Power Your Business with ESRI GIS

An ESRI White Paper • October 1999

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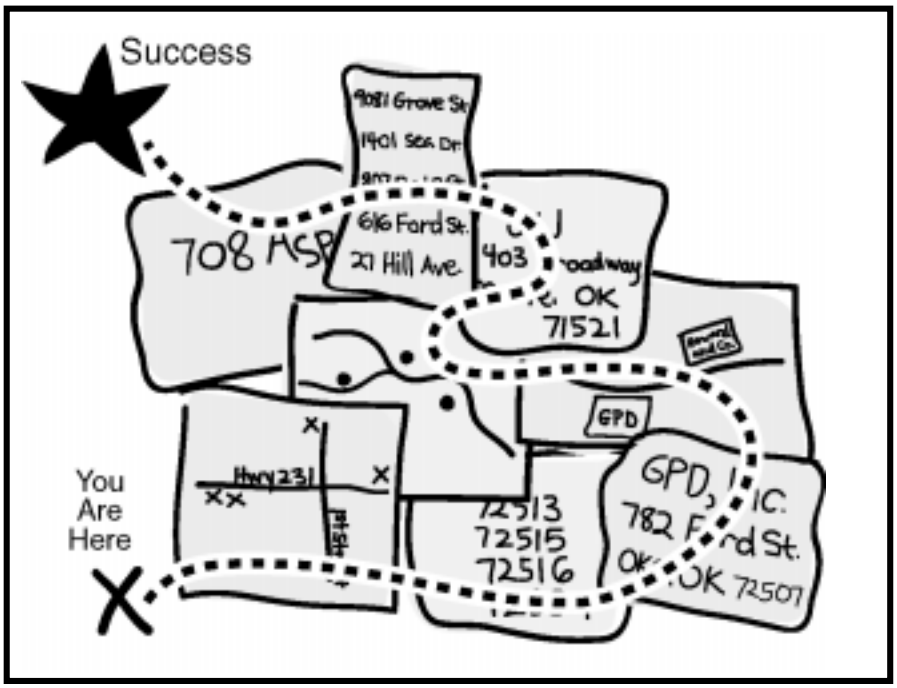
Power Your Business with ESRI GIS

You may have heard a lot about geographic information system (GIS) technology lately and how it can improve the decision making process within your business. Companies like SAP and IBM are making big investments to improve access to spatial data by embedding ESRI's GIS technology within their software programs. ESRI® spatial data servers and map-enabled browsers are making it possible to provide companywide access to maps and spatial data. As a result, you may be wondering just how spatial data fits into your enterprise databases and what role GIS should play in your company's information architecture. This white paper is for you—the chief executive officer, the chief information officer, and the information system architect. It will give you an overview of the benefits that GIS will bring to your company as well as a set of directions for getting you on the road to GIS success.



The Roadmap to Success

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Introduction

First of all, what do we mean by spatial data? We are talking about business data that is connected to a physical location somewhere on the surface of the earth. Your business databases already contain a lot of spatial components that you may not be utilizing.

- Customers have street addresses and postal codes.
- Sales data has store locations and customer product registration information.
- Stores, factories, and warehouses all have locations.
- Equipment, such as telephone poles and electrical transformers, has addresses or cross streets or even coordinates from a global positioning system receiver.
- Points, such as stops on a delivery route, have a street address.

These spatial components are integral parts of your company's data assets. Whether you maintain your store revenues, customer spending patterns, use of health care facilities, or sales force results in a data warehouse, in data marts, or in a relational database management system (RDBMS) such as Oracle or Informix, you can take advantage of these spatial components to add insight and make better business decisions.

In addition, you may already have access to third party data such as demographic data showing incomes, occupations, and education. This data already has a spatial component included and is usually available from private companies such as Dun & Bradstreet or various governmental agencies. However, all of these data sources just add to your information overload unless you can turn them into business insights. An enterprise GIS from ESRI lets you link these data sources together and analyze them in a fundamentally different way, producing new insights into your business that improve your decision making processes.

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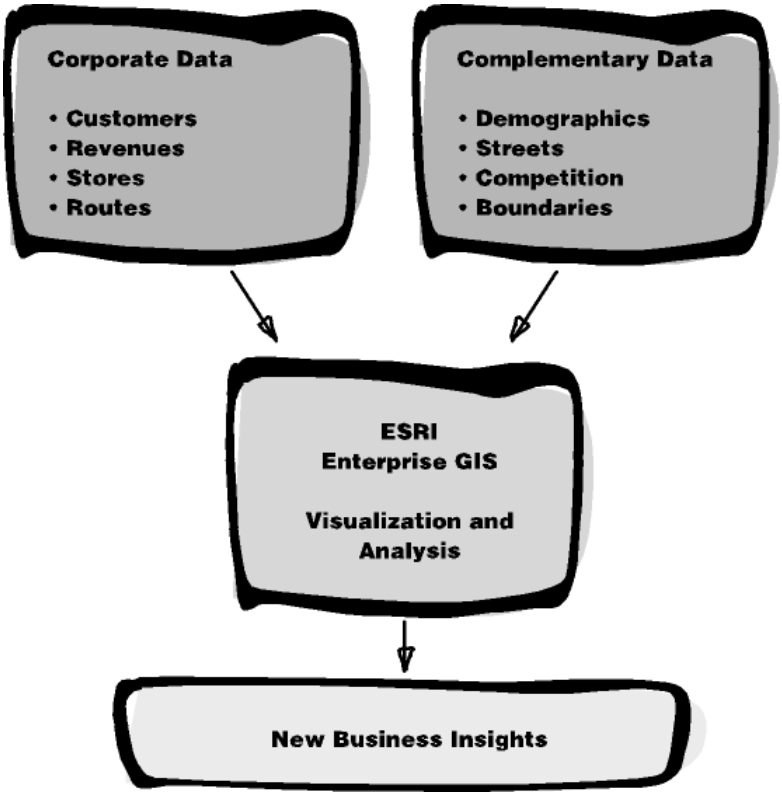

