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Business Intelligence + Geospatial = Location Intelligence

APOS Location Intelligence: Teradata Edition

Raising Intelligence with Geospatial BI

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The APOS Location Intelligence Solution enables organizations to drive the full potential of geo-enabled business intelligence by integrating the geographic visualizations, analysis and content from Esri with the business intelligence reports and analytics of SAP BusinessObjects, while utilizing the Teradata® Database as the powerful analytic foundation for both spatial and business data.

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PERSPECTIVE

Find your edge

With geospatial analytics, enterprises are integrating a new dimension of insight.

by Scott Gnau

"Who Moved My Cheese?" Dr. Spencer Johnson's 1998 best-selling book, tells the story of mice that, after doing the same thing over and over, get accustomed to the same result—finding cheese at the end of a maze. One day, however, they follow the prescribed routine only to discover their cheese has been moved, and they don't know where.

This fable has broad implications and parallels in the business world. First, being surprised by change is not a good thing, and second, the location of your business's "cheese" is really important. Increasingly, Teradata customers are expanding their use of geospatial data, which shows them where their figurative cheese is and will be, as well as how to reach it.

Another dimension

Many organizations are embracing location and spatial extensions to analytics. Location intelligence (LI) offers new opportunities for enterprises that effectively integrate location and spatial information with their traditional analytic data. In so doing, they add a new, solvable dimension of "where" to their traditional business analyses of "who," "what," "when" and "how much." Two market factors are driving an accelerated adoption of these extensions:

> **Fast integration of sensor technologies is creating an unprecedented amount of detailed and real-time data, which now includes locations.** Consider cell phone, automotive and PC technology, all with embedded GPS technology for consumers, or expanded radio frequency identification (RFID) deployments in the retail and healthcare industries. Suddenly, various devices are generating discrete and actionable location information. When integrated with traditional types of analytic data, it can provide for higher-order decision making, optimization of distribution and, ultimately, profitable customer experiences.

> **Spatial applications are proliferating.** Heat mapping to optimize customer flows in retail, for example, has demonstrated great value. Early adopters are looking for the next level of integration with their analytic data—such as the ability to optimize customer flow for high-value market baskets—to create better business decisions. Like most paradigms in the data warehouse industry, integration of these applications with the enterprise data warehouse (EDW) not only yields extended and better decision-making capabilities but also reduces costs by eliminating duplicate data stores and the management of separate, stand-alone marts.

Find the cheese

As always, Teradata leads the way, in this case by enabling its customers to incorporate LI for better decisions. We are helping drive adoption of location data and spatial algebra with the release of Teradata 13. In this release, we added extended functions supporting more spatial analytics. At the same time, we introduced major performance enhancements for all location data and spatial operations. This makes it easier than ever to add the "where" dimension to your EDW.

Analytics and business intelligence (BI) are key tools for enterprise leaders to embrace change. Explore extending your analytic reach by integrating spatial information into your data warehouse. Doing so will empower you to fully answer your "where" questions. So unlike the mice in Johnson's tale, you won't be caught off guard. Instead, you'll know exactly where to find your cheese and where it will be tomorrow. T

Scott Gnau is chief development officer of Teradata.

Photography by Robert Houser

Pinpoint opportunity

Location intelligence empowers organizations to discover new insights

BY CHERYL D. KRIVDA

In the IT industry, "Where?" is a question most commonly answered by facts about storage locations, Internet URLs or virtual servers. With the growing use of geospatial data in enterprise data warehouses (EDWs), however, the question "Where?" is leading many organizations to new insight—and potential competitive advantage.

Although business intelligence (BI) practices have long focused on answering questions about who, what, why and how, rarely have business analysts been able to use geographic data to support their work. The growing availability and increasingly mainstream use of geospatial data is changing that.

By combining information about location or geography with other critical business data, organizations create location intelligence (LI). With this new perspective on their data, consumers and businesses can make more efficient and effective choices. "Location analytics use the spatial aspect of data to determine patterns and items that are not found without understanding location and distance," explains Mark Smith, CEO of Ventana Research, a research and advisory services firm. "LI can help companies gain critical insights, make better decisions and optimize important processes and applications. We believe that LI will be one of the key technologies to enable business innovation in the rest of this decade."

> "Today GIS is being implemented as an **enterprise asset.** GIS data and processes are viewed as **strategic assets.**"
>
> —Jack Dangermond, Esri

Enriching data with geography

Using geographic data to inform business decisions is not groundbreaking for some industries. Traditional geospatial technology has been used for decades by companies with extensively distributed assets—such as logistics providers, utility companies and government agencies. Technicians with deep geography and analytics backgrounds use rich spatial databases, third-party demographic data, and specialized geographic information system (GIS) tools to plan more efficient routes, place new power lines or map pole locations.

But compared with the next generation of business analytics, traditional geospatial technology, which is typically found in departmental applications run on dedicated servers, is the technological equivalent of a fold-out map. Used primarily for special-purpose applications, this technology is eclipsed by the instantaneous, Google Earth-like views provided by LI tools, which can be accessed by users at many skill levels across an enterprise.

Executive summary

The trend: Savvy organizations are incorporating information about location and geography in their enterprise data warehouses (EDWs), enabling them to use geospatial data to support business intelligence (BI).

The results: By creating geographic context within data, companies can gain better insight, enhance customer service, reduce fraud and decrease risk.

The keys: Integrating geospatial data directly in the EDW enables in-database processing and analytics, leading to faster business insight and innovation.

How does it work?

Organizations create LI when they integrate postal references, mapping and other geographic information within their EDW. In many cases, locations are already in existing data stores but not in a format that's conducive to analytics. A simple process called geocoding can convert postal addresses to geospatial data that can then be measured and analyzed to deliver LI. By tapping into this resource, decision makers can use the geographic or spatial context to inform choices and respond to opportunities. The possibilities are vast:

- By merging location information with demographic and other business data, companies can create interactive maps that let users drill down to details about any specific location.

- Analysts can investigate new relationships and trends to pinpoint the average income in areas where the highest-performing stores are established.
- Retailers can determine how store sales vary by population level or proximity to competitors.
- Consumer products companies can identify customer complaint locations, enabling rapid product traceability if a recall is required.
- Sales reps might better target their customer visits by analyzing the geography of sales targets.
- Fleet managers are able to use new tools to maximize asset utilization across the business.

US Transportation Command

Integrating detailed global intelligence, location information and logistics data in a visual, easy-to-access format is a key enabler of the US Transportation Command (USTRANSCOM), according to retired Gen. John W. Handy, commander of USTRANSCOM from 2001 to 2005. An immense organization, USTRANSCOM is made up of more than 150,000 people stationed worldwide, representing components of the US Army, Navy, Marine Corps, Air Force, Coast Guard, National Guard, Air Force Reserve and civilian agencies.

"TRANSCOM is responsible for the worldwide distribution of all personnel and equipment in the Department of Defense via air, land and sea modes of transportation," Handy explains. By integrating a staggering amount of information concerning these shipments by way of computer programs, commanders are able to access accurate critical data on countless missions. "Where is my stuff?" becomes just one question that can be answered quickly and factually.

"With a flat-screen TV on the wall of my office and a remote mouse on my desk, I could click on an airplane icon on a map of the world," Handy recalls. This instantly displayed information about the type of aircraft, its maintenance history, a complete list of the crew, the equipment and supplies on the aircraft, where it was going, where it had been, and a history of the entire mission. Similar information is available for ships at sea as well.

Real-time location data, incorporated with other detailed information, empowers USTRANSCOM to make timely, well-informed decisions to coordinate its global operations.

—Mike Westholder

A broader worldview

The maturity of LI applications varies by industry. "Public sector organizations, especially governments and municipalities, are leading the charge in terms of spatial applications," says Michael Gonzales, managing partner of DSS42 LLC, an industry research company specializing in strategy and architecture. "They can't function without LI. On the other hand, there are many larger companies that could benefit from spatial analysis capabilities but are holding back."

