Geographic Information Systems and Business Intelligence: Perfect Together

A Technology Brief
## Table of Contents

1. Executive Overview
2. Introduction
3. What Is Business Intelligence?
4. How Does Business Intelligence Work With GIS?
5. What Are the Primary Benefits That GIS Users Receive From BI?
   - Enhanced Analysis for Problem Solving
   - Data Access
   - Superior Reporting Capabilities
6. What Other BI Benefits Can be Extended to GIS Users?
   - Integrated Data Management
   - User Security
   - Other BI Functions
   - A Synergistic Relationship
7. How Do I Enable My GIS Data for Enterprise Reporting and Will This Require Additional GIS Resources?
8. How Does a Dynamic BI Reporting Adapter Differ From My Current GIS Reporting Tool and Where Can I Get One?
Executive Overview

Using a question-and-answer format, this paper presents a vision of the synergistic power that can be exploited by integrating business intelligence and geographic information systems. Examples that graphically demonstrate the business potential of these combined solutions are provided.

A geographic business intelligence solution (GBIS) enables users throughout the extended enterprise to rapidly and intuitively analyze real-time information with a spatial component by presenting business intelligence information in the context of physical location. GBISs are available today, thanks to a corporate alliance between Information Builders and ESRI Technology. The two leaders in their respective fields have joined forces to deliver a GBIS that extends the real-time enterprise business intelligence and reporting capabilities of Information Builders' WebFOCUS to ESRI's powerful ArcIMS geographic information systems (GIS) environment. The combined solution improves decision-making and responsiveness while extending the reach of GIS to address a wider range of business applications and integrate natively with more than 250 data sources.
The one dimension often missing from a map is its full informational context. And the one dimension missing from certain business reports is their spatial context. What if the two could be combined? These scenarios demonstrate the potential:

- For years, the USDA had used business intelligence (BI) technology to report on the disposition of funding for its land development program. But when the agency installed a geographic information system (GIS) and began to plot grant disposition geographically, they found something they had never noticed before. Although intended to assist rural farmers, the grants were concentrated around city suburbs! It took a GIS-generated map to clearly illustrate the problem.

- A supermarket ran a BI report showing groups of products most often purchased together. They were surprised to see disposable diapers and beer in the same group. Their GIS software had predicted buying habits by plotting the movement of people through the store, but it took a BI system to analyze the data and uncover this relationship. (Apparently, dads are sent out to purchase the diapers.)

Until recently, cultural barriers have prevented the combination of GIS and BI technologies, which were designed for use by people who were trained in separate disciplines, working in separate departments. GIS solution coordinators traditionally work for the vice president of engineering and have degrees in geology or some scientific area, whereas BI tools are usually under the domain of the CIO or a business department and are supported by programmers and business analysts. The two might share data resources, but until recently, GIS was not available to business users, and IT assets like BI were not generally available to GIS coordinators.

But now an exciting convergence of GIS and BI is taking place – creating geographic business intelligence solutions (GBIS). Information Builders and ESRI, leaders in business intelligence and mapping technologies, respectively, have created adapters that integrate the two technologies. As a result, users of each can benefit from the other. The analysts at the USDA, for example, are able to select data, run a report, and map it. And the supermarket's management can select a product from a floor map and run a related-purchases report. By combining the functionality of both solutions, users are able to discover new patterns that reveal new business opportunities.
What Is Business Intelligence?

To a GIS coordinator and to GIS end users, business intelligence may be unfamiliar terminology. It generally refers to the information that is garnered from the raw data organizations collect from their various processes. Since data in its raw form can only offer so much information, enterprises are increasingly electing to use business intelligence software to realize that data’s full potential. BI software is comprised of specialized computer programs that allow an enterprise to easily aggregate, manipulate, and display its data as information.

