define the role of metadata: availability, fitness for use, access, and transfer. Specifically, the standard defines data elements for the following topics:

- Identification
- Data quality
- Spatial data organization
- Spatial reference information
- Entity and attribute descriptions
- Distribution information
- Metadata reference information

The standard does *not* specify:

- how information is organized in a computer system
- how information is organized in a data transfer
- the means by which this information is transmitted
- the means by this information is communicated to the user

The Federal Standard has received mixed reviews across the country and among the various levels of government. Its complexity has resulted in debate regarding the resources required to create and maintain metadata which conforms to the standard. Questions regarding the complexity of the standard and its applicability at the state and local level have been raised. The effort undertaken in this project was to analyze the adoptability or adaptability of the standard within New York State.

Since standard metadata is critical to the success of a spatial data clearinghouse that supports the exchange of data sets, the prototype NYS Spatial Data Clearinghouse adopted the Federal Metadata Standard as the standard format for data description. One project goal was to assess the usability of the Federal Standard by NYS organizations. This assessment developed into a joint effort with the SARA-funded Erie County Water Authority (ECWA) project which operates in partnership with the National Center for Geographic Information and Analysis at the University at Buffalo. Since metadata evaluation was an objective of both projects, the effort was defined in two phases:

> Phase 1: Within the CTG project, CTG, SARA, ECWA and NCGIA worked with members of the GIS community to develop an analytical process to evaluate the Federal Content Standard and adapt it for use in New York State.
>
> Phase 2: Full application of the metadata development process has become part of the ECWA project and will continue under its direction.

The first phase focused on development of a draft NYS metadata creation guideline tailored to spatial data producers in New York State. Specifically, this effort identified which elements of the full federal standard are useful and necessary and how they should be completed. A small

group of experienced spatial data managers and GIS experts, knowledgeable about the standard, met in a one-day workshop to conduct a category-by-category analysis of the Federal Content Standard. The group determined what information is sufficient to enable a user to assess the suitability of the data sets.

The group limited its review to the citation section of the Federal Content Standard (there are seven categories in the full standard, involving hundreds of data elements). Decisions regarding a data element were accepted by the group when there was full consensus. During the workshop, the group:

- determined and articulated the rules for completing this element of the metadata standard. The rules define the meaning and content of the data element (i.e. what goes in here). This may require expansion of the rules provided in the Federal Content Standard or simply adopting the wording without change.

- identified acceptable thesaurus or thesauri, beyond those required by the Federal standard, that must be used to complete the element in such a way as to make it useful for GIS data users and producers in New York State.

- determined if the guidelines developed by the group satisfied the criteria for usability and understandability in the "real-world." They agreed that the guidelines would be useless if creators of data would find using them onerous or would give rise to more questions than answers regarding the "right way" to complete a data element.

- determined whether the data element was mandatory or optional for New York State purposes.

The workshop was successful in drafting New York State metadata guidelines for the citation section of the Content Standard. As a result, the group agreed to adopt this approach to analyze the rest of the Federal Content Standard and to transition this effort to the ECWA project. Eventually, this effort should produce both a complete Guidebook for using the standard in NYS and a user friendly software tool for developing metadata.

VALUE OF THE NYS GIS COOPERATIVE PROJECT

The New York State GIS Cooperative Project demonstrated the depth and variety of existing human, technical, and data resources in New York State. It showed the extent to which spatial data needs overlap among key policy and applications areas and examined how data sharing strategies can reduce the cost and increase the value of geographic information systems at every level of government and in the private sector. Existing local and regional coordination efforts were identified as were the formal coordination activities of the federal government and other states. The project identified and examined existing barriers to data sharing and coordination and developed specific recommendations for overcoming those barriers. Finally, the project created a new spatial data resource for New York State--the NYS Spatial Data Clearinghouse.

The project offers several important lessons that should help New York State leverage existing resources and build needed linkages.

- Geographic information systems issues and applications represent a convergence of state, local, public, and private interests. Every government agency and nearly every business enterprise has a stake in the development and management of spatial data resources. All New Yorkers will benefit from a comprehensive effort to apply GIS data and technology to common goals of economic development, environmental quality, and community services.

- The information policy, technology, and coordination issues examined in this project are not limited to geographic information systems. They are general, systemic issues that underlie all government operations. The entire information policy framework of state government can be strengthened by the analysis and recommendations that emerged from this project.