Companies just like yours are already using spatial data and ESRI GIS to operate their businesses more effectively. These companies find that ESRI GIS

- Saves them time
- Saves them money
- Promotes internal organizational efficiencies
- Helps them make better business decisions

Here are two examples.

- **Ace Hardware:** Ace Hardware is one of the world's largest hardware cooperatives with over 5,000 independent Ace Hardware retailers and over $2.7 billion in sales in 1996. Ace Hardware uses ESRI GIS to perform market analysis and to target various advertising and promotional campaigns.

  - In one analysis, customer addresses obtained from an in-store point of sale file were plotted on a map showing ZIP Code boundaries. Most of the customers came from three nearby ZIP Codes, but weekly advertising had been mailed to a much larger area using saturation mailings. Store management restricted mailings to those three ZIP Codes without impacting store traffic. Direct result—money saved on mailings.

- Using the same survey data and some census block group data, it was determined that a high-income area located near the store was not contributing many customers to store traffic. Management did a direct promotional mailing for home security systems to those specific block groups that resulted in immediate gains in store traffic and revenues. Direct result—increased revenue.

- **Chase Manhattan Bank:** The Chase Manhattan Bank is one of the largest banks in the United States, with more than $300 billion in assets. Chase focuses on consumer finance and consumer retail banking through its branch locations. Chase analysts used ESRI GIS to evaluate the financial performance of one of its branches with the following results:

  - Using customer data that included addresses, Chase was able to determine that roughly two-thirds of the branch's customers lived in the branch's trade area, which consisted of seven census tracts located around the branch. This meant that one-third of the branch's customers worked in the area but lived elsewhere. This situation had never been realized before and was only made evident through the use of GIS. The branch managers could now begin to develop specific marketing programs aimed at these two separate customer segments. Direct result—targeted marketing through improved segmentation.

  - Analysis of the remote customers determined that many of them worked at local medical centers, and that as a group, they represented over half a billion dollars in potential deposits. By plotting the hospital locations and the location of the Chase branch, as well as competitors' branches, the analysts were able to determine that a competitor's location gave a significant advantage as it was closer to the medical centers. The color coded maps and tabular results from this analysis were used as input to a recommendation to consider relocating the Chase branch. Direct result—improved competitive analysis.

These two companies, like many others, realized that

- They already had lots of data in their enterprises that contains a spatial component such as customers and stores with addresses.

- They could obtain complementary data, such as streets and roads, and demographic data from commercial sources.

- They had lots of other valuable data, such as customer records, linked by a customer ID.

- ESRI GIS would let them visualize and analyze these databases, producing new insights into their business resulting in saved time and increased revenues.

ESRI GIS helps you achieve these benefits in two main ways:

- **Visualization:** ESRI GIS makes it possible to *see* your data in a different way. By using a visual geographic display (a map), you get new insight into existing data in a way that spreadsheet rows and columns just cannot provide. The first time that you see revenues on a map displayed by sales districts, or a map showing competitive trade regions when you are planning a new store location, you will begin to understand your business in a new way. You are probably already organizing your data geographically, grouping it by states and regions, but the human brain can see patterns much more easily when the data is presented on a map.

Rhode Island ZIP codes

Zip	Pop1996	Post Office	Median home value
02861	26129	PAWTUCKET	111900
02863	17163	CENTRAL FALLS	102900
02864	28595	CUMBERLAND	143200
02865	14407	LINCOLN	156700
02871	16437	PORTSMOUTH	173300
02872	121	PRUDENCE ISLAND	156000
02874	3637	SAUNDERSTOWN	169500
02877	1139	SLOCUM	162800
02878	13745	TIVERTON	139600
02879	14374	WAKEFIELD	161500
02881	7565	KINGSTON	172300
02882	14383	NARRAGANSETT	168200
02883	1837	PEACE DALE	116800
02885	11462	WARREN	138100
02886	40875	WARWICK	116400
02888	20794	WARWICK	114500
02889	20702	WARWICK	114000
02891	21610	WESTERLY	155800
02892	4300	WEST KINGSTON	150500
02893	28126	WEST WARWICK	124300
02894	743	WOOD RIVER JUNCT	124200
02895	38452	WOONSOCKET	127300