High-quality enterprise BI technology, like Information Builders’ WebFOCUS, provides comprehensive, fully integrated functionality including enterprise reporting, and query and analysis capabilities that streamline decision-making throughout an organization. The best BI solutions are Web-based for scalability/performance, zero-footprint deployment, and ease in integrating with other applications and technologies. Leading enterprise solutions like WebFOCUS are also known for their ability to deliver reports throughout the enterprise and beyond, formatted according to the needs of end users.

For a simple example of business intelligence at work, think of a publicly available Web site that assists high school students in the selection of colleges. Drop-down boxes provide selection ranges for school size, location, course offerings, sports programs, grade average, SAT scores, and tuition. Selections are made, a process is run, and a listing of schools is returned in the form of a report. Students can analyze results, change parameters, and resubmit queries.

Applying GIS technology to this scenario, we would see users go through a similar process, but instead of generating a report, they would generate a map. Once in the mapping environment, they could perform analytical tasks, such as routing, that are spatial in nature. Back in the BI view, end users also could perform online analytical processing (OLAP) on the data, drill down to greater detail, or download the data into additional tools such as spreadsheets.
How Does Business Intelligence Work With GIS?

GIS adapters allow GIS and BI environments to interoperate. This extends and enhances the functionality of each. In the previous example, the student looking to visit her favorite colleges can use the BI tool to select her schools, run a report, then map the results, move into the GIS environment, and use routing to plot out a college visitation trip. Once the important schools are mapped out, she can select an area on the map and return to the BI environment to widen the search and possibly visit other schools outside her initial query but close enough to her itinerary to warrant a visit.
GIS users gain three immediate benefits from BI systems:

■ The first is the enhanced decision-making that comes from combining reporting analysis with GIS analysis.

■ The second is improved data access. GIS tools are able to access relational data through ODBC and native drivers. But the 360-degree business view demands more, especially since enterprise data comes in many different formats and is often nonrelational. Data access is central to an enterprise business intelligence solution; WebFOCUS provides complete data-access functionality, including the ability to translate nonrelational to relational data, join capabilities across different data types, and cross-platform data access. A single WebFOCUS query can select, extract, and join data from several different databases and operating systems. In our simplified college selection example, the student could join data from a table listing NCAA divisions and their standings and use this to help select possible schools. See Figure 3 (page 8) for a transportation company’s more complex scenario.

■ The third benefit is superior report presentation and delivery. GIS tools provide some reporting capability, but presentation and delivery are strengths of a top business intelligence offering like WebFOCUS. In our college selection example, it would be helpful to have control over the final presentation of the report so schools could be sorted and display fields selected. In addition, it might be beneficial to print the report in PDF format or to download it into a spreadsheet and e-mail that to the soccer coach at one of the schools. All of these things could be done with good enterprise BI technology.

Enhanced Analysis for Problem Solving

BI tools can manipulate data in many ways. Data can be grouped, sorted down and across a page, or displayed in both a tabular report and a matrix. Any row, column, or cell can be linked to another report and the underlying data passed to that process. This, in fact, is how BI and GIS tools interoperate. Parameters are passed from a BI-generated report to the GIS environment, which selects comparable data from its attribute and spatial databases, renders a map, and uses the data to plot the coordinates. This makes all the special functions of the BI environment available to the GIS coordinator and end user.

The following examples demonstrate this interoperability.
**Ad Hoc Reporting**

Ad hoc reporting allows an enterprise's BI end users to generate reports with a simple wizard-like series of menus. Report output is generated in HTML, PDF, or Excel. In the same way, output can be passed to the GIS and mapped. In addition, these reports can be incorporated into the GIS menu of reports and launched from the map.

**Grouping**

In Figure 1, a report is displayed on the right. As you can see, it groups information by liability amount. In the above case, there are six counties in this group. By selecting the value greater than or equal to $200,000,000, the unique identifiers for the six counties are passed to the map and are highlighted. Grouping is just one of the many BI functions that can benefit GIS end users and the people who design their applications.