- New York State already has a vast array of spatial data, GIS expertise, and localized coordination efforts. The value of these resources could be substantially leveraged by a policy-driven coordination effort.

In addition to these overarching lessons and results, the project had specific value for various participants.

Value to the Department of Environmental Conservation

DEC tested the feasibility of an Internet-based repository for sharing spatial data. Given that DEC currently spends significant time and effort distributing spatial data sets, the investigation of a internet-based repository as a mechanism for distributing spatial data was a key agency goal. The project allowed DEC to investigate the usability of a clearinghouse as a mechanism for data sharing and to assess how well it encourages data interchange.

DEC increased awareness and improved access to its spatial data resources. DEC's goal for the project was to establish a framework for cooperation within the context of a shared information resource. Since spatial data sets are expensive to create and maintain, sharing the costs of creation and maintenance can reduce the cost to any one organization. DEC data has become better known and more readily available for those who want to use spatial data to make decisions.

The project demonstrated how the GIS community can apply concepts like "reduce, reuse, and recycle" to improve data management. DEC wanted to increase the overall level of communication and information sharing among members of the GIS Community. Adopting a well-know phrase from the environmental movement, DEC sought to "reduce, reuse, and recycle" by reducing redundant data creation efforts, re-using existing expensive spatial data sets, and recycling information about spatial data sets and geographic information systems.

DEC acquired knowledge about web site construction and on-line search and retrieval tools. As a partner in the design and development of the NYS Spatial Data Clearinghouse, DEC technical staff acquired first-hand experience in new information technology tools for creating internet sites, authoring world wide web documents, and maintaining an Internet-based data resource.

Value to the State and Local Government GIS User Community

Members of the public sector GIS community at all levels identified barriers and recommended improvements in data sharing and coordination. The expertise and the enthusiasm to support effective coordination of GIS efforts in NYS already exists. This interest is evident in regional coordination efforts, in the annual NYS GIS Conference, and in many other informal partnerships and alliances that have been formed to improve the ability of all participants to use GIS effectively. Project seminars and presentations promoted awareness of related programs at the State Library, State Archives and Records Administration, and the National Center for Geographic Information and Analysis at the University at Buffalo. Each program works to increase awareness of existing resources, to enhance coordination and collaboration, and to improve the ability of the participants to provide new and enhanced services.

The prototype NYS Spatial Data Clearinghouse is a new production-quality information resource for New York State. The prototype NYS Spatial Data Clearinghouse is one of the two state clearinghouses to be formally linked to the National Spatial Data Clearinghouse. It not only provides a vehicle for data sharing, but also demonstrates the use of the Internet as an effective tool for government-wide communication.

Members of the public sector GIS community initiated an ongoing user-oriented analysis of the Federal Content Standard for Digital Geospatial Metadata. Standard metadata is an

essential prerequisite to effective information sharing. It provides a common language for thoroughly describing data that may be of value to many different users. This part of the project involved an analysis of the underlying data model as well as an analysis of the metadata standard itself. This process heightened awareness of the standard and enhanced understanding of the value of metadata in a shared data environment. A structured process for continued analysis of the standard was developed and will be continued by project partners in Erie County and the University at Buffalo.

The project heightened awareness of existing coordination efforts and exemplary GIS applications. Through formal presentations, case studies, and regional meetings, the project highlighted a number of exemplary public sector GIS applications. These activities served to heighten awareness of existing coordination efforts in NYS which have resulted in complex, but highly successful GIS applications, such as in the State Emergency Management Office. The project helped inform the GIS community about coordination efforts in other states.

Several objectives of the Temporary GIS Council were directly addressed: demonstrating the value of GIS, assessing the need for a formal coordinating body, and providing for broad public participation. The Council is responsible for analyzing the value and application of GIS in NYS and for making recommendations to the Governor and the Legislature regarding future coordination efforts. The CTG project provided significant opportunities for members of the public, private, and nonprofit sectors to participate in project activities. Information valuable to the Council has been gathered through literature reviews, interviews, regional data collection efforts, and case study documentation.

Value to the Nonprofit and Private Sectors

Private and nonprofit organizations had a direct voice in issues identification, analysis, and recommendations. The project provided opportunity for not-for-profit organizations and the private sector to work with public sector colleagues to increase the ability of all members of the GIS community to share the costs and benefits of spatial data and geographic information systems. Additionally, the project provided these groups with an opportunity to help propose an action agenda for a future NYS Coordinating Body.