Median Home Values in Tabular Format

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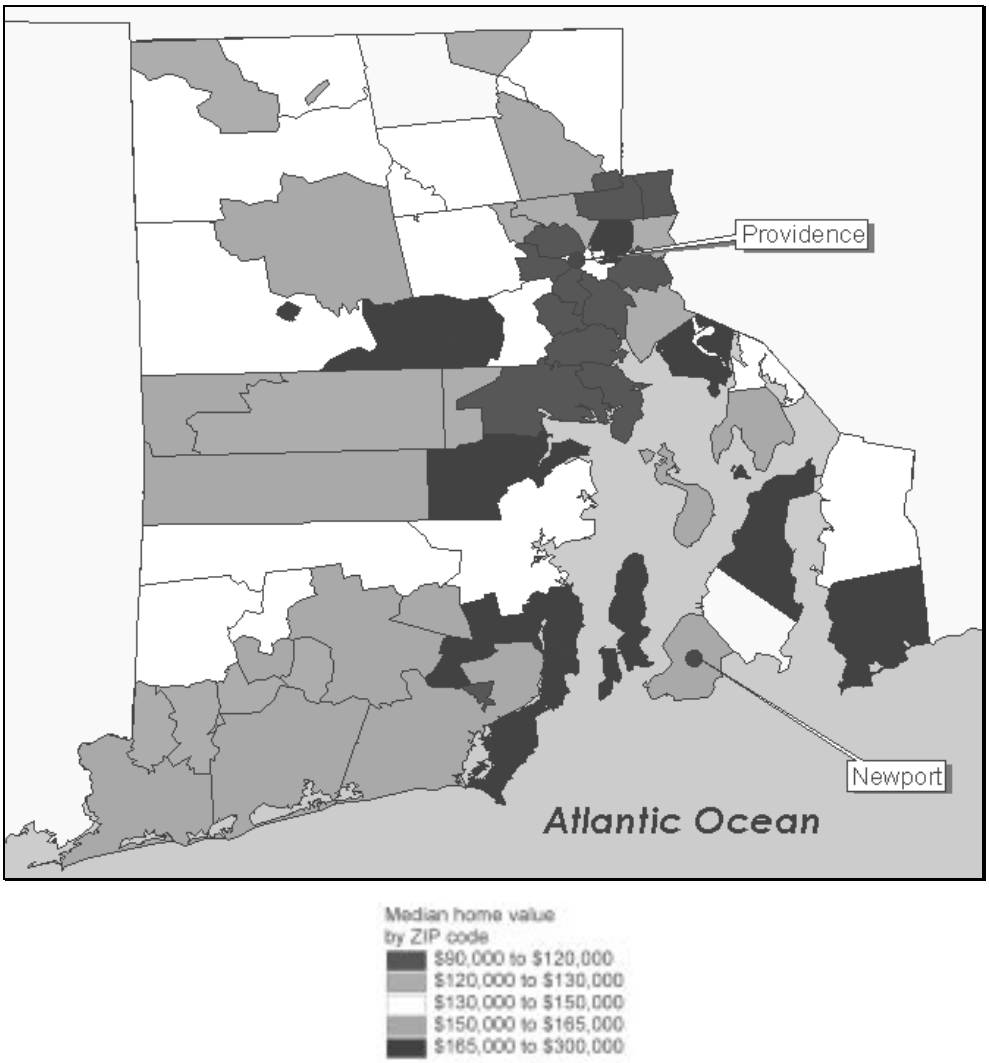

Median Home Values in Map Format

- **Spatial Analysis:** ESRI GIS also makes it possible to *analyze* your data in a fundamentally new way. You can ask questions about *where* things are, in addition to their normal attributes.

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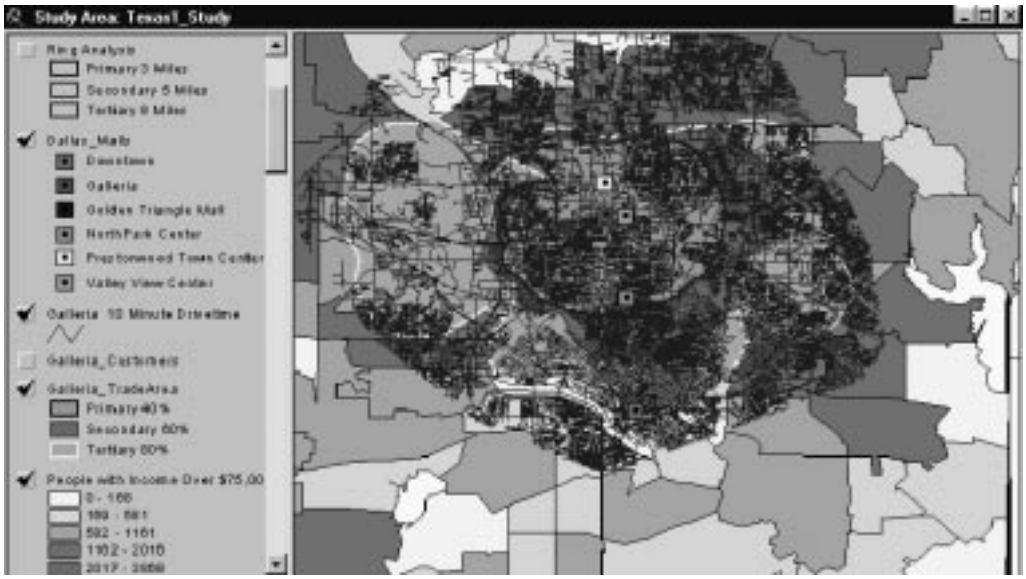

Comparison of Ten-Minute Drive from Store to Trade Area with 80 Percent of Sales

- Think of GIS as adding a new dimension to your query language. For example, you can ask a question such as "Show me all of my customers who live within a two-mile radius of Store A and who live in regions with median incomes of greater than $50,000," or "Show me all of my customers who live within a five-minute drive time of Store B and who live in regions with high concentrations of university degrees." These are questions that cannot easily be answered without a GIS.

