Enterprise GIS in Health and Social Service Agencies

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An ESRI White Paper

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Enterprise GIS in Health and Social Service Agencies

1.0 Introduction

1.1 A Paper to Assist Agencies Planning for Enterprise GIS

This white paper is intended to assist decision makers in health and social service agencies by providing (1) a definition of geographic information system (GIS) and enterprise GIS and the benefits and issues of GIS in the health and social service arena and (2) a description of the planning process needed to establish enterprise GIS in a given organization.

1.2 Structure

This paper is composed of four parts. The first part is this Introduction. It describes the purpose and structure of this paper and defines terminology used throughout the paper. The second section describes GIS and the enterprise model in terms of health and social service applications. The third section gives a general overview of a planning process to create an enterprise GIS in an organization. The fourth section describes costs of enterprise GIS and the planning process.

1.3 Terms and Abbreviations

Automate Automate means to convert data to a digital format that can be displayed on a computer as a map. This can be accomplished through geocoding address information, digitizing, scanning, reading coordinate information from text files, or from direct keyboard input.

Geocode The process of identifying the coordinates of a location given its address. For example, an address can be matched against a TIGER (census) street network to determine the location of a home.

Feature A feature is the representation of a geographic feature that has both a spatial representation (referred to as a "shape") and a set of attributes. Features can be represented as points, lines, polygons, or grids.

Spatial Modeling Analytical procedures applied with GIS. There are three categories of spatial modeling functions that can be applied to geographic features within a GIS: (1) geometric models, such as calculating the Euclidean distance between features, generating buffers, calculating areas and perimeters, and so on; (2) coincidence models such as *topological overlay;* and (3) adjacency models such as pathfinding, redistricting, and allocation. All three model categories support operations on spatial data such as points, lines, polygons, and grids.

2.0 GIS and the Enterprise Model

2.1 Case Study

A state health and social service agency is interested in investigating the feasibility of establishing a GIS. There are some existing GIS users in the health division's environmental epidemiology section, mapping with water quality and air quality information, and working with cancer registry data. They have been frustrated because of the time they must spend preparing data to use and the poor quality of data they have to automate. The health division is also setting up an online data warehouse allowing access to aggregated birth records to the public and county health departments and is interested in adding a map component. Existing legacy systems (such as data warehouses and data marts) at the division include vital statistics, cancer registry, and reported communicable diseases, and WIC nutrition programs.

Health Services
– CON
– Licensure
– Inspections
– Data Publishing

The health division is also responsible for a Certificate of Need (CON) process, inspecting, tracking, and permitting changes in ambulatory surgery centers, hospitals, group homes for the mentally ill and developmentally disabled, homes for adults, and nursing homes. This involves review of blue lines and site visits by architects/inspectors. The Certificate of Need area has been criticized for being antidevelopment because of the time it takes to get approval and the many changes that must be made to drawings. The CON area would like to investigate automating some of their procedures since they have received many requests for lists and maps of different types of facilities from different local jurisdictions. The health division also has a mandate to support the county health departments that are responsible for animal control, administration and tracking of vaccinations, administration of the WIC program, wellhead inspection and capping, lead poisoning prevention, communicable disease surveillance, and licensing and inspection of restaurants and hotels.

Social Services
– Access
– Managed Care
– Economic Development

The Social Services Division has been coping with the advent of welfare reform and Medicaid Managed Care. The Medicaid Managed Care Division is interested in measuring capacity and access to care for entire HMO health provider networks. They want to gather and maintain statistics on access to understand how it impacts public health and HMO organizational issues, and they want to be able to offer incentives to HMOs with the most capacity and access. The Office of Workfare wants to be able to route income support recipients to nearby child care, employment, health providers, and education facilities. The Child Care Section is responsible for licensing and inspection of day care centers and HeadStart programs. There is an interest in providing incentives to site more day care centers, and they would like to target these incentives to areas with a strong current and future need for day care. Existing legacy systems in the Social Services Division include Medicaid/Income Support, Child Support Enforcement, and Child Protective Services. The agency also desires to provide Internet access to its clients and the public at large.

GIS technology can help this organization map air pollution, associate air pollution with medicaid asthma cases, show excess hospitalizations for asthma, and compute how far from a primary care physician the asthma cases actually lived. GIS can help caseworkers tell eligible families the four day care centers nearest to their houses, can tell the child

care section which areas in which counties have the strongest need for additional day care, and can establish optimum routes for day care center inspectors.