Value to the Federal Government

The project furthered the goals of the National Spatial Data Infrastructure. New York State is now a part of the NSDI, as a result of the creation of the NYS Spatial Data Clearinghouse. The project also increased awareness in New York State of the NSDI initiative and increased awareness, understanding, and use of the Federal Content Standard for Metadata.

Value to The University Community

CTG gained valuable experience in managing a project with government-wide, rather than agency-specific, goals. The primary value to CTG staff, faculty, and students was the experience gained in conducting a project focused on a strategic statewide problem. The level of coordination and the complexities of project management required in all aspects of this project activities were notably different from projects which focus on the needs of a single agency. CTG gained valuable experience which should be useful in future projects that have interagency, intergovernmental, or statewide goals.

Significant technical experience was gained in the area of web site construction and of the use of the various approaches to on-line search mechanisms. This led to many connections with the "Web Community" engaged in the design and development of web tools to support the NSDC and clearinghouse efforts such as the NYS Spatial Data Clearinghouse. The project team gained further experience in geographic information systems, and issues associated with spatial data and the need for coordination and information sharing.

An agenda for future information science research has emerged. The project raised several important topics for future university-based research: cost-benefit methodologies for GIS, records management issues associated with a shared data repository, effectiveness measures of clearinghouse services, inter-organizational information sharing, and standards development.

Value to Corporate Partners

Ten corporate partners contributed to the success of the NYS GIS Cooperative Project. Each provided unique and valuable resources to address the three overall objectives of the project. The project was the first at CTG to offer corporate partners the opportunity to participate in an intergovernmental effort involving all levels of government in cooperation toward a common goal.

National and international exposure
The web-based prototype NYS Spatial Data Clearinghouse contains a section listing each of the project's corporate partners and gives information about their respective contributions. Through the Internet, corporate partners received extensive exposure within New York State, the US, and the world.

Opportunity to understand and apply Internet concepts and tools to support the spatial data sharing needs of the GIS community. Applied GIS, Inc. had the opportunity to work together with the CTG and DEC in designing an internet-based tool to support the spatial data sharing needs of the GIS Community. The project provided the opportunity for other partners

apply and test their tools and expertise in the creation of the Clearinghouse. Additionally, it provided opportunity for the corporate partners, some for the first time, to work on a project directed at using the Internet as a mechanism for sharing information.

Opportunity to work on an application with government-wide appeal. The NYS GIS Cooperative project provided the opportunity for corporate partners to work on a project which involved all levels of government as well as many representatives from the private sector. The GIS Community was enthusiastic about the project and committed to the project activities. Corporate partners were able to gain insight into the various concerns and needs of the participating government entities. Additionally, they gained firsthand experience with those issues related to interagency coordination and communication. This knowledge will enable corporate partners to more effectively respond to their customers' needs.

APPENDICES

Appendix A - Project Timeline

December 1994	Project Definition and Partner Identification First Meeting with Agency Members of the NYS Temporary GIS Council
January 1995	"Kickoff" Project Meeting Tour Department of Environmental Conservation GIS Unit
March 1995	Partnership Building with Erie County Water Authority and SARA First Prototype Version of Clearinghouse Released for Staff Evaluation
April 1995	Presentations to Potential Corporate Partners.
May 1995	Project Research Design and Community Event Planning Partnership Building with NYS Library
June 1995	Community Event in NYC- GISMO meeting Presentation to Multi-County GIS Cooperative at GIS-SIG Presentation to Tri-County GIS User Group meeting Presentation to Capital Region ArcInfo User Group (CAPARC) Released Refined Clearinghouse to Working Group for Evaluation
July 1995	Metadata Analysis Workshop
August 1995	Facilitated Data Collection Meetings in NYC, Albany, and Buffalo Released Clearinghouse to Public
September 1995	First Temporary GIS Council Meeting Presentations at the Government Technology Conference (GTC)
October 1995	Presentation at 11th New York State GIS Conference Public Demonstration of Project Results
December 1995	Presentation to Temporary GIS Council Final Project Report

Appendix B - Project Participants

NYS Department of Environmental Conservation
Lawrence Alber, Manager, GIS Unit
Thomas Donovan, Director, Division of Information Systems and Management Planning

NYS Forum for Information Resource Management
Terrence Maxwell, Ph.D., Executive Director
Meghan Kiernan, Graduate Intern