Among the laggards are private sector organizations that suffer from a lack of understanding of spatial data as well as a fear of highly complex geospatial data technology. "IT sometimes struggles with trying to understand spatial data," says Gonzales. "'What is it? How do we maintain it? How can we glean value from it?' For these groups, LI is just new."

Yet the growing use of geospatial technology is forcing even late adopters to rethink their approach. With today's technologies and platforms that support geospatial data, it can be easily incorporated and managed within most standard BI architectures. A simple user interface enables vendors to buffer the complexity of spatial technologies from users. What's more, geospatial data is increasingly embedded in other systems.

> "LI can help companies gain **critical insights,** make **better decisions** and optimize **important processes** and applications."
>
> —Mark Smith, Ventana Research

At the same time, business users are becoming more familiar with spatial technologies. With tools such as Google Earth and Global Positioning System (GPS) devices in their cars and mobile phones, they are more accustomed to thinking about data from a geographic perspective.

LI meets the EDW

As a result of these trends, companies are beginning to migrate from siloed geospatial tools designed for use by departmental experts to enterprise tools available to a broader range of users. Many in the private sector are rethinking their earlier aversion to geospatial tools, especially considering how readily available the technology has become.

In addition, users need little or no mathematical or statistical training. "Today's LI is easy to use and designed for a broad range of business needs—not only the GIS specialist," says Smith.

In addition, early adopters of GIS technologies are beginning to incorporate geospatial data into their EDWs so they can generate cross-enterprise intelligence. "Today GIS is being implemented as

an enterprise asset," says Jack Dangermond, founder and president of Esri, the leading GIS technology vendor. "GIS data and processes are viewed as strategic assets and competitive differentiators in the current economic environment."

Industry experts detect clear parallels between LI and technologies such as data mining, which also existed in silos for most of its first three decades. Then, as BI teams began to see the value of performing in-database processing to handle applications—such as immediate scoring of customers—they realized they could no longer propagate the data to siloed marts. Instead, they had to work within the EDW. "Spatial analysis shares similar characteristics and will progress on the same path," Gonzales predicts. So just as in data mining, geospatial analysis is shifting to an in-database approach.

Competitive advantage

However, organizations should not wait to get started. "If you're not at least at the start of a spatial perspective in your data warehouse, then you're behind," notes Gonzales. "In the next two to three years, it will be difficult to remain competitive without some spatial perspective."

As geospatial technologies become mainstream, companies can find new ways to use LI to create competitive advantage. Consider the following scenarios:

> "In the next two to three years, it will be difficult to **remain competitive** without some **spatial perspective.**"
> —Michael Gonzales, DSS42 LLC

- **Public safety.** A municipal contact center representative takes a call from someone who says a light is out in front of her house. After receiving an address, the agent displays a map of the area, which shows multiple nearby streetlights. With a view of the intersection, the agent asks focused questions and determines that the non-functioning light is a traffic signal. By tying the geospatial data into the EDW, the agent is able to submit a proper repair request.
- **Optimum store locations.** A retail chain with plans to open several hundred new stores uses geospatial technology to determine where those stores should be placed. Using LI, analysts identify relevant clientele demographics, such as most profitable customers. Analysts combine that knowledge with information about potential sites' proximity to highways, public transportation and competitors' stores to select the best location options.
- **Proactive service.** An insurance company represents customers in an area that sustains hurricane damage. Geospatial data shows wind velocities in the vicinity of the storm. The company sends service representatives to affected customers to survey damage, offering payment on the spot for damages or repair services. At the same time, the company uses the data to identify potentially fraudulent claims from customers whose properties lie outside the range of the storm's damaging winds.

The benefits delivered by creating geographic context within data can be significant. Early adopters report cost savings, faster and more effective decision making, and enhanced customer service and satisfaction. Better intelligence supports increased insight, reduced risk, decreased fraud and improved business process efficiency—all creating a wealth of bottom-line advantages. In one case, an insurance company that used LI to create a self-service, risk-density analysis environment for underwriters reduced data processing time from three hours to five minutes.

Map a path to success

If there is a challenge to successfully deploying LI, it might lie in demystifying spatial technology to incorporate location analytics as part of corporate BI culture. With sufficient knowledge within IT and business organizations, enterprises can identify spatial opportunities to enhance analytics insight. Essentially, it's a matter of applying business knowledge with existing corporate data to determine LI.

Because IT organizations may be unfamiliar with geospatial data, that knowledge can be transferred by hiring experts to facilitate geographic data integration. Fortunately, BI vendors are starting to offer solutions to do just that as they guide their customers down the LI path. In the end, the key to driving value is for companies that understand their business and data to derive new location measurements and analytic data.

As always, cultural change—especially from the top down—is critical. "Getting business executives to understand the power of LI and how to ensure their organization is using it effectively is key," Smith says. "Leadership and sponsorship are also critical, along with understanding the benefits of the investment."

However, as business executives grasp how they can use LI to not only innovate but also discover opportunities, the value will be obvious. Then the primary question will shift from "Where?" to "Why not?" T

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For more information visit **Teradata.com**.

PARTNER CONNECTION

Enhanced understanding

Visualization unlocks the power of location intelligence.

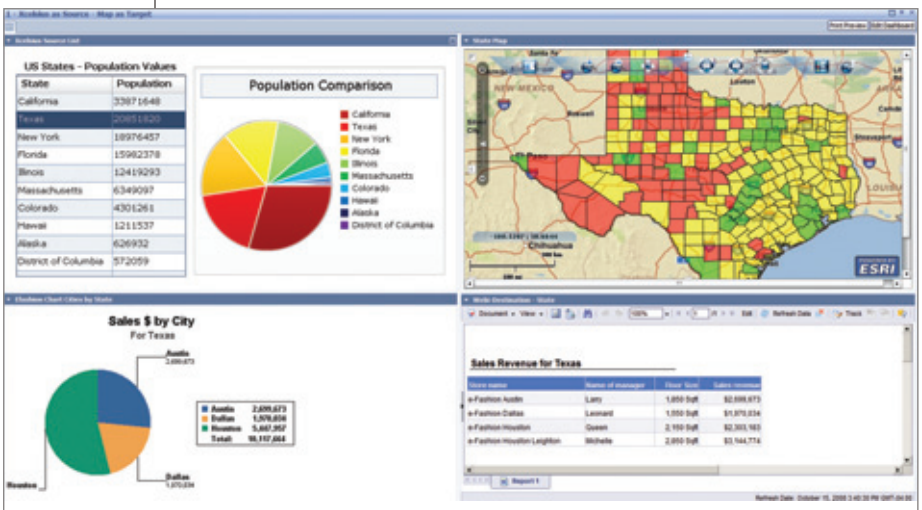
by Allan Pym

Today, most business intelligence (BI) users deal with spatial data in the same way they do other data—in the form of tables, charts, and graphs in standard printed or Web reports or dashboards. Any map visualizations are often predefined, static, and generally limited to simple shapes, labels and annotation.

Moreover, ad-hoc analysis in the spatial dimension, such as drill up/down or slice-and-dice, is mostly done by interacting with a table as opposed to a more natural and intuitive map. Maps are used simply to provide another baseline representation of the results versus being a front-end tool for analysis.

Fortunately, the technology exists to do more with geospatial data through high-quality cartographic representations that convey meaning not apparent in reports or simple maps.

FIGURE **Geospatial Sales Analysis Dashboard**



Enhanced understanding is just one advantage of this dashboard that utilizes a thematic, color-coded map linked with other statistics and graphics to monitor and analyze market and sales success by city, county and state regions.

Express yourself

Enhanced mapping and spatial data visualizations bring an inherently clear expression of location and are unsurpassed in their ability to provide context to spatially relevant information. Such geospatial content provides a natural and easily consumed representation of complex factors from a wide range of decision topics such as risk exposure, asset deployment, program effectiveness, consumer behavior, and market potential.