By now, you can probably begin to see some ways that you can apply the power of GIS visualization and analysis to your business. Here are a few more examples of real-world business problems and their spatial solutions.

Customer Relationship Management

- **Problem:** A national consumer goods products company has recently implemented a new customer relationship management (CRM) system to enable its sales representatives to more effectively manage their time and reduce the amount of time spent on nonsales-related activities. However, the expected return on investment has not been achieved. Sales representatives are still spending too much time locating and getting to customer locations.

- **Solution:** An enterprise GIS server was implemented to provide mapping services within their CRM browser application. Sales representatives can determine customer locations, print maps, and even download detailed driving instructions where needed. A new logistics module is being added that will enable sales representatives to optimize their customer visits automatically by generating a suggested calling order. As a result, driving times and costs have decreased significantly, and sales representatives are spending more time with customers.

Store Site Selection

- **Problem:** A grocery and drugstore chain was spending large amounts of money each time it analyzed a potential new store location. Local data was being purchased on an ad hoc basis, and different analysis techniques were being used in different parts of the county.

- **Solution:** A single, large spatial database was implemented, accessible to more than sixty real estate analysts nationwide. Street data for the entire country as well as demographic data and competitive data were purchased and loaded into the GIS. Custom site selection tools were developed using ESRI client software. The result was faster turnaround for analysis requests, more accurate site locations, and most importantly, the use of a single selection methodology companywide.

Telecommunications

- **Problem:** A competitive local exchange carrier (CLEC) is about to start placing new fiber in a territory already served by its competition, the incumbent telephone company. The CLEC specializes in serving midsized, high-technology companies with high-volume data and voice requirements. It has identified several possible fiber routes and wants to know which one will be the most profitable. A major constraint is that potential customer premises must be located within a specified distance of the new fiber.

- **Solution:** The potential fiber routes are digitized on top of digital street maps. For each route potential customers are selected based on their distances from the proposed fiber. In addition, commercially obtained demographic data is used in conjunction with historical CLEC records to predict the data and voice volumes from each potential customer. The best fiber route is chosen and built. In addition, the data resulting from the spatial analysis is used to create a targeted marketing campaign once the fiber is activated. Because of the success of this analysis, GIS is used throughout the CLEC for all business planning and marketing.

Insurance

- **Problem:** A large insurance company is spending too much effort during claims processing trying to validate the accuracy of preliminary claims. For example, after a large storm passes through an area, claims processors are spending a lot of time checking that the claim location is actually within the boundaries of the area affected by the storm.

- **Solution:** Claims processors are given access to online maps during their analysis of a claim. Using the customer or claim location address, the processor can see the location on a map relative to other claims and to boundaries such as flood and storm limits.

An Overview of GIS

A geographic information system is a system for managing geographic or spatial data combined with tabular information linked to that spatial data. It can be as simple as a stand-alone desktop system that color codes census tracts on maps according to the median income, all the way to systems that provide distributed access to multiple gigabytes of data and to hundreds of simultaneous desktop and Internet clients. It is the linkage between spatial data and information about that data and the ability to display and analyze the combined data with a map-based interface that characterizes what most people think of as GIS.

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ESRI is the leading developer of GIS software with more than 300,000 end users worldwide. ESRI also provides consulting, implementation, and technical support services. In addition to its headquarters in California, ESRI has regional offices throughout the United States, international distributors in more than seventy countries, and more than 700 resellers and developers. ESRI's users include many of the Fortune 500 including retail, banking, insurance, governments, telecommunications, utilities, agriculture, defense, oil, health care, transportation, and environmental management.

ESRI provides a complete range of GIS solutions including

- ArcInfo™ software, the de facto professional GIS for industry, government, and academia
- ArcView® GIS, the world's most popular desktop mapping and GIS software
- ArcView Internet Map Server for serving interactive spatial content in an Intranet or Internet environment
- Spatial Database Engine™ (SDE®) software, a high-performance universal spatial server
- MapObjects® software, a developer toolkit for building high-performance GIS applications using any standard Windows development environment such as Visual Basic, Visual C++, Delphi, PowerBuilder, and Access
- ArcLogistics™ Route, a shrink-wrapped solution for complex vehicle routing problems
- ArcView Business Analyst, a desktop tool with bundled data for making business decisions based on analyzing geographic information
- ArcIMS™ software features an out-of-the-box solution for creating, designing, and managing Web mapping sites. ArcIMS offers GIS capabilities in an easy-to-use framework, integrating local data with Internet data in a simple browser interface.
- Arc Facilities Manager (ArcFM™) software is a powerful ArcInfo-based application designed specifically for the editing, maintenance, modeling, and data management of utility information. Users from different utilities can use ArcFM out of the box or easily customize it for their specific organization.