Erie County Water Authority
Paul Becker, Distribution Engineer
Philip Cook, Ph.D., Administrative Director

University at Buffalo, National Center for Geographic Information Analysis (NCGIA)
Hugh Calkins, Ph.D., Director

Center for Technology Government
Anthony Cresswell, Ph.D., Faculty Fellow, School of Education
Sharon Dawes, Ph.D., Director
Ann DiCaterino, Manager, Project Support
Sally Goodall, Administrative Assistant
Winsome Hérard, Assistant Project Coordinator
Fazal Ilahi, Graduate Assistant, Department of Computer Science
Kristine Kelly, Research Associate
Anne Miller, Graduate Assistant, Department of Geography and Planning
Theresa Pardo, Project Coordinator

Division of Budget
Paul Fisk, Deputy Chief, Technology Management Unit
Michele Lachiusa, Senior Examiner

State Archives and Records Administration

Thomas Ruller, Archivist III
Junlei Zhang, Senior Public Records Management Specialist
Daniel Lorello, Archivist III
Elizabeth Maio, Senior Public Records Management Specialist
Stanley Schwartz, Local Government & Technology Services Program

Corporate Partners

Applied GIS, Inc.
Aule-Tek, Inc.
Blue Moon Training Systems
Digital Equipment Corporation
Documentation Strategies, Inc.
Full Circle Communications
Harlan Wallach Graphic Arts
Sun Microsystems Computer
Xyplex

Appendix C - NYS Spatial Data Clearinghouse Technical Information

Environment

The NYS Spatial Data Clearinghouse exists as part of a larger spatial data clearinghouse environment. The National Spatial Data Clearinghouse (NSDC), an initiative of the Federal Geographic Data Committee, is a network of virtual and physical repositories of spatial data available over the Internet. The url for the FGDC home page is http://fgdc.er.usgs.gov/

Hardware

The Clearinghouse was implemented within CTG on a DEC station 5000 running Ultrix 4.2, with 1 gigabyte of storage and 128 megabytes of memory.

Contents

Forty-nine spatial data sets are described in the Clearinghouse with metadata which conforms to the Federal Standard for Digital Geospatial Metadata.

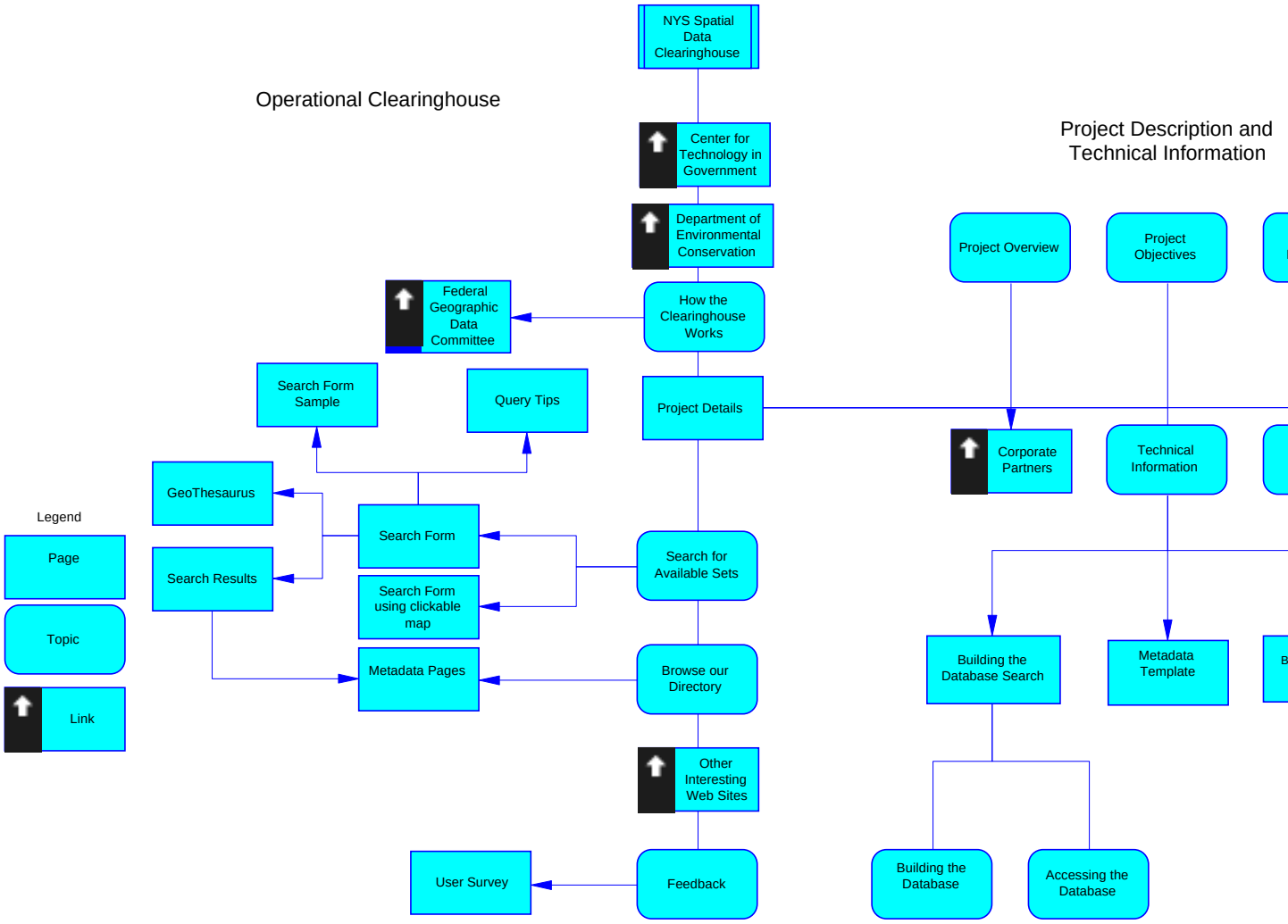
The Federal Metadata Standard was adopted as the standard for the Clearinghouse. Organizations interested in submitting data were provided with a packet containing information about the standard and a template of the standard on disk with embedded html code. The template was provided to support the collection of the metadata. In addition to providing metadata some users provided both the data set and an image of the area represented by the data set.