The value of such enhanced visualizations is maximized when provided within a meaningful, flexible and broad-view framework that brings improved visibility and clarity to the user, with the least amount of intrusion to existing workflows. With so many decision workflows being facilitated by reports and dashboards which BI systems provide, combining the maps and geographic content into the BI platform and content is a natural and far-reaching combination.

The considerable opportunities for enhanced understanding derived from this joint leverage of technology platforms have been the key drivers behind the APOS Location Intelligence Solution.

Exploiting the geographic dimension

To fully exploit the geographic dimension of data, existing data warehouses and the front-end BI tools that use them must be extended or interfaced with geospatial tools and content.

Teradata has shortened the gap between such tools and their use by providing basic spatial data storage and analysis capabilities within the database. The decision and analysis power of combining business intelligence with mapping and geospatial visualizations is taken to a new level of performance and insight when utilized with the Teradata 13 spatial engine.

Spatial data from any source can be moved into the Teradata enterprise data warehouse (EDW) to take advantage of its inherent speed and scalability in support of historic and predictive analysis or real-time integration with operational systems such as CRM. With the spatial and business data stored together, users have a single source and version of the truth for both tabular and spatial data under one roof which simplifies system life-cycle management as well as integration with other enterprise applications.

The decision and analysis power of **combining business intelligence with mapping and geospatial visualizations** is taken to a new level of performance and insight when utilized with the Teradata 13 spatial engine.

The Teradata Edition of the APOS Location Intelligence Solution allows organizations to drive the full potential of geo-enabled business intelligence to existing and new user communities by integrating the geographic visualizations, analysis and content from Esri with the business intelligence reports and analytics of SAP BusinessObjects. Utilizing Teradata as the powerful data foundation for spatial and business data in the EDW users can access spatial data from either the Teradata system or Esri and use it within their familiar BusinessObjects applications. (See figure)

For a GIS-centric information consumer, this means beginning the query process by navigating and making selections on a map, then directly launching context-sensitive reports based on the selections made in that map. For a BI-centric information consumer, the solution enables maps and other GIS content to be embedded within reports and dashboards. The embedded maps can be dynamically linked with the data, charts and graphs and other analytics used in Crystal Reports, Webi, or Xcelcius. This lets users immediately see refreshed report or map views based on selections in either one. Maps can also be included in Web or printed reports, such as PDF.

Visualize this

Location intelligence brings a wealth of new insight—visualization of that data can make it even richer and more meaningful. The Teradata Edition of the APOS Location Intelligence Solution brings it all together in one, complete and powerful application so organizations can reap the benefits that much easier and faster. T

The Esri Platform

Esri, a leading provider of geographic information system (GIS) solutions, has been developing software, providing services and educating the industry since 1969.

Its GIS platform works with the simple feature model of the Teradata Database by providing storage of complex spatial data. These representations facilitate the use of advanced spatial analysis and visualization and help to ensure the quality and integrity of the spatial data.

The Esri platform also helps harmonize and consolidate spatial data found throughout the organization by serving as a staging, cleansing and enrichment platform for spatial data destined for the EDW—data in multiple formats or from different vendors. In the end, it enables map visualization, advanced spatial analysis, and high-quality cartographic output of data in the EDW.

"GIS has become an enterprise application that helps businesses run better in a variety of innovative ways," says Jack Dangermond, Esri's founder and president. "By integrating geospatial data and functions directly in the enterprise data warehouse, organizations are realizing greater operational efficiencies and providing new and consistent insight to decision makers."

Allan Pym, APOS Vice-President of Sales, has spent over 12 years with APOS focusing on helping organizations with their SAP BusinessObjects deployments.

ONLINE
For more information on the Teradata Edition of the APOS Location Intelligence Solution, visit **Teradata.com**.

Location intelligence, all in one place

Safe Software and Teradata work in tandem for easy geospatial data analysis. *by Lori Janies*

A look at the partner

SAFE SOFTWARE

COMPANY
For more than 15 years, Safe Software has specialized in overcoming spatial data interoperability challenges. The choice of leading geographic information system vendors for integration into their own solutions, Safe Software, headquartered in Surrey, British Columbia, enables thousands of customers worldwide to break the barriers to spatial data access.

PRODUCTS
Safe Software powers the flow of spatial data with its software platform, FME. The recognized standard in spatial extract, transform and load, FME is the only complete solution for data conversion. Designed for true data interoperability, FME enables people to use spatial data where, when and how they choose.

ATTRIBUTES
FME provides a flexible tool for organizations to bring their geospatial and non-spatial data together into a central location within the Teradata Database and access it for use in spatially enabled applications.

BENEFITS
Organizations can efficiently combine their geospatial data with the business intelligence (BI) in their Teradata system for an integrated view, helping fuel better, informed business decisions based on a complete, integrated view of all of their data.

An underwriter at a large insurance company wants to determine the likelihood that a particular piece of land is in a zone prone to floods, earthquakes or other hazards. To clearly understand the risk before writing a policy for a client who is planning to build there, she will need to analyze the data her company has in 15 different applications and systems that capture some kind of geospatial data in multiple formats, such as weather statistics, historical floodplain information, client addresses and maps.

If the company had specialized software that could extract and transform geospatial information from all of its systems into a common data model and load it into the enterprise data warehouse (EDW), the underwriter could quickly and easily analyze and derive location intelligence directly in the EDW and deliver the results to a visualization tool such as Google Earth. An accurate decision about the land's potential could be made in a relatively short time.

The company could reduce overall risk exposure, raise its bottom line and help boost stockholder confidence. The time saved would also afford the insurance underwriter the opportunity to complete analytical tasks or perform job duties that would not have been possible otherwise.

Location intelligence

Geospatial analysis captures the exact coordinates of a location using precise latitude and longitude data. Once thought to be applicable only to specific industries, such as oil and gas or transportation, the use of geospatial data has intensified. Cell phones and cars often have embedded GPS devices, and Web navigation sites such as Google Earth let users visually home in on virtually any location on the planet.

Furthermore, it's estimated that up to 80% of data in the EDW has some kind of location reference. With the right tools, this information can allow companies to tap a rich vein of strategic intelligence.

> The joint solution enables organizations to **centralize their geospatial data** for easy access, integration and analysis.

Solution components

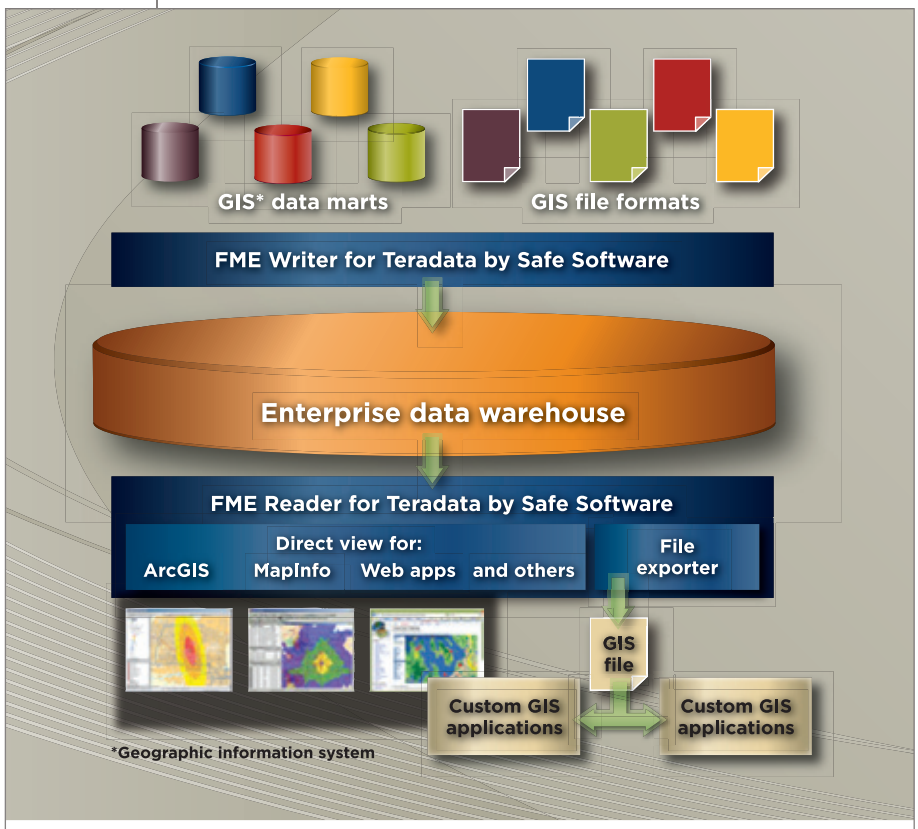
The partnership between Safe Software and Teradata combines the strengths of the leader in geospatial extract, transform and load (ETL) tools with those of the leader in data warehousing to create an environment applicable to any industry wanting to improve its business intelligence (BI) capabilities through location-related data.