How ESRI GIS Works Within Your Business

ESRI GIS is built on a scalable high-performance platform for deploying enterprisewide spatial visualization and analysis tools. A quick note to those who have already completed or are planning an enterprise resource planning (ERP) or CRM installation—good news; ESRI enterprise GIS coexists with and enhances your ERP or CRM. ESRI enterprise GIS is built on an open architecture platform, uses industry-standard RDBMSs and application programming interfaces (APIs), and is Internet/Intranet ready. In the case of SAP R/3, ESRI has already built a number of interfaces to make it easy to access your R/3 databases in a spatial environment.

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ESRI enterprise GIS is built on the following architectural foundation:

- A scalable spatial data server that uses industry-standard RDBMS engines. ESRI's SDE stores mapping data using your existing database engine, whether it is DB2, Oracle, SQL Server, Informix, or Sybase.

- Support for large seamless databases. GIS built on top of SDE supports very large spatial databases without partitioning or tiling of the data.

- A range of clients from the desktop (ArcView GIS) to the workstation (ArcInfo) to the Web (Internet Map Server).

- An open API for customization and development. Mapping clients can be built using MapObjects in any standard Microsoft development environment or using ArcInfo software's Open Development Environment. Because all the clients sit on top of SDE, you can access large spatial data sets without having to implement the spatial components yourself.

- Component technology to support sophisticated spatial analysis. ESRI GIS has tools to support geocoding, three-dimensional visualization and analysis, raster image processing, and more.

- Conformance to industry spatial data standards. ESRI was the first company to achieve certification for compliance with the OpenGIS Consortium's specification and had led the industry with the implementation of other standards such as Spatial Database Transfer Standard (SDTS).

- Compliance with spatial data warehousing environments. ESRI GIS supports Online Analytical Processing (OLAP) activities such as routing, customer profiling, and competitive analysis. Users are now beginning spatial knowledge exploration, or spatial data mining, using ESRI GIS.

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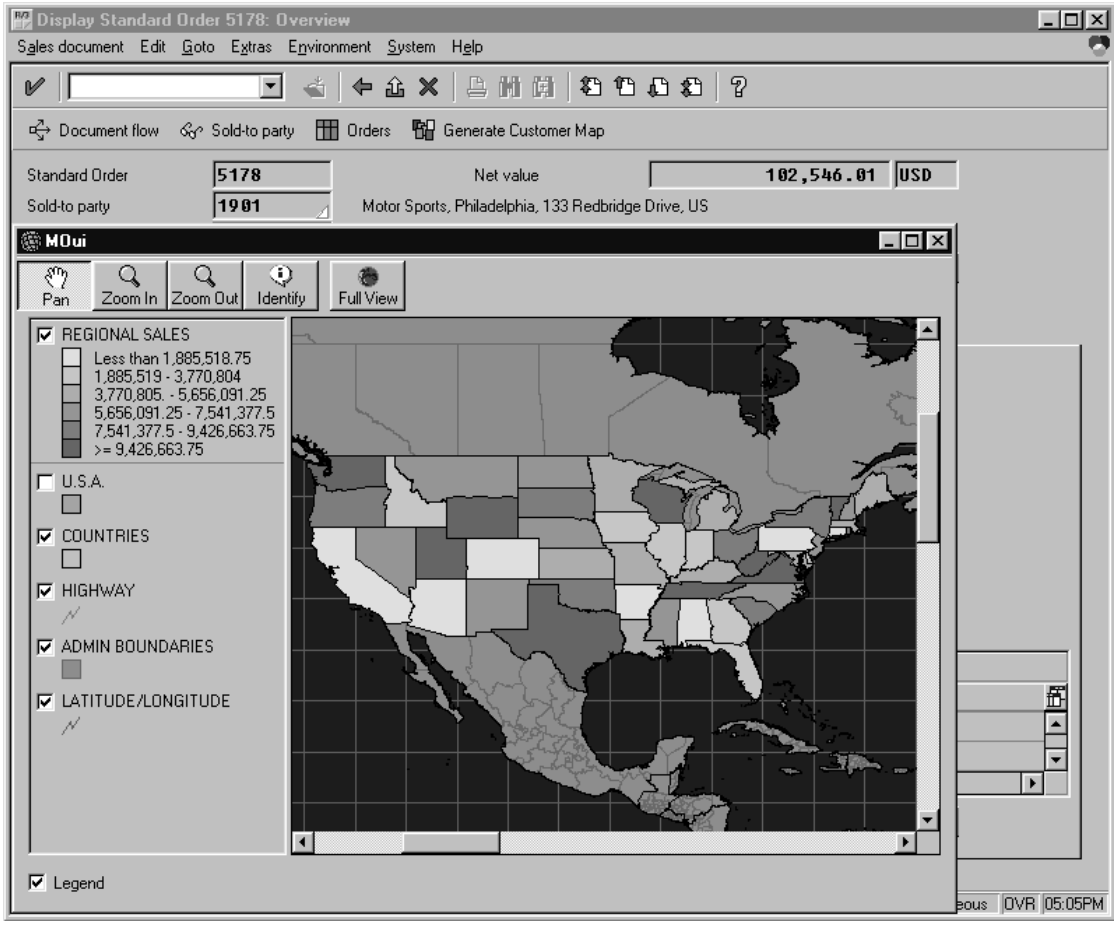


ESRI GIS Within the SAP GUI

Addresses and Geocoding

By now, you have probably seen some of the value that ESRI GIS can bring to your organization, and you are starting to think of specific applications. However, you are probably also wondering just how your existing data can be visualized and analyzed in a spatial environment. The key is often an address, whether a traditional street address (101 N. Main St.), a street intersection (corner of Main and Maple), a postal or ZIP Code, or various combinations of the above.