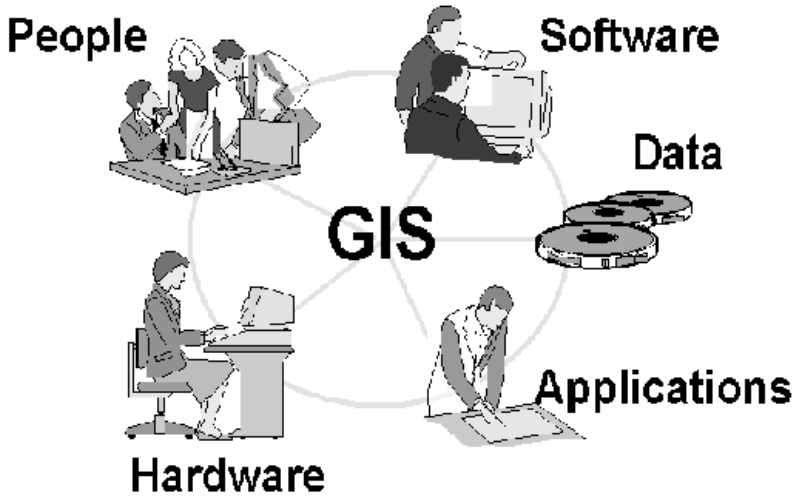
2.2 What Is GIS?

A geographic information system is a computer-based tool for mapping and analyzing things that exist and events that happen on earth. GIS technology integrates common database operations, such as query and statistical analysis, with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to organizations for explaining events, predicting outcomes, and planning strategies. The major challenges we face in the world today—economic development, program outcome evaluation, ensuring access to services—have a geographic component.

GIS is a powerful tool for examining population-level effects of services as reflected in geographical and spatial distribution of populations. Mapmaking and geographic analysis are not new, but a GIS performs these tasks better and faster than do the old manual methods. And, before GIS technology, only a few people had the skills necessary to use geographic information to help with decision making and problem solving.

Data Integration—DBMS

Many people associate specialized software and powerful computers with the idea of geographic information systems. GIS actually has five equally important components: people, hardware, software, data, and applications. GIS technology is of limited value without the people who manage and use the system, ranging from technical specialists to spatial analysts to casual users. Possibly the most important and costly component of a GIS is the data. Geographic data and related tabular data can be collected in-house or purchased from a commercial data provider. A GIS will integrate spatial data with other data resources and can also use a database management system (DBMS), used by most organizations to organize and maintain their data, to manage spatial data. A successful GIS operates according to the data needs, models, and operating practices unique to each organization. Applications are designed to enhance and automate everyday procedures or to produce informative statistics on the state of public health or the results of a given program.



2.3 Public Health and Social Service Agency Functions

Public health organizations operate on vast bodies of data. Access to accurate and timely information is critical to their ability to carry out their core functions. On a daily basis public health departments are required to make accurate assessments of the public's health and safety, develop health policy and plans, and provide assurances to the public they serve.

Public Health

Delivering on the core public health functions requires building and maintaining mission-critical databases that are rich in content. Effectively assessing this data also requires powerful analytical software tools. For example, public health departments collect data on a daily basis and make judgments and assessments about the following:

- Air and water quality
- Safety of hazardous wastes and toxic materials
- Sanitary conditions of food handlers
- Licensing of health providers
- Safety of radiological equipment
- Public access to health services
- Vital events such as births, deaths, and immunizations
- Community health status
- Readiness to respond to natural and man-made disasters

Social Services

Social service agencies may or may not be combined with public health agencies. Social service agencies follow the same core mission as public health agencies—to protect and enhance public welfare. Social service agencies most often serve the most vulnerable part of the population: children and those lacking means. Social service agencies protect children from neglect and harm, provide public medical insurance to those eligible, ensure dependents receive child support from noncustodial parents, and help fund daytime child care for parents who might otherwise have to choose between poverty and work. With the advent of welfare reform, social service agencies have also become job training and economic development agencies, seeking to foster independence in clients as well as provide services.

To manage their functions, social service agencies maintain large amounts of data on

- Medicaid recipients
- Allegations of child abuse
- Certified foster parents
- Medicaid-funded health encounters
- Custodial parents receiving child support
- County welfare-to-work plans and policies
- Venues accepting food stamps

Health and Human Services

Health and social service agencies use similar types of data and report them in similar ways. Data in health and social service agencies focuses on people (clients, cases), providers (doctors, therapists), and facilities (clinics, day care centers). Each of these types of data has an address and therefore can be analyzed spatially. Health and social service organizations provide services to populations within a geographic area. These service areas are usually defined, for example, by county, physical geography, or municipal boundaries.

2.4 Data Integration—The Enterprise Solution

Many units of a public health or social services department depend on geographic information to create tables that report service use by county, associate applicant names with school districts, examine patterns of foster care placement by distance from family origin, and create inspection districts for child day care. Changes in the welfare system from income support to workforce development have increased the need for geographic information relating to the availability of employment, child care, and adult education.

GIS provides the ability to view and analyze geographic data in a spatial context. GIS does more than create maps; it can also associate clients with nearest service providers, locate underserved areas, and measure access to care across a county, just to name a few of the possible applications.