![Grouping Example](Image)

**Symbiotic Analysis**

GIS environments offer visual analyses that would otherwise be unavailable to BI users. In Figure 2 (next page), an insurance agent zooms in on the west coast of Hillsborough in order to identify large policies whose owners are located in the path of a storm coming through the gulf. GIS tools are best at answering the question “where?” whereas BI tools like WebFOCUS are best at presenting information in the textual or numeric format that is most meaningful to a particular user. In this example, the menu of reports has enabled an area of the map to be selected and
the underlying data has been passed to a report that summarizes the information in a spreadsheet-like matrix. From here, the insurance analyst can toggle between the report and the map to locate high-value policies whose owners are among those most exposed to danger.

![WebFOCUS GIS Adapter for ArcIMS](image)

Figure 2.

This symbiotic type of analysis can only be provided with a two-way adapter. Reporting tools that simply display mapped data in a formatted list don’t provide this level of benefit. Only a two-way adapter can provide the benefits of both GIS and BI to someone by enabling them to use both technologies at once. This kind of interoperability ultimately makes GIS more strategic within an enterprise.

**Adding a Geographic Dimension to Enterprise Dashboards**

By seamlessly wrapping GIS into a dashboard for business users and providing standard BI menus within the map itself, IT can look at using GIS as a standard part of their enterprise dashboard interface. This integration of reports and their associated maps implemented as “portlets” within a portal environment like WebLogic, Plumtree, or WebSphere is only possible with BI tools like WebFOCUS, whose components have been implemented in this way.

Ultimately, by publishing spatial and BI information as a Web service, the GBIS functions, defined by a combination of reports and maps, will become a common part of all Web-based information delivery.
**Data Access**

Of all the benefits BI offers, none is more valuable to the GIS user than enhanced data access. BI tools are designed to access multiple data formats. Information Builders’ WebFOCUS, for example, can provide access to more than 250 data sources and applications. Its data adapters can perform three functions: translation, data joining, and cross-platform access.

To the GIS developer and end user, this provides a tremendous leap in functionality. The BI tool sees the GIS attribute table as just another database. This allows users to query and report on all data in the enterprise – from geographic to financial and beyond. And because the adapter is dynamic, this data can affect the design of the map, or be included in a report that results from a map selection.

![Enterprise Level Integration – Transportation Model](image)

As shown in Figure 3, a transportation company has a storehouse of business data in a variety of database and operating systems. This data is tied to different applications that monitor customers, suppliers, and accounting information. It also has a GIS department that has been building a system to track information about railroad cars, switching conditions, and cargo.

By incorporating a BI solution’s suite of adapters, the railroad company can get a single view of data that lets them ask questions that cross disciplines. For example, if a switching problem
occurs, they can ask as a GIS question, “What service organizations are within 50 miles of the problem?” and pass the results to the BI system to help answer the follow-on business question, “Of the selected suppliers, which have been most reliable?” The data that is used to answer these questions is operational, not staged. The BI adapter system ties the GIS system to the enterprise in real time allowing analysts to make decisions with the most current data available.

**Superior Reporting Capabilities**

To best communicate a message, we need the flexibility to present our information in whatever way is most meaningful to our audience. BI tools excel at presentation. Information can be presented in tabular format or a matrix. It can be converted to any graphical format. Traditional reports might not actually look like reports at all but might take the form of letters, income statements and balance sheets, or business prospectuses.

The screen in Figure 4 is a compound document that displays multiple reports as a set of frames within one screen. In this case, the reports consist of tables and graphs. The table in the center of the document uses data visualization. Colored bars highlight revenue values that can be cross-referenced to areas on the pie chart.
At the bottom of the screen is a table that uses a stylesheet template to clearly present headings and data in the body of the report. Conditional styling can be applied to color code values and cells based upon business rules. At the top of the screen, we can see that the compound document has been personalized and that summary information has been placed where it will be most visible to the reader.