The joint solution enables organizations to centralize their geospatial data in the Teradata Database for easy access,

integration and analysis. Components of the solution include:

- **Safe Software's FME® application.** This spatial ETL application enables organizations to quickly centralize and access their geospatial data. Optimized to work with the Teradata system, FME enables the fast transfer of geospatial data into the Teradata Database, as well as easy access to this centralized data within geographic information system (GIS) applications. The software is available in a desktop version, which provides a stand-alone authoring environment for smaller volumes of data, and a server version, which offers access to larger volumes of data in a distributed environment or over the Internet.
- **Teradata Database.** Geospatial capabilities accept and transform native geospatial data types for in-database analytic functions. Teradata provides a robust analytic foundation by combining and storing strategic and operational data with geocoded and spatial reference data inside the EDW.

FIGURE **Safe Software spatially enabling the Teradata system**



FME, the spatial extract, transform and load solution from Safe Software, works directly with the Teradata system to enable users to take advantage of the location intelligence provided through geospatial analytics.

Reap the rewards

Geospatial data specialists can use the solution to extract information from disparate sources originating in hundreds of file and database formats, transform that information into a common data model, optimize its quality and load it into the Teradata Database. There, the data can offer company leaders a more complete picture of their business operations through spatial information analysis.

FME makes it simple to extract information from the Teradata Database for use in spatially enabled applications regardless of the target system and schema. The solution also offers read-access to the Teradata Database within popular GIS applications such as Esri ArcGIS, Intergraph GeoMedia, Autodesk Map 3D and MapInfo Professional.

The ability to perform robust geospatial information analysis:

- Adds a geospatial dimension to data analysis for broader, more accurate results
- Better informs business strategies, operational tasks and risk analyses with more reliable BI
- Lowers operating costs through increased productivity and greater efficiency
- Reduces overall risk

Analyzing geospatial data in an EDW environment can make an enormous difference to organizations, not only in insurance but also communications, banking, government and other industries. Providing state-of-the-art access to this previously unavailable data, the Safe Software and Teradata solution offers companies a strategic advantage against their competition. T

Lori Janies writes about business and technology for various publications.

ONLINE
Go to **www.safe.com/teradata** or select Our Partners on **Teradata.com** for more information.

SERVICES

Which way from here?

Assess your geospatial capabilities to gain greater BI value. *by William M. Smith and Lance Miller*

Geospatial analytics are nothing new. Dr. John Snow, considered the father of epidemiology, is credited with the first use of geospatial analysis when, in 1854, he developed a map of the spreading cholera epidemic in London.

In an effort to determine the root of the epidemic, Snow mapped the location of cholera incidents in relation to various sites that were suspected causes, such as water pumps and workplaces. He discovered that those afflicted with cholera got their drinking water from a specific pump, while those not taken ill received their water elsewhere. His findings, via the analytic use of mapped data, helped prove the connection between water sources and the disease.

Photo illustration by Randall Nelson

Sense of place

Flash forward more than 150 years. The widespread adoption of GPS-enabled mobile phones and other products, along with the general availability of geospatial analytical tools, offers organizations the opportunity to glean information from enormous amounts of geospatial data:

- **Events or point patterns** expressed through occurrences identified as points in space. Examples are crime spots, nodes on a distribution or transportation network, and location of customer residences in relative position to competitors.
- **Continuous surfaces** estimated from a set of field samples and regularly or irregularly distributed. The type of data results from surveys of geological, topographical and ecological resources.
- **Areas with counts and aggregated rates**, including data from population surveys, such as census and health statistics, that refer to individuals situated in specific spatial points. These are aggregated and delimited by closed polygons that can be tailored to evaluate a particular business opportunity, such as comparing the locations of a store, its shoppers and its competitors.

Standard relational database management systems that include spatial SQL now perform an analysis that explicitly considers spatial relationships present in data. Before spatial queries are developed and formally tested by SQL, they are usually preceded by an exploratory analysis that includes a visual examination of the data in the form of graphs and maps, followed by discussions of spatial patterns.

Geospatial techniques have significantly developed since Snow's analysis. What has not changed is the first law of geography: While all things are related, near things are more related than distant things. Building geospatial analytical capabilities—with a proven approach that also provides immediate business benefits—is a sound way to understand those relationships and the opportunities they create.

A proven approach

To develop a long-term vision for their geospatial initiatives, successful organizations use best practices to align business and technology. Without this vision, businesses often revert to a "define it as you go" approach in which they build a solution without first knowing where they are headed. The initial release of a geospatial solution might be successful, but design decisions will make it difficult down the road to support new and evolving requirements, often resulting in costly rework.

Businesses considering their geospatial analytical capabilities need to evaluate their existing portfolio of tools and techniques and develop a strategy that provides for their orderly and cost-effective optimization and improvement as required. The insight and knowledge of experienced experts will enable companies to gain a thoughtful assessment of their geospatial solution.

Establishing itself as a leader among geospatial consulting firms is Claraview, a division of Teradata. Not only can it solve the most complex geospatial challenges but it also provides business intelligence (BI) and geospatial services to clients in the Americas. Claraview's capabilities leverage Teradata Database functionality and are optimized via collaboration with Teradata solution architects and technical leads to develop an integrated geospatial solution.

The organization's extensive experience working with the most popular geospatial tools enables its consultants to assist with assessing and developing geospatial analytical capabilities. This allows its clients to exploit geospatial technology, all while delivering a fully functional system on time and on budget. The assessment comprises five key activities:

1 INFORMATION-NEEDS ASSESSMENT

Articulating the business uses of geospatial data is fundamental to a company's success at location intelligence. A documented model is used to chart how the geospatial value chain can improve a company by linking its business objectives with decisions, decisions with questions, and questions with the geospatial data required for analysis.

2 EXISTING SYSTEMS ANALYSIS

After the information needs assessment, organizations must review their existing systems to understand the level of effort required to complete three critical tasks:

- Geocode data
- Perform comparisons
- Distribute analytic results

Latitude and longitude coordinates must be assigned to business locations to make geospatial analytics functional. Geocoding entails either subscribing to an outsourcing service such as NAVTEQ or Tele Atlas or purchasing an application for internal use. Each service maintains a worldwide database of addresses with latitude, longitude and geospatial features. Additionally, most address-cleansing tools, like those from Informatica or Trillium that exist as part of extract, transform and load (ETL) functions, can match coordinates to addresses maintained in the organization's database.

Comparisons can now be performed with most relational databases that have adopted spatial SQL standards. Furthermore, many conventional BI providers offer the capability to accept the results of geospatial analytics, as well as invoke the services of your spatial SQL-enabled relational database.