Let us say that you want to display the location of all your customers who spent more than $1,000 last year on a map that also shows your store locations. The customer addresses represent locations on the earth, but they need to be converted to another kind of location (called geographic coordinates) that the GIS uses to display its map data. These coordinates can be the familiar latitude and longitude or rectangular grid coordinates such as northing and easting.

The process of converting address locations to geographic coordinate locations is called geocoding. ESRI GIS contains a geocoding engine to perform this task for you. You may need to spend time up front standardizing and cleaning addresses in your existing databases in order to get high-quality results from the geocoding process. You will also

want to consider increased address validation at data capture. There is no hiding the fact that improving address quality does entail additional work. However, the payoffs come not only from GIS applications but also from more accurate mailing campaigns and reduced customer address duplication.

A Roadmap for Implementing ESRI GIS in Your Business

You have spent years building your company's databases and implementing your current information systems. You want to leverage that investment into a GIS environment as soon as possible. This white paper presents a three-phase approach that enables you to achieve a return on your GIS investment quickly while building toward your long-term information architecture goals.

Please note the following:

- The implementation of GIS throughout your business can be complex. However, although the data content is specialized and the application software unique, the same principles of information system design and implementation that you use for the rest of your enterprise systems apply here. The points that follow should be used to complement your normal practices, not replace them.

- ESRI can provide system design and implementation consulting services to complement those of your in-house team. We have been in this business for thirty years, and have helped thousands of customers implement GIS in lots of different environments.

- Throughout the implementation of any GIS, you need to stay focused on your data. Investment up front in capturing and maintaining high-quality data will be repaid many times during downstream system deployment and use.

Phase I: Add Spatial Clients on Top of Your Existing Databases

The goals of Phase I are to

- Focus on a few high-profile business problems that can be solved quickly.

- Get key IS and line-of-business team members using GIS and thinking about where it can be applied.

- Get the business started on acquiring and organizing the data that is required.

- Get a fast return on investment.

The following is what you need to do.

- Pick two or three of your most critical and highest value business problems where the solution can be optimized with the use of ESRI enterprise GIS. These will typically be in the categories of determining new store location, developing targeted marketing campaigns, reorganizing sales territories, and optimizing delivery routes.

- Review your existing data assets for spatial information that can be used in the GIS. Locate all addresses in customer, sales, and store location records.

- If you have already deployed an ERP, such as SAP R/3, determine how you are going to access your data such as customer addresses. In Phase I, it might be easiest to download the required records from the ERP, as needed, on a batch basis. As your GIS architecture evolves, you can move toward a transactional approach.

- Undertake a focused short-term evaluation of data quality. Select a sample of your customer records and evaluate the addresses for completeness. Perform a quick geocoding test and see what percentage of the records match an address. The goal right now is not to fix data but simply to evaluate whether the quality is sufficient for your immediate needs and to let you weigh the results. Decide whether or not you need to geocode to the street address level or whether you can use ZIP Codes or sales regions or some other larger boundary.

- Determine what external data, such as streets and roads, municipal boundaries, and demographic data, is required. Find out where you can obtain it (a lot of data is bundled with ESRI GIS solutions to get you started) and how much it will cost.

Spatial Data Availability

Access to good external data sources is a key component of implementing your GIS. Fortunately, the data formats used by ESRI GIS are the most widely available in the world. Some of the data that is readily available include

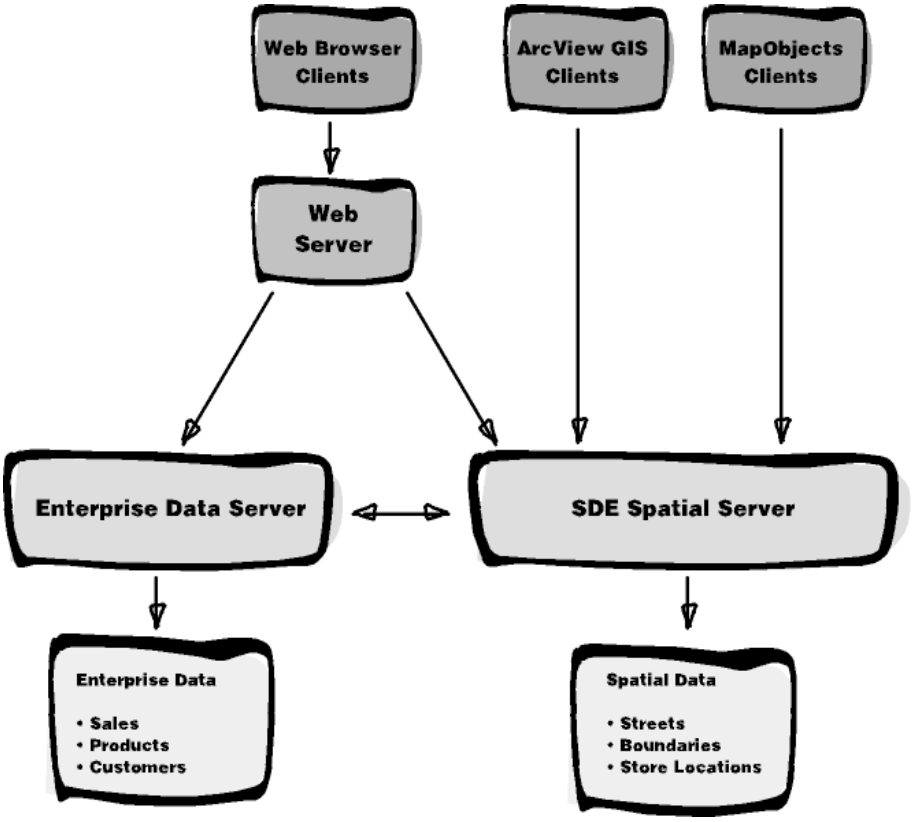
- Street and road networks
- Governmental boundaries—states, provinces, counties
- Natural features such as lakes and rivers
- Basic demographic attributes