Structure

The following figure represents the structure of the Prototype Clearinghouse.

NYS Spatial Data Clearinghouse

Information Structure



Implementation

The NYS Spatial Data Clearinghouse contains a wealth of technical information about how the Clearinghouse was constructed and the technical tools that were used. To access this information, go to the Clearinghouse at http://www.ctg.albany.edu/gisny.html

In the first paragraph, click on “Project details”
In the next screen, click on “Technical Information”

This will give you access to three documents, each of which has many links to more detailed information:

- How we built the database search using free Wais-sf and a Common Gateway Interface
- Metadata Template
- Boolean Searching in WAIS

Appendix D - Related Products

NYS Department of Environmental Conservation, *Development of a NY Geographic Information System Cooperative*, CTG.GIS-001, May 1994.

DiCaterino, Ann. *NYS Prototype Spatial Data Clearinghouse*, CTG.GIS-003, December 1995.

Kelly, Kristine. *Compelling Reasons for GIS Coordination in NYS*, CTG.GIS-004, December 1995.

Kelly, Kristine. *A Framework for Evaluating Public Sector Geographic Information Systems*, CTG.GIS-005, December 1995.

Appendix E - Annotated Bibliography

Arkansas Mapping and Land Records Modernization Advisory Board. (1994). *Mapping and land records modernization strategies for Arkansas.* Little Rock, AR: author.

This document presents both an overview of the land records and mapping activities in the state of Arkansas and recommendations to the Governor on mechanisms to coordinate and maximize the benefits of these activities. The recommendations include the establishment of a Land Information Advisory Board, the establishment of an Office of Land Information Technical Support, the completion of a statewide basemap, the development of a digital map clearinghouse and archive, and the funding of these activities through general revenue. The document outlines the potential economic development impacts of land records modernization and further presents the expected benefits of the recommendations in terms of a reduction in the cost of data development, a reduction in "time to product," and costs for studies and analyses.

Brudney, J.L. & Brown, M.M. (1992, Spring). Do geographic information systems meet public manager's expectations? *State and Local Government Review*, 84-90.

The authors indicate that while substantial investments have been made in GIS at all levels of government, little empirical research has been conducted to assess the costs and benefits of these investments. An overview of GIS is provided as well as a description of three types of GIS benefits: improved performance and efficiency, enhanced decision-making, and strengthening service to the public. Obstacles to achieving these GIS benefits are also presented. The authors evaluate the impacts of technology on a sample of 17 departments in seven Florida counties and find that the managers of the responding departments felt that the technology has assisted in attaining the goals for which the system was developed. According to the analysis, most of the departments indicated they realized gains in performance, decision making, and service to the public. Only moderate improvements were noted in efficiency although it was noted that these improvements were not as highly anticipated.