3 GEOSPATIAL WORKSHOP

To validate and refine your geospatial business requirements, a workshop is offered that includes a broad group of units within your organization. Using the information model in a top-down approach, the workshop's goal is to define and build upon the relationships between current geospatial capabilities and business applications. The solicited feedback and commentary help clarify the organization's expectations as to how businesspeople will use this information in day-to-day decision making.

4 TOOL EVALUATION

While a geospatial systems analysis reveals potential gaps between your organization's current capabilities and its information needs, a tool evaluation will help fill those gaps. Based on communications with IT personnel, decision makers and relevant business units that perform

Implementation roadmap

One method of measuring the value of an organization's geospatial solution is through an implementation roadmap. By defining the scope for each project, a roadmap will enable more accurate estimates regarding the time and level of effort involved. The cost of each project can then be weighed against the expected value based upon business requirements.

Implementation roadmaps can also generate support from business units. During geospatial initiatives, conflicting views about the potential business value and return on investment (ROI) can be problematic. The roadmap provides a means to communicate the overall geospatial direction to business units. This will provide early feedback regarding the perceived value of an initiative. Such feedback can help ensure that geospatial development activities focus on the areas of greatest business value. Lower priorities can be deferred or eliminated from the roadmap so that time and money aren't wasted.

—W.M.S. and L.M.

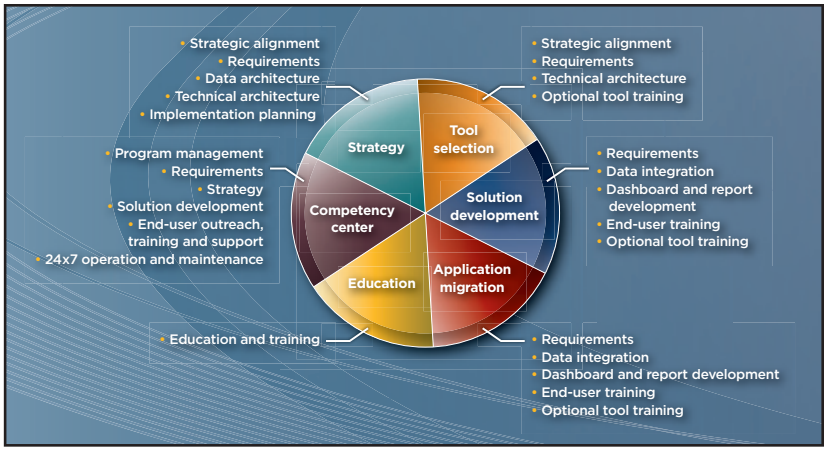
Claraview/Teradata services

The Claraview/Teradata advantage is built on five fundamental pillars:

1. **Breadth and depth of geospatial expertise.** Claraview/Teradata consultants continue to increase their expertise as clients increasingly incorporate capabilities into their business intelligence (BI) infrastructure.
2. **An end-to-end geospatial services portfolio.** This suite of professional services supports the entire enterprise geospatial life cycle—geocoding, geospatial data warehousing and geospatial-enabled BI.
3. **Delivery excellence.** Claraview and Teradata have a proven history of delivering projects on time and on budget.
4. **Geospatial-focused methodology.** Projects are delivered through a repeatable geospatial-focused methodology.
5. **The Teradata advantage.** As a division of Teradata, the leader in enterprise data warehousing, Claraview has unique and unparalleled access to Teradata capabilities, resources, knowledge and general data warehousing consulting services.

With the six pre-defined available program offerings shown in the figure, Claraview and Teradata can assist clients in making the best possible use of their geospatial solution.

—W.M.S. and L.M.



geospatial analysis, a scorecard is prepared that ranks tools according to features and functions, analyzes them, and recommends the best tool among them.

5 GEOSPATIAL ASSESSMENT

When conducting your assessment, think strategically but act tactically. Strategic thinking involves adopting a vision of how geospatial information will enable your organization and how the resulting analytics will support its business needs for long-term growth. Acting tactically translates this vision into a set of value-based projects with clear dependencies and checkpoints for measuring the success of a specific initiative.

The assessment uses the results from the geospatial workshop and applies strategic thinking and tactical action to produce four key items:

- **Conceptual view** describes a vision for the solution based on the business requirements identified during the geospatial workshop.
- **Data architecture** identifies in your database the sources of data needed for geospatial analysis and describes how those sources must be transformed, or geocoded.
- **Technical architecture** shows where software such as geocoding, geospatial ETL and analytical tools fit into the architecture. It identifies the high-level information flow among all architectural components and recommends vendors that are best able to supply products, if any are required.
- **Implementation view** uses a roadmap to establish geospatial capabilities over time as a series of manageable projects, each one of which returns value to the business. It proposes a phased implementation based on the priorities identified during the geospatial workshop. The proposed sequence focuses on maximizing business value while minimizing project risk.

Valuable answers

Developing geospatial analytical capabilities is crucial to an organization's competitive strength. No longer can a business settle for answers to "When?" "How?" and "How quickly?" The focus should also include "Where?" To get these answers, companies must apply a tested, repeatable approach to geospatial analysis that will deliver greater business value. T

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ONLINE
Go to **Teradata.com** for more information on Claraview/Teradata's geospatial services.

Beyond numbers

Turn geospatial data into smarter decisions.

by Arlene Zaima and Ellen Boerger

To the uninitiated, it might seem like geospatial analysis would be useful only to the likes of NASA engineers or military commanders. However, much of the data stored in a corporate enterprise data warehouse (EDW) has a spatial component—including addresses, weather data, phone numbers and postal codes.

Until recently, there had been no easy way to integrate and analyze spatial and enterprise business data. Fortunately, technology has advanced to the point where companies can capture and analyze geospatial data in the EDW, adding a new aspect to business analytics.

Geospatial analysis

Geospatial data is precise location data represented by latitude and longitude coordinates. While data traditionally found in the EDW can reveal some location-related information, such as addresses or regional boundaries, that information has limited potential for tracking trends and making predictions. For example, most EDWs contain company or customer postal code data. However, a single postal reference can represent hundreds to thousands of different addresses. As these can span an enormous region, they fall far short of accurately pinpointing a location or mapping a specific area of influence.

Location data by itself is one-dimensional. Tying it to data about a company's products, services or customers is what enables in-depth analysis. With access to integrated geospatial and traditional EDW data, however, company analysts need not limit themselves to any pre-defined parameters. Geospatial analysis enables them to define virtually any area of interest they want to explore. In addition, company leaders can manage their organizations based on business-specific points, areas and locations.

Technological challenges

An explosion of geographic location data has occurred recently thanks to Web navigation sites like Google Earth and Global Positioning System (GPS) devices embedded in cars, cell phones and portable navigation units. Despite the prevalence of this type of data, many companies do not incorporate the information into their business analytics. This is because:

- Many different coordinate systems and file types exist for presenting geospatial data. In addition, thousands of geospatial reference systems calculate coordinates differently with algorithm variations among countries and geospatial product manufacturers. Manually attempting to reconcile these variations to produce business intelligence (BI) requires more resources than most companies are willing or able to expend.
- Not all data warehouses are capable of integrating geospatial and enterprise business data, much less dealing with the data transformation issues required to analyze it.
- The enormous amount of geospatial data generated typically exceeds what most systems can process in a timely manner.

Companies looking to add geospatial analytical capabilities to the data warehouse should make sure the solution they

choose offers fast, in-database analysis of integrated traditional EDW and geospatial data. The product must also work seamlessly with leading third-party geospatial and data visualization tools and applications.

Industry examples

Businesses that want to glean the greatest strategic information from their company data will benefit from an EDW with geospatial analysis capabilities.

COMMUNICATIONS

Network operations and communications engineering companies generate massive amounts of data every day. The ability to analyze that data quickly with a high level of granularity holds the key to reducing churn and increasing revenue through greater operational efficiency and improved quality of service.