Community Resource Directories

GIS is a tool for integrating and sharing data. GIS may already exist in a public health or social service department and generally has been used at the project level to analyze individual programs for occasional reports. Small samples of large data sets are used and may be stored on individual PCs.

Underserved Populations

The data is not available for use for other projects or departments, or if it is, it is not complete. For example, births may have been recorded, but the information was not available for immunization programs or well-baby care programs.

Enterprise Databases

An enterprise, or organizational GIS implementation can reduce or eliminate the duplication of effort across an organization. An enterprise database can leverage an organization's investment in departmental data by spatially enabling the data and making it an agency- or organization-wide data resource.

Data Layers

All internal data layers can be centrally stored and served across a network. Many data layers such as census, roads, county boundaries, and hydrology are available from public agencies and can also be shared across the network. Data are far more valuable when it can be integrated and used in the decision making process across the whole organization rather than individual departments.

2.5 Enhancing the Way Health and Social Service Agencies Do Business

An enterprise GIS is a new way of thinking about the way of doing business within a public health or social service organization.

Customer Service—Provides accurate and timely information showing where services are located and how to get there. Internet and GIS capabilities allow organizations to publish site-specific information, travel directions, and maps based on where the customer is located.

Service Scheduling—Provides efficient scheduling of home health care and caseworker visits. By analyzing transportation factors and street patterns, GIS can recommend the most efficient route to and between client homes.

Epidemiology—Provides disease occurrence and trend information. Understanding the determinants of disease and its spread from person to person and community to community has become increasingly global. GIS provides a powerful analysis tool to present spatial information (individual occurrences) and conduct predictive modeling.

Site Selection—Identifies a new service location. GIS provides the ability to quickly access the geodemographic dynamics of an organization's existing service area in contrast to the likely demand for services at a new location.

Service Location Tracking—Keeps track of the geographical locations of service providers, customers, employers, payers, and health plans, is a significant task. GIS provides a database approach to the collection and maintenance of geographic information and a vehicle by which everyone can access accurate and timely geographic information.

Resource Management—Knows where equipment and supplies are located as well as maintenance information. GIS can link the physical location with the condition of the equipment or supplies. GIS can also provide a visual link to other enterprise applications that track resources and their consumption or deployment.

Multimedia Functionality—Provides access to additional information from a wide variety of sources. GIS can link reports, forms, or photos with geographic data stored in the database and help in paper reduction efforts.

2.6 Health and Social Service GIS Data Benefits and Issues

1. Data Gathering and Data Automation

The largest part of data that health and social service agencies will use is available in legacy databases. Most of this data can be geographically enabled through simple automatic processes known as geocoding or address matching in which other data used by health and social service agencies, such as county and municipal boundaries, streets, and rivers, is available in varying forms of completeness from public and private sources.

2. Address Verification

GIS offers the benefit of performing address verification for your legacy data sets. GIS can help determine if the correct city or county jurisdiction has been assigned to a particular case or client, and if that client's address has been miskeyed in any way; GIS can also help to correct client misspellings.

3. Data Confidentiality

Most health and social service data at the client or case level is strictly confidential. GIS can help aggregate and display this data accurately to the census tract, county, or region level.

4. Metadata

Metadata is information about the data itself such as its physical and logical format, original source, purpose for which it was collected, and any known limitations or restrictions in its use.

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3.0 Creating an Enterprise GIS

3.1 The Enterprise GIS Planning Process

Creating an enterprise geographic information system in a health or social service organization is accomplished through a process that involves six key steps:

Six Key Steps

1. Statement of Goals
2. Needs Assessment
3. System Architecture Design
4. Creation of an Implementation Plan
5. Design of Geographic Database(s)
6. Implementation (hiring or assigning staff, creation of data, and use of software)

Why Planning Is Essential

Good planning takes time. Technology changes rapidly, and some items that were once very expensive—data storage and processing power—are now readily accessible. Functions that once had to be customized are now available with out-of-the-box software. It is hard to defend an involved planning process for any single solution to a given business problem.

Enterprise GIS focuses on more than hardware and software. Creation of databases and investment in staff are equally key in the establishment of an enterprise GIS and far more expensive. Access to legacy systems, which represent many extensive dollars of investment in work processes and information, is another important consideration, as is impact on existing network resources. All five components of a GIS—people (management, staffing, and training), hardware, software, data (and database design), and applications (data access and customized geoprocessing routines)—are important in enterprise GIS. Whether it is before establishing a GIS or after first introducing GIS as a solution to a specific problem or an analysis tool, going through a planning process when creating an enterprise GIS must occur eventually.

This section of the white paper will describe the steps of a planning process for enterprise GIS in health and social service organizations. Tools to assist you in this process are available in other materials; among them are needs assessment and the system architecture design white paper. System integrators, engineering and planning firms, and GIS service providers all may have some experience in performing these tasks. ESRI's Implementation Services team also has experience in performing needs assessments and system architecture design and may be available to help you.