Budic, Z.B. (1994). Effectiveness of geographic information systems in local planning. *Journal of the American Planning Association,* **60** (2), 244-263.

The author identifies the need to analyze the impact of GIS activities on local government planning activities. A review of the literature on factors related to GIS effectiveness is presented. Rather than focusing primarily on efficiency improvements of GIS implementation, the author examines the effectiveness of GIS in terms of improvements in the quality and quantity of planning-related data (operational effectiveness) and facilitation-related decision making (decision-making effectiveness). Using survey data from 22 local government planning offices from four southeastern states, the factors related to GIS effectiveness are correlated with four indicators of operational effectiveness and four indicators of decision-making effectiveness as perceived by the respondents.

Dawes, Sharon S. Interagency information sharing: Expected benefits, manageable risks. *Journal of Public Policy and Managment*, forthcoming Summer 1996.

The sharing of program information among government agencies can help achieve important public benefits: increased productivity, improved policy-making, and integrated public services. However, information sharing is often limited by technical, organizational, and political barriers. This study of the attitudes and opinions of state government managers showed that more than eight in ten judge information sharing to be moderately to highly beneficial. It also revealed specific concerns about the inherent professional, programmatic, and organizational risks. The study proposes a theoretical model for understanding how policy, practice, and attitudes interact and suggests two policy principles, stewarship and usefulness, to promote the benefits and mitigate the risks of sharing.

Dickinson, H.J. & Calkins, H.W. (1990). The economic evaluation of implementing a GIS. *International Journal of Geographic Information Systems*, **2**, 307-327.

Dickinson, H.J. & Calkins, H.W. (1990). Comment on 'Concerning the economic evaluation of implementing a GIS'. *International Journal of Geographic Information Systems*, **4**, 211-212.

Wilcox, D.L. (1990). Concerning 'The economic evaluation of implementing a GIS'. *International Journal of Geographic Information Systems*, **4**, 203-210.

Implementation of geographic information systems (GIS) involves a substantial commitment of resources by the sponsoring agency. Economic evaluation of a proposed GIS is an important step in the implementation process. These articles discuss traditional benefit cost analysis and its applicability to the evaluation of geographic information system implementations. The first article outlines some of the difficulties in performing benefit cost analysis for GIS applications. In particular, difficulties in assessing the benefit side of the equation are noted and alternative approaches are suggested. Wilcox disputes several of the points in the Dickinson and Calkins article including the definition of "supply" of GIS products and the notion that many GIS products are intangible and indicates several traditional economic mechanisms which could be used to quantify these benefits. Wilcox also indicates that benefit cost analysis can be used to evaluate and compare different system options. The third article is a response to some of the comments presented in the Wilcox article. Dickinson and Calkins indicate that the derivation of aggregate supply and demand curves for GIS products is difficult because the system products may be very different from one another and from those products generated by the manual system. Further, the authors indicate that additional research is necessary in order to establish a dollar-based value for those products that a system will provide.

Drummond, W.J. (1995). GIS is a visualization tool for economic development. *Computer Environment, and Urban Systems*. **17**(6), 469-479.

GIS technology is now being applied to the economic development process at local, regional, and state levels of government. Most of the existing systems have utilized the analytical capabilities of GIS to locate suitable sites for various types of development. A computer system recently developed by Georgia Tech and Georgia Power uses GIS technology in a new way: as an interactive-visualization and decision-support tool designed to directly support business location decision-makers. The development of such presentation systems, along with the more traditional analytical systems, raises important policy implications of concept transferability, appropriate organizational structures, and the potential savings to be achieved by the rational targeting of future infrastructure finance.

Granger, K. (1995). Dimensions of vulnerability: The human aspects of disaster. *Urban and Regional Information System Association Proceedings,* **1**, 238-248.

This paper explores the incorporation of physical, social, cultural, demographic and organizational characteristics of a community in the assessment of vulnerability to disasters. The author defines vulnerability and vulnerability surfaces such as the people of the community and their characteristics and the built environment. Hazard surfaces, the more commonly considered factor in vulnerability assessment, are also discussed and the importance of secondary hazards is stressed. GIS is discussed as a valuable tool for aggregating the diverse data types necessary to support comprehensive vulnerability analysis.