Through geospatial analysis, companies can, for instance:

- Capture daily transactions from the network to identify areas that are experiencing a large number of failed connection attempts for voice, data, text or Internet
- Identify all complete and incomplete calls by time of day, location and subscriber to quickly diagnose problem areas and follow through with troubleshooting procedures
- Determine busy periods by location and call type so that capacity can be increased or hotspot areas rerouted to improve call throughput and service in areas of high call density

Photography by Corbis

INSURANCE

Insurance companies rely heavily on predictive analysis and risk measurements. The ability to use geospatial data in addition to traditional EDW data offers this industry a rich vein of analytical knowledge that was previously unavailable.

Geospatial data can help insurance companies:

- Quickly perform density analysis to identify the number of policies written for the same block near a high-risk area so that the insurer can mitigate that risk
- Easily aggregate and analyze an area's geography, topography, construction, history of claims, and details of the risk zone for flood, earthquake or other issues to accurately price a policy

RETAIL BANKING

The retail banking industry is under enormous pressure to reduce costs and offer greater individualized tools and services to customers. Geospatial analysis can help bank leaders achieve these goals faster and with greater data transparency.

Among other possibilities, geospatial analysis enables this industry to:

- Perform a robust analysis of ATM use based on location, demographics and proximity to other businesses to help ensure adequate placement and optimal usage
- Conduct a mortgage density analysis to ensure the bank does not hold the mortgages for an entire block of retail stores; such a case could expose the bank to undue risk or losses, because when one anchor store leaves or fails, it often has a negative impact on others in the area
- Determine whether branch locations are optimized to attract and retain the highest-value customers—analysis could include comparison of branch and customer location demographics, services offered and peak period staffing requirements over time

By **integrating traditional** and **geospatial data** in the **EDW**, companies of all types and sizes can add a **valuable new dimension** to their **data analysis.**

GOVERNMENT

Along with their supporting agencies, governments generate vast amounts of data—exponentially more than the average enterprise. Because of the enormous size and complexity of this data, these

entities have an even greater need to use geospatial data to help quickly perform the most accurate analysis possible. Like other large industries, government can benefit greatly from the geospatial visualization tools that make understanding and synthesizing large volumes of data easy and intuitive.

For example, integrated geospatial analysis can let government agencies:

- Solve or prevent transportation problems quickly by providing tools to predict or measure the impact that shifts in travel demand or capacity have on infrastructure resources
- Help military aircraft operators predict the time between repairs on key aircraft parts based on how they have been historically affected by weather conditions and geographical areas
- Aid healthcare workers in determining disease patterns and the efficacy of treatments across large populations over time by visually overlaying disease types and total number of cases within high-risk areas such as those with exposure to communicable diseases

RETAIL AND HOSPITALITY

Company leaders in the retail and hospitality industry already know the value of analyzing who their customers are, as well as why and how they make certain purchases. Incorporating geospatial data into this analysis helps these organizations easily answer other questions that were previously too difficult or impossible to pin down, including, "Where are my customers driving from, and what products or services entice them to make long journeys?" and "Which loyal and highly profitable customers are 'at risk' due to a competitor's store opening in the area?"

> Companies should make sure the solution they choose offers **fast, in-database analysis** of integrated traditional **EDW** and **geospatial data.**

Other uses of geospatial data for the retail and hospitality industry include the opportunity to:

- Accurately forecast the competitive position of stores over time to improve targeted marketing campaigns, set product price points and drive product assortment
- Optimize the prices and boundaries of delivery service areas to focus on the largest set of customers for the greatest profit

Added value

By integrating traditional and geospatial data in the EDW, companies of all types and sizes can add a valuable new dimension to their data analysis. This opens for them countless new possibilities to meet strategic initiatives, increase competitiveness and thrive with confidence. T

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Ellen Boerger is a global industry solutions director at Teradata with a focus on the retail industry.

Why Teradata for geospatial analysis?

Teradata offers a cost-effective way to integrate location data into your enterprise data warehouse (EDW) for in-depth analysis and robust location intelligence (LI) by providing these components:

- **Teradata Database** supports native geospatial data types and performs geospatial functions directly in the database.
- **Geospatial services** help customers implement new geospatial projects or enhance existing environments with comprehensive, end-to-end geospatial data integration services.
- **Solution partners** maximize LI by providing complementary technology such as spatial extract, transform and load (ETL) capabilities, data visualization, geospatial data and applications.

By integrating geospatial data and functions directly in the EDW, the features provide all of the benefits of in-database processing, such as:

- **Enhanced efficiency and cost-effectiveness** reduce the cost of geospatial analysis by consolidating data marts and eliminating data redundancy and inconsistencies across applications.
- **Higher-speed processing** leverages the parallel capabilities of the Teradata Database for fast response to questions and queries. The Teradata Geospatial solution helps eliminate data movement between systems, making data available for analysis sooner.
- **Improved analytics** adds a new dimension of analytics and business intelligence (BI) capabilities to your organization with other locations to help increase efficiency, make better-informed strategic decisions and boost profits across the enterprise.

—A.Z. and E.B.

Planning a route to location intelligence

Geospatial capabilities create new opportunities for enriched analytics.

by Michael Riordan and Michael Watzke

Traditional location data—customer address, shipping address, sales region, etc.—has long been part of data models. While database platforms have offered powerful business analytics based on these postal locations, much more accurate geographic location data is now easily available with Global Positioning System (GPS) technology.

The ability to capture geospatial data across almost every aspect of business should prompt companies to re-evaluate their analytics and processes to find ways to leverage this capability. With Teradata 13, geospatial is brought to the enterprise data warehouse, and powerful location analytics expands out of specialty applications and becomes available throughout the organization.

New opportunities

The Teradata geospatial feature is based on the SQL/MM standard and includes a new geometric data type, along with a library of spatial functions. The ST_GEOMETRY type supports a large spectrum of shapes, from simple points, lines and curves to complex polygons. This allows representation of real-world objects in the database, such as:

- Locations
- Streets and railroad tracks
- Rivers and lakes
- Neighborhoods, towns and cities

In essence, any shape that supports your particular business, such as a complex sales territory, can be identified by the ST_GEOMETRY type.

Beyond capturing point locations, a new level of analysis can be achieved as third-party geospatial reference data is added alongside your business data. For instance, insurance companies can add flood-zone maps to their data models to help analyze insurance policy risk, and retail companies can integrate demographic data to target customers.

Adding geospatial data

Location information already exists in data models. Generally, tables that capture addresses are candidates for adding the ST_GEOMETRY field. The following are examples of how geospatial data is added to the database using SQL. (A database script for these examples is included in the online version of this article.)

In the first example, three tables are created to represent stores, customers and competitors. A minimum set of fields captures entity ID and name with location as a geospatial field:

```
CREATE TABLE customers (
   id          INTEGER NOT NULL,
   name        VARCHAR(50),
   location    ST_GEOMETRY )

CREATE TABLE stores (
   id          INTEGER NOT NULL,
   name        VARCHAR(50),
   location    ST_GEOMETRY )

CREATE TABLE competitors (
   id          INTEGER NOT NULL,
   name        VARCHAR(50),
   location    ST_GEOMETRY )
```

In the next step, known as geocoding, the street addresses are translated into longitude and latitude coordinates. These coordinates are used to create the SQL insert statements. Geocoding can be done manually with mapping tools or through services from an outside vendor, such as Google Earth:

```
INSERT INTO Stores (id,name,location)
  VALUES (1,'Store #1','Point(-82.440
  27.997)');

INSERT INTO Competitors
  (id,name,location) VALUES (1,'Competitor
  #1','Point(-81.300 28.577)');

INSERT INTO Customers (id,location)
  VALUES (1,'POINT (-82.218 28.163)');
```

Geospatial analytics

With this data loaded in the database, value is added to the existing business intelligence (BI) analysis as new ways to harness the power of location intelligence (LI) are understood. Generally, capitalizing on the benefits of geographic location data is accomplished by starting with the basic extension of existing location-based queries and working up the ladder to answer questions like, "How many customers are within three miles of our stores?" and "What is the average distance from each store to our customers?" The paramount advantage comes with integrating location with business data to answer questions like, "What's the average purchase amount for customers from a selected area?"