Here are some places to start looking for additional data.

- ESRI's ArcData℠ Publishing Program has hundreds of data sets from dozens of vendors, all available in ESRI-compatible formats. Some ArcData data sets can be downloaded directly from ESRI.
- ESRI Web Site—Data Hound is an ESRI service that catalogs and searches Web sites that offer freely downloadable data compatible with ESRI software.
- Internationally, your local ESRI distributor is often the best source of country specific data.
- ESRI's Database Services Group can help you develop your own databases.

- Find out who needs access to the system to solve the problems you identified earlier, and who will be viewing, analyzing, or editing data. From this analysis, you can now begin to put together a preliminary system design. One of the key decisions at this point will be where and how you store your spatial data. During prototype development, you can initially store smaller data sets in ESRI's shapefile format on a server and have them shared by multiple clients in a read-only mode. However, for actual system deployment, you will want to implement SDE. SDE uses spatial

indexing to speed access to large data sets and is designed for multiple user access in a client/server environment.



Typical Phase I Deployment

- Deploy the software. A trial deployment may be as straightforward as installing ArcView GIS on a few existing PCs and accessing a single SDE spatial database on a network server. However, you will quickly want to move to
  - Multiple ArcView GIS clients for users doing more sophisticated analysis
  - Web browser access for distributed enterprise viewing
  - MapObjects applications for custom applications
  - Specialized shrink-wrapped clients such as ArcView Business Analyst and ArcLogistics for specialized analysis
- Begin your analysis. The first step will frequently consist of a geocoding effort, where your existing data, such as customer records with addresses, are run through

the geocoding engine in one of the ESRI clients such as ArcView GIS and their geographic locations are determined. Depending on your system design, you may do this once and store the results for reuse or rerun the geocoding as needed. Then start attacking the business problems that you defined at the beginning of Phase I.

- Plot your customer locations with respect to your stores.
- Color code your sales regions by revenues.
- Compute the demographic profile of all the households within a fifteen-minute drive of a proposed new store location.

- Begin a training, education, and monitoring period. You will need to watch system response times, requests for access to additional data, and additional functionality.
- In parallel, start Phase II.

Phase II: Improve Your Data Breadth and Quality and Enhance System Scalability

Phase II can be started in parallel with Phase I. Its goals are to improve your data quality, especially with respect to addresses, and to start to expand the deployment of the GIS throughout the enterprise.

The following is what you need to do.

- Set up an enterprise GIS team. This team should have representation from the IS organization and the user community. One of its main functions will be interdepartmental cooperation on data stewardship. Groups within your organization need to start discussing who is responsible for spatial data creation and maintenance. The team should plan on regular meetings, perhaps once a month, once established.

  For example, let us assume that you are the publisher of a large metropolitan morning newspaper and are going to use ESRI GIS to manage your carrier routes. These routes have existed on paper maps until now. You are starting to use the GIS to optimize the routes, both to speed delivery and also optimize the use of carriers and delivery trucks. However, now the advertising department wants to use the routes to start selling targeted advertising inserts based on demographic characteristics of subscribers in each route. Who is responsible for maintaining the digital maps of the routes? Is there a cross-charging mechanism for the use of the digital data by multiple departments? This is the real nuts and bolts of enterprise GIS, and you need to think about it up front. You will quickly find that this can be your greatest challenge, not the software deployment as you might have thought.

  You might wonder why you would not set up this team during Phase I. That is an option, depending on the size and nature of your organization. However, it is often more effective to start deployment with a smaller more focused team that can operate in a rapid deployment mode. Then, as applications and data become available, you can "sell" the benefits of GIS to additional departments and begin to expand the reach of the system. Of course, without some communication about what you are

building, you run the risk of alienating your potential users and supporters. It is a fine line between overselling the system and not providing enough information up front. However, this problem is no different from any other IS deployment you have done.

A Note on Organizational Change

Earlier, we said that one of the benefits of implementing ESRI GIS within your organization is that it leads to internal organization efficiencies and promotes organizational change. GIS has this impact for several reasons.

- GIS encourages scattered departments to cooperate on data maintenance and access.
- GIS adds a unified framework within which to view previously segmented data sets.

Taking the earlier newspaper example, the marketing group will become more aware of the issues of carrier route design by virtue of using the route data to develop their targeted marketing program. GIS breaks down institutional barriers and challenges previously isolated departments to work more cooperatively within the enterprise.