3.2 Statement of Goals

The first step in creating an enterprise GIS is to form goals by looking closely at the agency mission and move toward articulation of actionable information for the system and for the planning process.

Agency Mission

For the system it would be useful to answer questions such as, Is the administration going to be centralized? What about data creation? What about data analysis? Is the GIS going to be used primarily to improve internal operations, enhance information provided to the public, provide services to partners (county health departments, contractors), or some combination of all of these functions? What are existing legacy systems that the GIS might work with?

Business Practices

For the planning process it might be useful to answer questions such as, How long should the process take? Are we going to do this in-house? How many years do we want to plan for? What will the end product of the planning process look like?

Prioritize Work Flows

To answer these questions it will probably be necessary to form a small workgroup. Appropriate workgroup members might include someone responsible for system design/information services within the agency, a staff member involved in organization administration, a representative of existing GIS users, staff involved in data distribution and/or analysis, and other interested and committed staff. The workgroup will create a statement outlining the importance of and goals for GIS in the enterprise and the importance of undertaking a GIS planning process. The approval of this statement leads to the next step in the planning process—the needs assessment.

Goal-Seeking Case Study

In our example of a health and social service department, some existing users, the data warehouse administrator, the manager of vital statistics, the director of social service program evaluation, the manager of the Certificate of Need area, and the systems design manager of the department's information technology section meet and agree to try to instigate a planning process for enterprise GIS. At a second meeting they create a brief policy paper to circulate that states the goals of GIS at the health department: centralization of GIS data storage, data creation and customized application development, access to legacy data, improving quality of legacy data, improved relationships with facility operators, and working with the counties to improve health in early childhood.

3.3 Needs Assessment

The needs assessment process helps determine the data projected users want to have spatially enabled and the kinds of things they imagine doing with that data (GIS applications). The needs assessment process also involves ranking or prioritization of data and applications. Analysis of the needs assessment allows the planner to phase implementation of data layers and applications, estimate numbers of users in different units, and estimate staff needed to manage and maintain the GIS. This information forms the base for a system architecture design and an implementation plan.

Developing Solutions

Participation in a needs assessment process can range from intensive one-on-one discussion and outlining of business processes to a group workshop to help refine an already determined list of data layers and common applications and apply a prioritization exercise. The more user involvement, the more customized your solution will be—but also, the more it will cost.

The Enterprise Needs Assessment

A needs assessment process can involve interviews, questionnaires, or a combination of these methods, and it might involve a group brainstorming session. A tour of a given work site can also be useful—note any maps hanging on walls and ask about them (Why are they there? What do employees use them for? How were they created? How often are new ones needed?). The statement of goals will be useful in helping to decide who to interview—if the aim is for a state to assist county partners, interviewing some county

partners and people who work with them will be useful. If connection to legacy systems is important, speaking to staff working with these systems will also be important.

The table on the following page illustrates the steps, purpose, participants, and products of the needs assessment process.

Components of a GIS Needs Assessment

Component	Purpose	Participants	Product
Kickoff meeting	Introduce GIS and the needs assessment process.	Managers of all key divisions should be notified if they want to send someone. All interviewees targeted by statement of goals	Presentation: GIS in Health and Human Services. Use slides and/or demonstrate software and/or have plots available.
Interviews	Understand business processes and need for data and GIS applications. Collect information about legacy systems and standards.	Managers of key legacy databases Other future users targeted by statement of goals Other interested users of GIS	Prepare a simple list of questions for each type of interview and note responses.
Questionnaire	Understand business processes and needs for data and GIS applications.		
Site visit (supplement to interview)	Understand business processes and need for data by inspecting work sites.	Business or organization partners Regional offices Areas where GIS will be accompanied by extensive business process reengineering per needs assessment goals	Collect or note maps used in processes—find out why they are there, how they are used, how they were created, and how frequently they are updated.
Needs analysis	Summarize information about GIS data and application needs—find out about existing spatial data availability.	GIS workgroup State or county GIS coordinator	Tables listing data and applications desired with characteristics (units requesting data, whether data is available electronically, number of records, and so on).