FIGURE **Out of harm's way**

This Google Earth snapshot was generated with data from the Teradata Database. It shows the path of a storm, the high-impact zone around the storm path and the individual customer locations.

POINTS AND DISTANCE

The Teradata geospatial library of spatial functions includes three distance methods: ST_Distance, ST_SphericalDistance and ST_SpheroidalDistance. With geolocation coordinates, a much more detailed analysis between customer and store location can be calculated than with only ZIP codes. For example, this query can be run to find customers within a certain distance from the stores:

```
SELECT   S.id, S.name, C.id, C.name
FROM     customers C, stores S
WHERE    C.location.ST_Distance
         (S.location) < [X units]
```

Though simplified, analyses using these types of queries are easy to use and understand. However, these queries have some drawbacks. For instance, it can be confusing as to which units of measurement—miles, meters or kilometers—are used for the comparison. When using longitude and latitude coordinates, some conversions from degree units to meters and miles must be done. While this is not overly complicated, it does call for some additional work. Another drawback is that these types of scalar queries require all rows to be calculated. This could result in full table scans—a process database programmers try to avoid. The next section describes a better approach.

POWER OF THE POLYGON

Geospatial is much more than location points. Lines, curves and especially polygons add tremendous value. In the customer distance example, a better approach than basing the query on addresses is to use area polygons. These polygons can be created dynamically with each query. This rewrite uses the ST_Buffer method to create a polygon around the store and the ST_Within method to find matching customers (ST_Within returns 1 or 0 for true/false):

```
SELECT   S.store_id, C.id, C.name
FROM     customers C, stores S
WHERE    C.location.ST_Within
         (S.location.ST_Buffer(x))= 1
```

This type of query can be optimized so that the database is not required to compare all of the records—something that cannot be avoided with the scalar ST_Distance comparisons. In addition, the ST_Geometry polygon can be added to the data model for future queries, thus reducing the need to recalculate the ST_Buffer polygon each time.

GEOSPATIAL REGIONS

Creating and adding regions as polygons to the data model enables using geospatial features to empower better analytics. The data can be from derived objects, such as the previous query, or geometries from third-party sources such as government agencies and commercial vendors on flood zones, census information and marketing demographics. These geospatial polygons can then be used to analyze risk exposure and help make better business decisions.

How an insurance company can use the geospatial functions to estimate a storm's impact on its existing policy holders is shown below. After adding predicted storm paths to the data model as LineString objects, the ST_Buffer method can populate the regions table with a polygon representing the high-impact zone around the storm's path. (See figure.)

```
CREATE TABLE Storms (
  id          INTEGER,
  name        VARCHAR(100),
  path        ST_GEOMETRY  )

CREATE TABLE Storm_Impact_Zones (
  id          INTEGER,
  storm_id    INTEGER,
  area        ST_GEOMETRY )

INSERT INTO Storms VALUES(1,'Hurricane
  Geo', 'LineString(-76.86 27.01,-77.42 27.13,-
  78.08 27.31,-78.66 27.44,-79.11 27.59,-79.48
  27.72,-79.89 27.86,-80.27 28.01,-80.73
  28.23,-81.03 28.39,-81.45 28.65,-81.78
  28.92,-82.05 29.14,-82.22 29.36)');

INSERT INTO Storm_Impact_Zones
SELECT 1,S.id, S.path.ST_Buffer(.15)
FROM   Storms S WHERE  S.id = 1;
```

The value .15 gives an estimated 10-mile buffer, using degrees. The distance between degrees of longitude varies depending on where the location is on the globe. The distance between longitude degrees at the equator is approximately 69 miles but reduces to zero as the location nears the poles.

The map highlights the power and value of integrating geospatial data with business data in the EDW. Enabling the query ST_Within to include customer location data, as shown below, will help calculate estimated risk exposure. This type of analysis empowers better business decisions by providing true LI.

```
SELECT    COUNT(C.id)
FROM      Customers C, Storm_Impact_
          Zones Z
WHERE     Z.id = 1 AND C.location.
          ST_Within(Z.area) = 1
```

From this step, calculating insurance exposure and potential losses is a simple query away.

DATA MODEL DIMENSIONS

Fully leveraging geospatial analytics is reached when data models are extended with new information based on location dimensions. This can be demonstrated with the previous retail example.

The location of the stores and customers, which has already been added to the database, can be extended by creating polygons to represent zones. These zones will be created based on the company's requirements. For this demonstration, the "sales territory" regions around each store will be used.

With the regions added to the data model, the analyses for trends—number of customers, average purchase data, etc.—within these zones can be run using SQL as shown:

```
CREATE TABLE sales_territory (
  id          INTEGER NOT NULL
              PRIMARY KEY,
  name        VARCHAR(100),
  area        ST_GEOMETRY )

INSERT sales_territory(id,name,area)
  values(1,'Store #1 Sales Territory',
  'Polygon((-81.258 27.713,-81.755 28.317,-
  82.665 28.418,-82.736 28.151,-82.362
  27.797,-81.258 27.713))');

INSERT sales_territory(id,name,area)
  values(2,'Store #2 Sales Territory',
  'Polygon((-81.575 29.105,-81.739 28.298,
  -81.262 27.719,-80.450 27.719,-80.627
  28.341, -80.582 28.493,-80.967 29.086,-
  81.575 29.105))');

INSERT sales_territory(id,name,area)
  values(3,'Store #3 Sales Territory',
  'Polygon((-82.683 29.136,-82.668
  28.420,-81.739 28.324, -81.583 29.112,-
  82.683 29.136))')
```

In addition, these aggregation values can become the basis to populate new summary tables, enhancing the data model well beyond the original location points. This derived data, calculated in-database, can uncover valuable trend information, which can then be used by BI tools for deeper analysis.

The following SQL represents the use of in-database analytics to create new aggregate data. Reporting can now be done that integrates these geospatial sales territory regions with customer YTD_sales data to create calculated data per region. Then, if summary tables are created within the database to store these results, they would be available for other reporting tools to use in an analysis:

```
CREATE TABLE customer_territory_stats (
  territory_id      INTEGER NOT NULL,
  customer_count    INTEGER,
  avg_purchase      NUMERIC )

INSERT customer_territory_stats
  SELECT    S.id,COUNT(C.id),AVG(Sales.
            YTD_sales)
  FROM      customers C,
            sales_territory S,
            customer_sales Sales
  WHERE     S.area.ST_Contains(C.loca-
            tion) = 1
  AND       C.id = Sales.cust_id
  GROUP BY 1
```

These numbers show the results:

territory_id	customer_count	avg_purchase
1	795	851
2	1579	781
3	884	756

The dynamics of geospatial

With advances in GPS technology, geospatial location can now become a valuable extension to data models. The examples have demonstrated how simple location-based queries can bring new value to business analytics.

By including third-party geospatial reference data, integrated location analytics can be easily added to the organization's decision-support toolbox. This can lead to the creation of new dimensions of data that might uncover new opportunities.

The power of the Teradata geospatial functions can change the way business location data is viewed and will add LI to business decisions. T

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ONLINE
See the extended version of this article on **TeradataMagazine.com** for more geospatial conversion examples. To get a free geospatial extension package that will accommodate database versions prior to Teradata 13, go to Downloads on **Teradata.com**.

Enabling geospatial

Automated features change latitude and longitude into actionable data. *by William M. Smith*

The sophistication of geospatial abilities and the benefits they bring make understanding this developing business intelligence (BI) component a competitive necessity. In response to this challenge, Teradata 13 has included geospatial features that store and analyze a location's longitude and latitude information. With this level of detail, organizations can link locations to business events.