GIS developers benefit from this enhanced ability to present their GIS data. Maps and reports can be combined in the same way to clearly present trends and relationships and to convey information to each user in a format that's most meaningful to that individual.
**Integrated Data Management**

Most GIS developers use data management techniques in some form. In many cases, data is extracted from multiple sources, cleansed in some way, loaded into a staged database, and then geocoded and mapped. Often this is a manual process that requires a complete refreshing of both the staged database and the GIS environment. As a result, the effort is time consuming, subject to error, and never results in a database that is completely synchronized with enterprise data.

BI platforms contain complementary technologies that can be made available to GIS developers in a dynamically integrated environment. One of those technologies is data warehousing. In a warehouse environment, data administrators access the same adapter technologies available to BI developers to create a single, SQL view of all data. In addition, metadata tools define enterprise data and add business rules for data cleansing. Finally, a schedule of work can be created that organizes download tasks into automated and regular routines.

Like most BI reporting technology, ETL (extract, transform, and load) tools generate SQL requests. However, instead of generating a report, they use the answer set to populate a cube or a data mart. GIS users can use ETL tools to copy data into data marts that they join to GIS attribute tables, or they can build and populate the attribute tables themselves. In either case, the addition of ETL technology can save the GIS developer time and increase the reliability of the data.

Figure 5 (next page) shows data stored in separate “silos” at the Louisiana Department of Social Services. Individual reporting systems were developed for each. These reports were run manually and consolidated. A data feed was extracted from each, placed in a separate table, and massaged so it could be available for mapping. This particular user used a mapping program available from Yahoo. The ultimate solution eliminated the manual processes and replaced it with an automated warehouse. Once built, a single reporting environment was created that accessed this consolidated data store. Because they implemented this system using a BI solution that incorporated ETL, the users obtained several additional benefits. One of these was the ability to drill through the data mart to get directly to operational data. Such a drill-through feature allows users to get the performance benefits of a warehouse with the timeliness and accuracy of an operational system. Additionally, because the BI solution’s dynamic GIS adapter was used, the ability to warehouse and drill through to detailed data was made available to GIS users as well.

This particular application is designed to monitor food stamp usage and minimize fraud. Inspectors are able to analyze warehouse data in reports and maps to isolate suspicious

**What Other BI Benefits Can be Extended to GIS Users?**
patterns of behavior and locate recipients and stores on a map. The reporting environment analyzes suspicious transactions such as even-dollar purchases and purchases that don't leave enough time to bag groceries. The GIS environment shows where a recipient lives, where he shops, and what other stores are located in his area. By toggling between GIS and BI environments, an inspector is able to identify cheaters. Any recipient who passes several stores and makes a fast, even-dollar transaction in another is considered to be acting suspiciously and will receive a visit from the inspector.

Because of the unique strength of these combined environments, users can access all the required data, present it in meaningful reports, and toggle between map and report to analyze behavior. The benefits to the developer and user are obvious, and the return on investment undeniable. The Department of Social Services estimates that it will save 1 to 10 percent on its $600 million food stamp program. This easily cost-justifies the efforts of IT and GIS in designing, building, and implementing the application.

**User Security**

BI systems incorporate security at many levels. Log on security protects intranet-reporting systems and launches the appropriate view for that user. Administrators have a complete view that allows
them to manage data and users. Developers write reports and create templates for knowledge workers and end users. End users generate ad hoc reports and customize and share templates.

To some extent, these capabilities can be extended to the GIS user. For example, the reporting menu in a mapping environment can be customized based upon the view of the user. In our transportation example, a maintenance manager may see one series of reports, a financial analyst another. And if appropriate, security can be applied at the data level, the visibility of fields and records varying according to each user’s privileges. A manager might see performance and salary information not available to those who report to her.

When maps are driven from reports, the GIS environment can be enabled with all the security features business intelligence provides.

**Other BI Functions**

Many other BI capabilities can be applied to maps. OLAP manipulates dimensions and measures in a drop and drag GUI environment. The results can be presented in a report and users can drill down from the report to a map.