- Develop a plan for address standardization if you do not already have one. How are you going to manage unusual addresses, especially in rural areas, that do not lend themselves to geocoding? What about addresses from multiple countries with very different address formats? Consider whether you should geocode addresses directly during data capture or update and add the geographic positions directly to your schema.
- Begin to improve the quality of existing data, especially addresses.
- Start to evaluate your spatial data server environment. Do you need to add additional SDE servers and bandwidth to support more users in more locations? Do you need to replicate static base data onto multiple servers to improve availability and redundancy?
- Begin a serious rollout of ESRI GIS on the corporate Intranet. Many users will want access to spatial data this way, just as they want access to other enterprise data on the Web. You need to consider all of the implications, such as security, bandwidth, and required functionality. In particular, network bandwidth can be an issue with spatial data.
- Tighten the coupling of the GIS with your ERP system. You will want to develop transaction-oriented interfaces between GIS and ERP, so that data can be shared transparently between systems.

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Phase III: Customized Applications and Extended Enterprise Deployment

You now have users, interesting data, and the beginnings of a GIS infrastructure. Now you can begin to really leverage your investment.

- Reevaluate your original business problems. At this point, you probably can envision quite a few more GIS applications that will benefit your organization.
- Start to build a small team that can develop custom applications to meet specific needs. Because the applications are so interesting and the development tools so powerful, you will probably find small pockets of ad hoc development already occurring in your organization. Now is the time to add enough structure to ensure good coding standards and the development of reusable code that can be shared by other teams.
- Start a program of GIS outreach within the enterprise. Almost everyone loves maps, and now is the time to capitalize on your hard work.
- Plan for the future. As usage increases, you will need to stay ahead of the database and bandwidth curve by monitoring response times and adding servers and network connectivity as needed. You also need to review your database backup and server disaster plans. Fortunately, because ESRI GIS uses standard RDBMS and Web server technology, you should be well covered by your existing backup and recovery processes.

How to Learn More About ESRI GIS

If you and your company are new to GIS, you might want to consider bringing in a consultant to help with the initial system design and implementation. ESRI itself can provide consulting services. In addition, because ESRI is the standard in enterprise GIS, there are lots of independent consultants available who are familiar with ESRI technology.

You should also start to take advantage of the wealth of information that is available both on the ESRI Web site and in printed format.

Check out the ESRI Web site at www.esri.com, where you can locate

- White papers including *Spatial Data Warehousing*, May 1998, and *Interfacing ESRI GIS to SAP R/3*, May 1999
- Sample data and extensive information on locating data sources
- Internet Map Server demos
- Information on the full suite of ESRI GIS solutions

ESRI Press publishes a number of useful books including

- *ArcView GIS Means Business*, ESRI Press, 1997
- *Serving Maps on the Internet*, ESRI Press, 1998
- *Enterprise GIS for Energy Companies*, ESRI Press, 1998
- *GIS in Transportation*, ESRI Press, 1999

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- *GIS for Everyone*, ESRI Press, 1999

These books are available from the online ESRI GIS Store as well as through online bookstores such as Amazon.com.

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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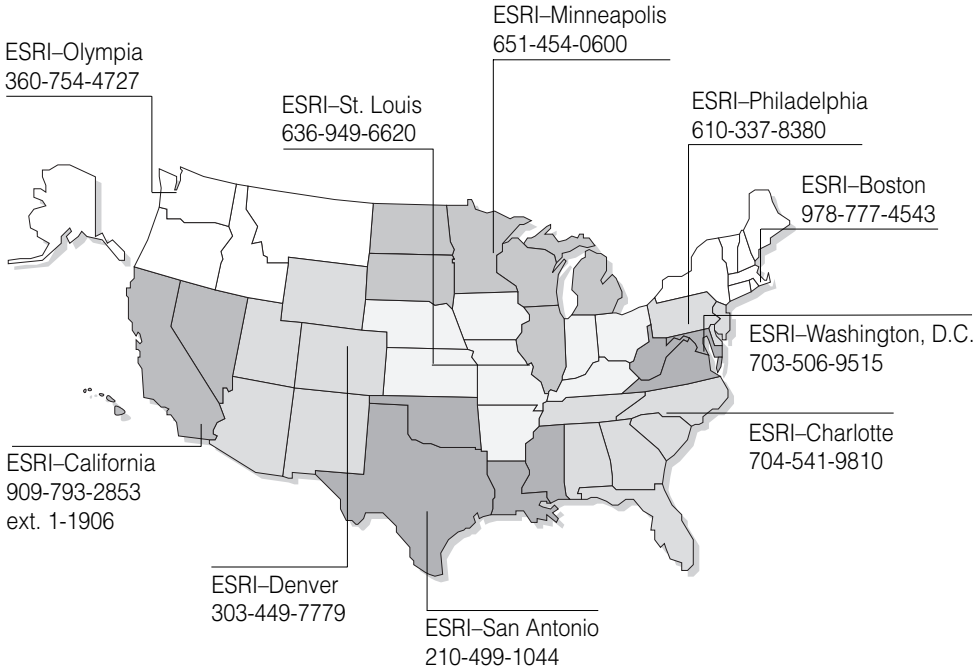

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No. GS-35F-5086H

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