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Components of a GIS Needs Assessment, Continued

Component	Purpose	Participants	Product
Brainstorming session (can occur at any point after kickoff meeting to before prioritization)	Review proposed data layers and applications and add missing items.	Managers of all key divisions should be notified if they want to send someone. All interviewees targeted by statement of goals	Additions to tables produced by the needs analysis
Prioritization	Rank proposed data layers and applications by importance to each unit and to the agency as a whole.	Managers of all key divisions should be notified if they want to send someone. All interviewees targeted by statement of goals	Prioritized list of data layers and applications
Implementation strategy	Group GIS applications/uses and data layers into phases for implementation.	GIS workgroup State or county GIS coordinator	List of applications and data to be developed and maintained during each implementation phase
User and application summary	Use information from prioritization and needs assessment to determine numbers, types, and physical location of GIS users.	GIS workgroup State or county GIS coordinator	Tables showing numbers of total and concurrent users by type and location

State Health Department Needs Assessment Case Study and User Total Tables

The needs assessment process involves a kickoff meeting to describe GIS and show simple applications to attendees. The kickoff meeting is followed by a brainstorming session to add desired data layers and applications to a predefined list of layers suggested by the GIS workgroup. The GIS workgroup then conducts an hour-long interview with the manager responsible for each of the legacy systems. The workgroup also interviews a manager, an architect, and an inspector in the Certificate of Need division. Three existing users are interviewed about their applications and issues, particularly focusing on geographically enabling legacy data that is currently hard to use. The GIS workgroup also chooses to interview staff working with the counties on maternal and child health issues, and selects two counties—one urban and two rural—and interviews their maternal and child health staff during a site visit.

The interviews with managers of the databases focus on issues and structure of the database, users of the database, and processes for getting information into the databases. Other interviews focus on tasks performed and map layers that would be useful for improving work quality. A two-page questionnaire will be filled out during the interview.

The GIS workgroup analyzes the result of the brainstorming session, interviews, and site visit. They create tables showing the GIS uses/applications (simple thematic mapping, disease cluster analysis, ability to accept electronic plans for facility expansion and geographically reference these plans to help plan inspection trips and make red-line comments), data categories (health department service areas, ambulatory health facilities and clinics, local government administrative boundaries, and reported cases of different diseases), and individual data layers (births for a given period, sewage treatment facilities, rivers and streams, county boundaries, and boundaries of large municipalities). The GIS workgroup researches the desired data to find out if it is centrally collected, available electronically, and currently mapped in the public or private sector. The aim of this research is to determine how costly data conversion might be.

The GIS workgroup then holds a prioritization exercise to rank these uses, data categories, and data layers. Prioritization attendees include staff at the brainstorming session and interviewees. Additions to the GIS uses/applications and data layers are explained as are issues and trade-offs involving data conversion. After the prioritization exercise, the workgroup plans a two-tiered implementation strategy that includes most of the GIS uses and half of the data layers. The implementation strategy and needs assessment information is used to estimate how many GIS users there might be in participating units and what GIS software they would be using based on their desired applications. After estimating total users, concurrent users can be estimated. These tables of concurrent users by department unit and type of software, which are indicators of the intensity of geographic operations that will be performed, are key inputs to the system architecture design process.

Location	ARC/INFO		ArcView GIS		MapObjects		Map Server
	Total	Concurrent	Total	Concurrent	Total	Concurrent	Transactions/Hour
County HQ							
Public Works	4	2	10	8			30
GIS Department	4	3	3	2			30
Land Records	3	2	10	8			30
Assessor			15	12	20	20	30
Information Systems	2	1	2	1			
Other Departments							100
Remote Sites							
Fire Station	2	1	5	5			30
Water Site	2	1	4	3			30
Utility Site	4	2	4	3			30
TOTALS	**21**	**12**	**53**	**42**	**20**	**20**	**310**

3.4 System Architecture Design

System architecture design provides a hardware and network solution that supports the performance and communication needs of users of GIS. The System Integration Department at ESRI provides services in system design and implementation support for major distributed computer systems.

How to Design the System Architecture

The white paper, *System Design Strategies*, contains the tools to determine an appropriate GIS system architecture design for a given organization. The paper outlines the relevant information collected during a system architecture review, describes ESRI software architecture, diagrams many different ways to configure a GIS, noting trade-offs, and provides useful hardware sizing diagrams. *System Design Strategies* was written to communicate the methods ESRI uses in system architecture design, making it available to system administrators or GIS service consultants helping to plan an enterprise GIS.

Considerations for the system architecture review include platform and network requirements, hardware policies and standards, system administration experience, operational constraints and priorities, and financial issues. The needs assessment user totals by software type and location must be associated with the appropriate type of network connection to understand possible system impacts. Understanding user performance requirements is also important. The decision of how the organization stores data should also be discussed during the system architecture design review.

Network Traffic

Because a GIS is data-intensive, it is important to determine where certain geoprocessing solutions will occur, not simply because a client machine may have slow performance but because transmitting data across an organization's network may significantly impact operations. ESRI software supports distributed workstation processing, central application processing, and client/server processing. ESRI software also supports Internet transaction processing, which is especially useful for serving a large number of widely dispersed users over a wide area network who have a need for a distinctly defined set of geographic queries and maps.

The system architecture design for most complex organizations will include a mix of solutions. The diagram below illustrates the system architecture design for our example health department.