Teradata's in-database geospatial analysis is based on the SQL/MM spatial standard:

- The ST_GEOMETRY data type enables the storage of geometric data, such as points, lines and polygons in the Teradata Database.
- More than 60 analytic methods enable spatial analysis of data.

These tools enable businesses to integrate geospatial with other more traditional data and glean new information from the resulting analytics. Insights could include identifying the biggest-selling product for consumers living in a particular neighborhood or the prime location to build a store with specialized products geared to a specific demographic.

How it's done

The following SQL example shows how ST_GEOMETRY converts latitude and longitude coordinates for "attractions" to be stored in the Teradata Database. First, the ST_GEOMETRY data type is created:

```
CREATE TABLE attractions
(
  id      INTEGER NOT NULL PRIMARY
          KEY,
  name    VARCHAR(100),
  city    VARCHAR(50),
  state   CHAR(2),
  geo     ST_GEOMETRY
)
```

The data type is then loaded with appropriate geocodes:

```
INSERT attractions
  (id,name,city,state,geo) values
  (2,'George Bush Intercontinental
  Airport','Houston','TX','Point(
  -95.347761 29.983982)');
```

Automated features

Teradata's geospatial features provide automatic functions to standardize the two critical specifications of coordinate formats and coordinate reference systems (CRSs) required for geocoding data for an enterprise data warehouse (EDW). (See figure, page 73.)

COORDINATE FORMATS

Three generally accepted formats for representing coordinates in latitude and longitude—and their examples—are:

- Degrees, minutes, seconds (DMS): 49°30'00"N, 123°30'00"W
- Decimal, minutes (DM): 49°30.0', -123°30.0', 49d30.0m, -123d30.0'
- Decimal, degrees (DD): 49.5000°, -123.5000°, generally with four to six decimal numbers

DMS, the most common format, is standard on all charts and maps. DD expresses coordinates as decimal fractions and is the most convenient for calculations or computations like those performed with SQL spatial functions.

Depending on the format of coordinates provided, it is likely that the EDW will require a conversion to DD to enable analysis. This mathematical function is automated in Teradata 13. For instance, the DMS coordinate W87°43'41" is converted to DD with these steps:

1. Calculate the total number of seconds: 43'41" = (43*60 + 41) = 2,621 seconds
2. The fractional part is the total number of seconds divided by 3,600: 2,621 / 3,600 ≈ 0.728056
3. Add fractional degrees to whole degrees to produce the final result: 87 + 0.728056 = 87.728056
4. Negate the result for a longitude west of the Prime Meridian
5. Final result is -87.728056

Once the latitude and longitude coordinates are converted, the next step of tagging business events to a location can take place.

COORDINATE REFERENCE SYSTEMS

CRSs use satellite and remote sensing imagery to provide location information. Many CRSs are available, but the two most common are World Geodetic System (WGS) and North American Datum (NAD).

In the same way that the formats are automatically converted in the Teradata Database to match a business's requirements, so too is the CRS. This assures that the coordinates used to geocode, or tag, business events are standardized so that geospatial analytics can be applied uniformly and consistently across an enterprise.

This ST_TRANSFORM function shows how the CRS for "attractions" is converted from NAD 83 to WGS 84:

```
INSERT attraction
SELECT  A.id, 2, A.geo.ST_
   Transform(SRS_1.srtext, SRS_2.srtext)
   .ST_Transform(SRS_2.srtext,SRS_1.
   srtext)
FROM    attractions A,
        sysspatial.SPATIAL_REF_SYS  SRS_1,
        sysspatial.SPATIAL_REF_SYS  SRS_2
WHERE   SRS_1.AUTH_SRID = 32615 --
   UTM 15 / WGS84
AND     SRS_2.AUTH_SRID = 4326
   -- WGS84
```

Other techniques include assigning coordinates to geometric shapes on the surface of Earth the way surveyors calculate their dimensions.

Geocoding alternatives

To achieve more scalable geocoding, businesses can provide address files to service bureaus for conversion, or acquire software and perform geocoding in-house.

OUTSOURCED GEOCODING

Tele Atlas, a subsidiary of the navigation system manufacturer TomTom, and NAVTEQ, a subsidiary of mobile phone manufacturer Nokia, continuously collect data from sources around the world to update their databases with the latitude and longitude of addresses and points of interest (POIs). Both vendors:

- Offer services by subscription or on a per-geocoded-address basis
- Accept files of addresses periodically
- Match addresses to their coordinates
- Return files of geocoded addresses

The subscribing business loads the geocoded addresses to its internal database and links the geocodes to, for instance, its operational and financial data.

IN-HOUSE GEOCODING

Google, Yahoo and Microsoft provide application programming interfaces (APIs) to their geocoding services, allowing businesses to:

- Invoke the APIs from business software applications
- Send addresses to the geocoding service for latitude and longitude conversion

Vendors such as Informatica offer geocoding as part of their address-cleansing transaction during the extract, transform and load process. The software matches the standardized addresses to the appropriate latitude and longitude coordinates (based on the geometric data types or values provided by the business) and stores the coordinates in the address file.

Geographic information system providers such as Esri and Pitney Bowes Business Insight also provide geocoding technology as part of their complete solutions.

Another vendor, First American Proxix Solutions, developed PxPoint, an application designed to find geospatial relationships from data on natural hazards and property information. PxPoint processes spatial layer files that contain information about a set of spatial features, such as:

- Street center-lines provided by map provider NAVTEQ
- POIs in North America and Europe
- US parcel polygons, which identify size, location and associated information of properties

These are a few of the geocoding solutions obtainable. Availability of geocoding technology varies widely in the different geographic regions.

Within reach

Geocoding describes locations, enabling businesses to use geospatial information for deeper analytics. With this level of sophistication, organizations can expand their service and products to reach the areas that are most lucrative. T

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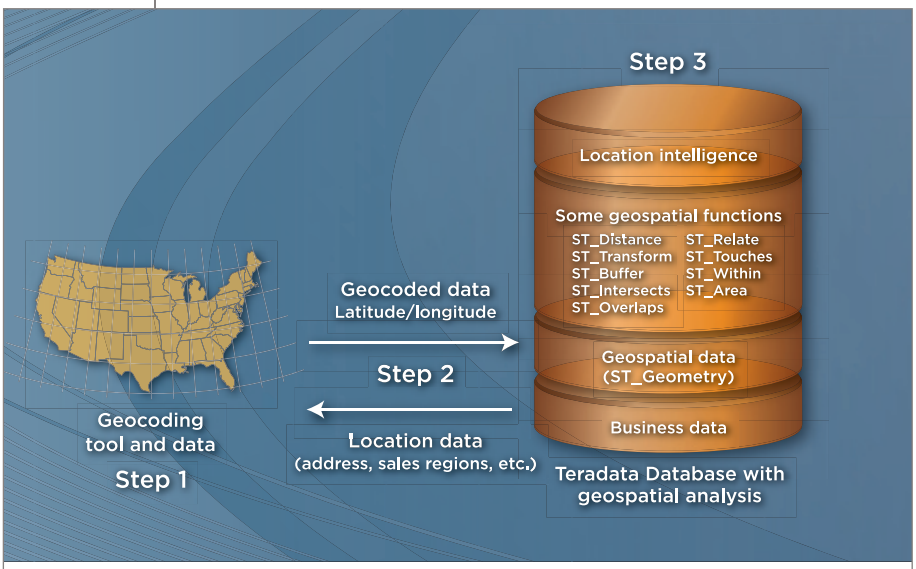
FIGURE Three steps to derive location intelligence



To derive location intelligence with Teradata's geospatial features, (1) geocode your data by converting business addresses to latitude and longitude, (2) create and insert geocoded data into an ST_Geometry type, and (3) apply geospatial functions in-database.