Griffith, D.A., DeGloria, S. & Harrington, L.(1994). Characterizing geographic information and analysis needs in New York State An overview and assessment. *Cartography and Geographic Information Systems,* **21**(2), 69-80.

The authors summarize the findings of a project conducted in New York State to inventory and describe GIS activities, identify mechanisms for accessing and linking information, develop a research and education agenda to address environmental and economic development concerns, and explore the potential benefits of statewide coordination. The paper identifies those agencies within the State utilizing the technology. Results from the Minnowbrook Conference are also presented. The following linking and integration mechanisms were found to be of major concern to the conference participants: Adoption of spatial data standards, central clearinghouse for existing data sets, use of uniform parcel-based format, directory of data sources, and cooperative data base development. Little agreement was found among the participants with respect to a statewide coordinating structure although two issues, performing networking functions and establishing an advisory council were consistently ranked the highest across all sectors. Results are also presented for research and educational needs.

Healy, D. (1994). National States Geographic Information Committee. (1994). *Survey of state GIS coordination bodies summary results and recommendations*. Calais, Vermont: Visual DATA,. Inc.

This report provides a comprehensive overview of state GIS coordinating efforts in the nation. Aggregate data on coordinating body budgets, structures, critical success factors, and barriers to success are included. Information is provided on individual state coordinating bodies such as funding mechanisms, frequency of meetings, enabling legislation, and allocation of time spent on various issues.

Joint Nordic Project. (1989). *Community benefit of digital spatial information final report and recommendations.* Helsinki, Finland: Division of the National Board of Survey, Finland.

This report presents the findings of the Joint Nordic project, an analysis of the public benefit of the use of geographic information systems. The paper explores the economics of digital mapping and models for the calculation of cost-benefit effects of the technology. Strategies for successful implementation of GIS technology are presented. Additionally, the authors argue that maximum benefit will result from those implementations which are coordinated across different activities.

Lang, L. (1994, July) South Carolina win corporate investments. *Government Technology,* **7**(7).

The collection of data, including geographic spatial data, is part of the economic development process that South Carolina uses to recruit companies and promote the state as a good place to do business. The South Carolina Infrastructure/Economic Development Project (SCIP) includes a four-member GIS group that provides technical and logistical support for production of recruitment documents.

Levy, J. M. (1990, Spring). What local economic developers actually do: location quotients versus press releases. *Journal of the American Planing Association,* **56**(1-4), 153-160.

The article reports on a survey of local economic development agency directors indicating that "sales" activities are more important and more time-consuming than "rational" (that is, planning and strategy) activities. The article argues that working to improve the market for sites and new structures, local economic developers contribute to overall aggregate economic performance.

Lopez, X. (1995). From gravel to diamonds: The national spatial data infrastructure at a crossroads. *Urban and Regional Information System Association Proceedings*, 611-625.

This paper discusses the advantages and disadvantages of three state and local public information dissemination models--cost recovery, public-private partnerships, and open access. The winners and losers for each of the three models are indicated and the barriers to public access to information are noted. The relationship between the various models and their predicted long-term impacts on the development of a national spatial data infrastructure are discussed. The author suggests that state and local government policies which promote open access to data are key to the success of the national spatial data infrastructure.

Millar, S.L. (1995, Winter). Establishment of a geographic information system in a county economic development office. *Economic Development Review*, 76-82.

This paper presents the need for improved handling of and access to information from both government and industry perspectives. Geographic information systems are discussed as effective tools for meeting this demand. The paper presents the analytical and mapping or presentation capabilities of geographic information systems and the potential for use in economic development activities. The authors also present survey results indicating that many county and urban municipalities are using GIS. An actual implementation of a GIS in a local economic development office in Catawba County, North Carolina is described as are the specific implementation steps. The importance of coordination with other government entities is emphasized.

New York State Department of Economic Development. (1994). *Economic review of New York State*. Albany, NY: author.

This document provides an overview New York State's economy and job performance as compared to the rest of the nation. Trends in the State's major economic sectors are presented in graphical and text formats. Regional statistics and trends are discussed. Factors related to economic growth such as the tax rate, regulatory environment, labor force changes, and technological innovation are also presented.