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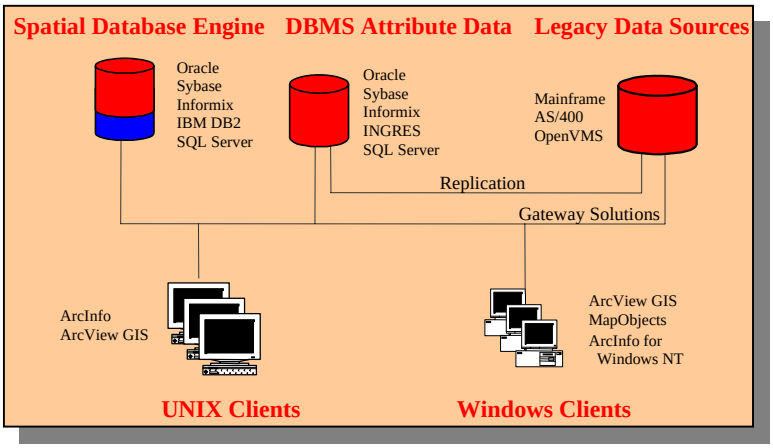

3.5 Implementation Plan

ESRI recommends a phased-in implementation approach that shows the benefits of GIS quickly within an organization and to the public, and then builds data layers and applications to expand the use of GIS. The incremental approach should result in lower start-up costs, better knowledge of requirements gained through experience, and the ability to keep up with changes in technology while providing the most highly prioritized functions quickly.

Household Basin Information

The implementation approach in health and social services may be slightly different compared to other public organizations. In other organizations the data that must be converted to use with GIS involves complex physical features—building footprints, contour lines, property parcels. Most health and social service agency data involves address-based information—clients or cases, providers and facilities—this data is far more easily converted. Therefore, instead of recommending a phased approach that starts by focusing on a geographically limited study area, health and social service agencies can begin by converting all items in very highly prioritized sets of data throughout the agency jurisdiction. An example would be geographically enabling immunization records for all children using public health departments throughout a state rather than four to five urban counties.

A Roadmap to Enterprise GIS

The implementation plan presents a systems level road map to developing GIS in an enterprise. The first step is to summarize goals and activities for each phase of the implementation plan; they are derived from the original statement of goals and the prioritization exercise results. The next step is to define tasks for each phase within each of four areas, as outlined below. Equal attentiveness to each of these four areas ensures that all elements of GIS—people, hardware, software, data, and applications—will be planned for adequately.

Management and Staffing (People). These tasks address the short- and long-term organization, management structure, and dedicated staff needed to support the development of GIS.

Hardware/Software. These tasks include activities related to the planning, procurement, and installation of GIS hardware and software.

Data and Database Development. These tasks address planning, design, and documentation of the organization spatial database and data acquisition/conversion.

Data Access/Application Development. These tasks involve establishing ways for users to access and manipulate geographic data including customized applications: setting priorities, analyzing requirements, and designing and developing GIS applications.

The final step in preparing is to schedule action items for preparing an implementation plan. Most tasks within each component of a GIS occur sequentially (establish a GIS section, hire staff, etc.). However, activities in several areas may take place at the same time (in many organizations it is wise to begin a purchasing process for hardware and software while hiring staff, so one is not waiting for the other for too long).

Following is an implementation schedule for Phase 1.

Implementation Tasks	Month								
	1	2	3	4	5	6	7	8	9
Track 1: Organization/Management									
1.1 Establish Organizational Structure	**xxxxxxxx**								
1.2 Hire GIS Section Staff	**xxxxxxxx**	**xxxxxxxx**							
1.3 Establish and Perform GIS Support Functions	**xxxxxxxx**	**xxxxxxxx**	**xxxxxxxx**	**xxxxxxxx**	**xxxxxxxx**	**xxxxxxxx**	**xxxxxxxx**	**xxxxxxxx**	**xxxxxxxx**
1.4 Promote GIS				**xxxxxxxx**	**xxxxxxxx**				**xxxxxxxx**
1.5 Review First Year Results								**xxxxxxxx**	
1.6 Update Implementation Plan									**xxxxxxxx**
Track 2: Hardware/Software									
2.1 Acquire GIS Server and Map Servers	**xxxxxxxx**								
2.2 Acquire PCs	**xxxxxxxx**								
2.3 Install Software	**xxStaffxx**	**xxStaffxx**		**xEndUsersx**					
2.4 Acquire Initial Training (GIS staff and end users)		**xxStaffxx**		**xxxEndUsersxxx**					
2.5 Assess Network Requirements								**xxxxxxxx**	
Track 3: Database Development									
3.1 Develop Database Design	**xxxxxxxx**	**xxxxxxxx**							
3.2 Define Conversion Procedures	**xxxxxxxx**	**xxxxxxxx**							
3.3 Acquire and Convert Data/Initial Geocoding	**xxxxxxxx**	**xxxxxxxx**	**xxxxxxxx**						
3.4 Define Data Maintenance Procedures		**xxxxxxxxxx**							
3.5 Perform Data Maintenance/Continuous Geocoding			**xxxxx**	**xxxxxxxx**	**xxxxxxxx**	**xxxxxxxx**	**xxxxxxxx**	**xxxxxxxx**	**xxxxxxxx**
Track 4: Application Development									
4.1 Define Functional Requirements	**xxxxxxxx**								
4.2 Design, Code, and Test Applications		**xxxxxxxx**	**xxxxxxxx**						
4.3 Document Applications			**xxxxxxxx**						
4.4 Install Applications/Train Users				**xxxxxxxx**					
4.5 Review Initial Applications								**xxxxxxxx**	