Another popular feature of a BI platform is its incorporation of information delivery technology. Reports can be scheduled, burst, and sent as an e-mail attachment to a directory of users. They can also be launched from a mobile device. Information delivery functionality like this allows the GIS user to generate a report from a map and deliver the selected information in an e-mail or to a mobile device.

**A Synergistic Relationship**

Any report that allows you to pass parameters and drill down to another report will also allow you to drill down to a map. When driving the map from a report, the map receives benefits of BI functionality like those mentioned in the report shown in Figure 4 (page 9). Similarly, when a report is launched from within a GIS menu, it often does so at the end of extensive spatial analysis. In this way, an end user benefits from the extensive analytical capabilities of the GIS tool. Each solution complements the other. Each enhances the other by enabling the analyst to drill deeper into data to predict behavior or events and uncover the truth.
How Do I Enable My GIS Data for Enterprise Reporting and Will This Require Additional GIS Resources?

GIS data does not need to be modified to enable enterprise reporting. The reporting tool with a GIS adapter will read GIS data as is. In addition, the best BI reporting solutions will join GIS data with any data in the enterprise regardless of format or location as long as there is a common data element. This is true for BI users who want to spatially enable enterprise data as well.

While GIS resources are needed to create a GBIS, this is a one-time task that should not require a dedicated resource after the implementation phase. Instead, knowledge workers and business users can do much of the ongoing development themselves. The goal of a good enterprise BI system is autonomy for the users who need to access and manipulate data for their everyday business tasks. By developing reports, sharing them, mapping the results, and including them in the catalog of map-driven reports, business users will build a system that satisfies their specific requirements. IT needs to simply provide them with the framework on which to build this system.
How Does a Dynamic BI Reporting Adapter Differ From My Current GIS Reporting Tool and Where Can I Get One?

If you're analyzing in your GIS tool and then reporting the results, you're not getting the benefits of a BI environment. This is only possible with a tool that lets you pass the results of BI queries and analyses back to the GIS map.

Geographic business intelligence solutions are available today, thanks to a corporate alliance between Information Builders and ESRI Technology. The two leaders in their respective fields have joined forces to deliver a GBIS that extends the real-time enterprise business intelligence and reporting capabilities of Information Builders’ WebFOCUS to ESRI's powerful ArcIMS geographic information systems environment.

The combined solution allows users throughout the extended enterprise to rapidly and intuitively analyze real-time information with a spatial component by presenting business intelligence information in the context of physical location. GBIS improves decision-making and responsiveness while extending the reach of GIS to address a wider range of business applications and integrate natively with more than 85 data sources.
Sales and Consulting Offices

North America
United States
- Atlanta, GA (770) 395-9913
- Baltimore, MD Consulting: (703) 247-5565
- Boston, MA (781) 224-7660
- Charlotte, NC Consulting: (704) 494-2680
- Chicago, IL (630) 971-6700
- Cincinnati, OH (513) 891-2338
- Cleveland, OH (216) 520-1333
- Dallas, TX (972) 490-1300
- Denver, CO (303) 770-4440
- Detroit, MI (248) 743-3030
- Federal Systems, DC (703) 276-9006
- Hartford, CT (860) 249-7229
- Houston, TX (713) 952-4800
- Los Angeles, CA (310) 615-0735
- Metropolitan, NY Sales: (212) 736-7928
  Consulting: (212) 736-4433, ext. 4443
- Minneapolis, MN (612) 602-9100
- New Jersey, NJ (973) 593-0022
- Orlando, FL (407) 804-8000
- Philadelphia, PA (610) 940-0790
- Pittsburgh, PA (412) 949-6969
- St. Louis, MO (314) 519-1411
- San Jose, CA (408) 453-7600
- Seattle, WA (206) 624-9055
- Washington, DC Sales: (703) 276-9006
  Consulting: (703) 247-5565