New York State Forum for Information Resource Management. (1994).*Geographic information systems: issues, activities and resources*. A briefing paper. Albany, NY: author.

This document summarizes GIS activity in New York State including the role of the New York State Temporary GIS Council and other State and local government initiatives. National initiatives such as the Spatial Data Transfer Standard and Digital Geospatial Metadata Standard are also discussed as are GIS coordination efforts in other states.

Public Policy Institute. (1995). What high taxes have done to New York and what we stand to gain if we cut state spending and taxes. Albany, NY: author.

This document explores the burden on the state of high taxes and the relationship between high taxes and job growth. Job growth in the state is presented and compared with that of other states by business sector. The various tax rates for the state are also indicated and compared to those of other states. The authors argue that a decrease in spending and taxes will result in an increase in new job opportunities in the State.

Public Technology, Inc. (1991). The local government guide to geographic information systems: planning and implementation. Washington, D.C.: author.

The authors present an overview of local government GIS including potential application areas, system objectives, and a mechanism for cost justification of system

implementation. Policy, technology, and management issues in planning and implementation are discussed. Future trends in GIS are also presented.

Smith, D.A. and Tomlinson, R.F. (1992). Assessing costs and benefits of geographical information systems: Methodological and implementation issues. *International Journal of Geographic Information Systems*, **6**(3), 247-256.

This paper builds upon previous development of methodologies for evaluating implementations of geographical information systems (GIS). The approach places emphasis on the measurement of benefits, using as the key elements the careful description and measurement of information products by users and potential users of the products. This approach is then utilized to evaluate an application in the City of Ottawa. Estimates are made of both costs and benefits for the period 1990-2000. The authors conclude from the analysis that GIS would be an attractive investment. They add that the estimates of benefits are conservative and do not include external benefits.

Thapa, K., & Bossler, J. (1992, June). Accuracy of spatial data used in geographic information systems. *Photogrammetric Engineering and Remote Sensing.* **58(6)**, 835-841.

Geographic Information Systems (GIS) are concerned with the collection, management, display, and analysis of spatial data. In order to utilize GIS, one needs to have appropriate hardware, software, and trained personnel. However, the cost of this portion of an automation project is small compared to that of data collection, which is very expensive. Moreover, the accuracy and quality of data required for different applications is not usually homogeneous. In this paper, a comprehensive outline of the different types of errors encountered in the process of data collection is presented. An overview of different errors encountered in the "primary and secondary" methods of data collection is explained. In addition, a brief summary of different standards and specifications used in the primary methods of data collection is provided. Finally, a comparison between the primary and the secondary methods of data collection is made. [Author abstract]

Tosta, N. (1994). *Continuing evolution of the National Spatial Data Infrastructure.* Washington, DC: Federal Geographic Data Committee.

The author, the staff director of the Federal Geographic Data Committee, presents the history, the rationale and the need for a National Spatial Data Infrastructure (NSDI). The benefits and necessity of standards are addressed as is the effort to establish a national geospatial data clearinghouse. The ability of various stakeholders to collaborate on data collection and the issues inherent in joint ownership of information are covered in the report as well.

Warnecke, L. (1995). Geographic information/GIS institutionalization in the 50 states: Users and coordinators. National Center for Geographic Information and Analysis (Technical Report 95-11) Syracuse, NY: National Center for Geographic Information and Analysis.

This document examines the use and institutionalization of geographic information systems in the 50 states. This concept is discussed in the context of the devolution of federal authority and an increase in the authority of states and local government in areas of public policy. The organizational structure of each state's executive branch is provided and the location of GIS coordination within that structure is noted. The document also provides a synthesized analysis which categorizes each state's GIS users according to a classification of state government functions and further provides information on the incidence, authorization, and administrative location of statewide GIS coordinators.

Worrall, L. (1994). Justifying investment in GIS: A local government perspective. *International Journal of Geographic Information Systems*, **8**(6), 545-565.

Justifying GIS in local government is a complex task for two main reasons: first, a GIS implementation can range from a single, well-defined application in one department to a corporate multi-purpose GIS; and second, local authorities are complex organizations currently facing major pressures for change, and considerable uncertainty about their future structure and role. This paper explores the potential for use of benefit-cost analysis in evaluating GIS and outlines the different types of costs and benefits attributable to GIS implementations. The authors also explore mechanisms that will serve to maximize the benefits of system implementation. A review of articles exploring the cost-justification of GIS is also presented.

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