3.6 Design of Geographic Databases

A database design defines the detailed structure and specifications of the ARC/INFO coverages, ArcView GIS shapefiles, and SDE GeoDatabases that will be used by the organization. The design specifications are documented in a data dictionary that contains a description of each layer, the data types used to model geographic features (point, line, and polygon), table structures, field definitions, coding schemes, and other information.

Database design can be accomplished in-house or contracted out. ESRI offers database design training to assist users. Another option is customized training involving the database design training materials and a hands-on collaborative workshop facilitating technology transfer between ESRI and client staff.

Before automating legacy address-based data (cases, clients, facilities, and providers) the organization must decide what percent of the data is sufficient to have automated. For example, a health department may decide it is sufficient to create points for 90 percent of their birth records for the last five years, with at least 85 percent coverage in every county. This is important because the ability to automate this data is dependent on the quality of the addresses and the quality of available geographic reference data (streets with address ranges). Both of these factors vary widely, with rural areas much more likely to offer post office boxes and other difficult-to-automate addresses and being less likely to have complete reference information available. Correcting addresses and placing points is time-consuming; the higher a percentage desired for automation, the more time-consuming to complete the data set. However, certain data sets require an almost 100 percent automation rate—if you are going to direct the public to nursing homes and hospitals, you would want the entire data set available for the application necessary to track and to understand the meaning and content of each of the files.

3.7 Successful Enterprise GIS

Implementation of a GIS may take some time, but it should be managed to produce useful information as soon as possible. Following the implementation plan should allow an enterprise to focus on all five key areas of GIS—people, hardware, software, data, and applications. However, successful, flexible implementation of enterprise GIS also includes periodic review and update of the implementation plan and geographic databases to respond to new or changing needs or to resolve issues that develop during the course of implementation.

Try to quantify the benefits of GIS as it is implemented. How have business processes changed? What time has been saved? What changes have taken place in quality of base data? What new products have people been able to create? Revisit original goals for GIS and match these goals to implementation outcomes. How have the goals been realized? What benefits/uses have resulted that were not planned? These "post-planning" processes allow you to understand and support your investments in creating new enterprisewide systems.

4.0 Costing Enterprise GIS

The cost for implementing enterprise GIS in an organization depends on the requirements of users, desired applications, and the systems environment. Because data acquisition and automation are the most costly part of a GIS, the more people use the system, the less costly it will be. The graphic below illustrates this. Enterprise GIS, where data is stored and is available centrally to those with permission to use it, is less costly per user than

project-based GIS. Administration of separate GIS hardware and networks and database designs are also costly and can be consolidated using enterprise GIS.

Undertaking a planning process will allow your organization to estimate the hardware, software, and training that needs to be purchased to accomplish your goals. Contact an ESRI regional office for pricing on hardware, software, and other peripherals (digitizer tablets, plotters, etc.). Another advantage to enterprise GIS accomplished through a planning process is the ability to purchase software, hardware, and training in bulk, rather than incrementally. Advantages include bulk discounts and the ability to keep an accurate count of software purchased. Maintenance and technical support payments can be grouped, and a technical support structure that centralizes and tracks issues can also be instituted.

While it is difficult to estimate how much a GIS will cost for an organization without a planning process, estimating the cost of the planning process itself is much easier. When Implementation Services consultants at ESRI undertake a planning process, they are typically referring to a GIS needs assessment, a system architecture design review, and creation of an implementation strategy/system architecture design summary document and implementation plan. ESRI can also be contracted to perform a database design to assist in software installation and tuning and to create desired custom applications.

Cost for the needs assessment process is heavily dependent on the number of interviews scheduled during the process and how much travel is involved. A highly structured needs assessment with an emphasis on cost containment would involve data listed in the appendixes.