Canada
Information Builders (Canada) Inc.
- Calgary (403) 538-5415
- Montreal (514) 630-1134
- Ottawa (613) 233-0865
- Toronto, ON (416) 364-2760
- Vancouver, BC (604) 688-2499
- Victoria (250) 995-8674

Mexico
Information Builders Mexico
- Mexico City 52-55-91-71-14-61

Europe
- Belgium Information Builders Belgium
  Brussels 32-2-7430240
- France Information Builders France S.A.
  Paris 33-14-507-6600
- Germany Information Builders (Deutschland)
  Düsseldorf 49-211-522877-0
  Eschborn 49-6196-77576-0
  Munich 49-89-35489-0
  Stuttgart 49-711-7287288-0
- Netherlands Information Builders
  (Netherlands) B.V.
  Amsterdam 31-20-4563333
- Portugal Information Builders Portugal
  Lisboa 351-217-230-720
- Spain Information Builders Iberica S.A.
  Barcelona 34-93-344-32-70
  Bilbao 34-94-425-72-24
  Madrid 34-91-710-22-75
- Switzerland Information Builders
  Switzerland AG
  Wallisellen 41-1-8394949
- United Kingdom Information Builders
  (UK) Ltd.
  London 44-208-9824700
  Warrington 44-1925-820111

Australia
Information Builders Pty. Ltd.
- Melbourne 61-3-9631-7900
- Sydney 61-2-8223-0600

Representatives
- Austria FOCUS Informationstechnologie GmbH
  Vienna 43-12-1136-3870
- Brazil InfoBuild Brazil
  São Paulo 55-11-3017-5178
- China InfoBuild China, Inc.
  Shanghai 86-21-5080-5431
- Colombia Coransa
  Bogota 571-635-0273
- Finland InfoBuild Oy
  Helsinki 358-9-7250-2250
- Greece Applied Science
  Athens 30-210-699-8225
- Guatemala IDS de Centroamerica
  Guatemala City 502-361-0506
- Gulf States Bahrain, Kuwait, Oman
  Qatar, Saudi Arabia, Yemen
  United Arab Emirates
- Al-Gosaibi Information Systems
  973-274-090
- Israel NESS A.T. Ltd.
  Tel Aviv 972-3-5483638
- Italy Selesti G C Applications S.P.A.
  Genova 39-010-64201-224
  Milan 39-02-2515181
  Torino 39-011-5513-211
- Japan K.K. Ashisuto
  Osaka 81-6-6373-7113
  Tokyo 81-3-3437-0651
- Simplex Solutions
  Tokyo 81-3-5652-3180/81
- Korea Unitech Infocom Co. Ltd.
  Seoul 82-2-3477-4456
- Malaysia Optegra Sdn Bhd
  Selangor 60-3-82042188
- Norway fSolutions AS
  Stavanger 47-51-44-47-44
- Philippines
  Beacon Frontline Solutions, Inc.
  63-2-750-1972
  Corporate Information Solution
  63-2-633-1321
- Poland Comfort/meridian Polska SP
  Warsaw 4822-630-2660
- Singapore
  Automatic Identification Technology Ltd.
  65-6286-2922
  Legato Solutions and Services Pte Ltd.
  65-684-63150
- South Africa International Computers S.A.
  (Pty.) Ltd.
  Johannesburg 27-11-2335911
- Sweden Cybernetics Business Solutions AB
  Solna 46-7539900
- Taiwan Galaxy Software Services
  Taipei 886-22-3897722
- Turkey Istanbul
  Erdogansoft 90-212-257-5555
  Key Soft Ltd. 90-216-428-5933
- Venezuela InfoServices Consulting
  Caracas 58-212-763-1653

Toll-Free Numbers
- Sales and Information
  (800) 969-INFO
- VAR and Reseller Information
  (800) 969-4636

*Training facilities are located at these branches; additional locations are available.