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Appendix A

Spatial Data

Client Address
Employer Address
Encounter Address
Event Address
Facility Address
Household Address
Insurer Address
Provider Address
Relative Address
School Address
Temporary Address

Appendix B

Organizational Functions Using GIS in Health and Social Services

Administration
Adoption Services
Adult Day Care
Aged, Blind, and Disabled
AIDS
Behavioral Health
Case Management
Certificate of Need
Child Support
Communicable Disease
Community Resources Information
Crisis and Information
Day Camps
Developmental Disabilities
Eligibility
Emergency Services
Employment Training
Environmental Protection
Epidemiology
Facility Licensing
Food and Plant Protection
Food Stamps
Foster Care
Fraud and Abuse
Head Start
Health Professions
Health Promotion
Hot Line
Infant Day Care
Inspector General
Intake and Screening
Laboratory
Medicaid Managed Care
Mental Health
Ombudsman
Policy and Planning
Protective Services
Public Housing
Radiological Control
Shellfish Protection
Tobacco Control
Vector Control
WIC

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Appendix C

Geographical Locations Referenced in Health and Social Services

Adoption Agencies
Assisted Living Facilities
Blood Drawing Stations
Clinics
Community Centers
Day Camps
Day Care Centers
Emergency Shelters
Family Foster Homes
Food Preparation Sites
Group Homes
Home Health Agencies
Hospitals
Independent Laboratories
Mobile Home Parks
Nursing Homes
Physician Offices
Public Health Agencies
Public Housing Locations
Public Transportation Stops
Residential Treatment Facilities
Satellite Office
Schools
Shelters
Vocational Training Sites
Wellhead Locations
WIC Vendors

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Appendix D

Areas and Boundaries Referenced in Health and Social Services

Areas of Dominant Influence (ADI)
Boroughs
Catchment Areas
Census Blocks
Census Tracts
Cities
Counties
Countries
Direct Marketing Areas (DMA)
Empowerment Zones
Federal Congressional Districts
Federal Lands
Fire Districts
Health Service Areas
Hospital Referral Areas
Hospital Service Areas
Indian Reservations
Metropolitan Statistical Areas (MSA)
Neighborhoods
Parks
Planning Districts
Police Districts
School Districts
State and Local Governmental Districts
States
Taxing Districts
Townships
Transportation Routes
ZIP Codes

For more than 30 years ESRI has been helping people manage and analyze geographic information. ESRI offers a framework for implementing GIS in any organization with a seamless link from personal GIS on the desktop to enterprisewide GIS client/server and data management systems. ESRI GIS solutions are flexible and can be customized to meet the needs of our users. ESRI is a full-service GIS company, ready to help you begin, grow, and build success with GIS.

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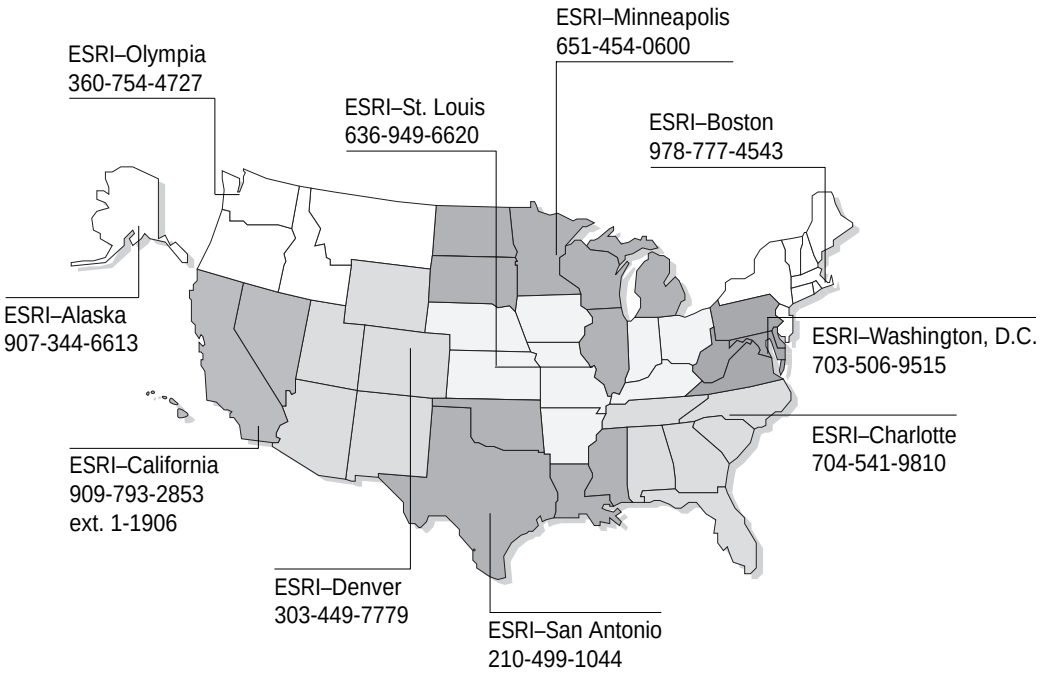

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