# Spatial Trends for 2005

**Jonathan W. Lowe**

Interviewed independently and representing the diverse interests of software, data, infrastructure, and academia, the experts polled in this column offer a common theme of predictions for the year ahead.

What technologies do you anticipate gaining importance or emerging for the first time in 2005? Ten geospatial industry experts offered the following predictions in response to that question.

### It All Starts with Data

Data are the core of our industry. Their quality and extent directly influence all other spatial technology. One spatial startup's CEO recently predicted, "Someday the extent of our industry maybe just Microsoft, ESRI, and a sea of content providers." In any case, experts anticipate demand for more detailed and extensive data, as well as increasingly sophisticated analysis of current holdings in 2005.

**Bob Denaro:** Demands from our increasingly sophisticated customer base are prompting NAVTEQ to enhance the quality of our rural road networks and making major investments in "perishable" data, such as traffic conditions. These customer demands indicate a trend of increasing enterprise reliance on digital data — not only do corporations recognize the value, but they understand the capabilities.

**Robert Shanks:** In 2005, geospatial firms will be pressed by customers to provide more complete, accurate, and diverse content than ever before. We will be working with partners to create the

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## WHO'S WHO

Buckeridge

David Buckeridge earned his MD MSc from Stanford University and is a PhD candidate in Biomedical Informatics.

Couper

Christopher Couper is a distinguished engineer at the IBM Academy of Technology.

Denaro

Bob Denaro is vice-president and general manager, Business and Government Solutions, at NAVTEQ.

Holmes

David Holmes is director of worldwide product strategy at Intergraph Mapping and Geospatial Solutions.

Maguire

David Maguire is director of products at ESRI.

Moon

George Moon is chief technology officer at MapInfo.

Ramsey

Paul Ramsey is a systems architect for Refractions Research, Inc.

Shanks

Robert Shanks is president of GlobeXplorer.

Tate

Matthew Tate is vice-president, Geospatial Solutions Federal at Intergraph Mapping and Geospatial Solutions.

Uleman

Robert Uleman is a worldwide spatial data management specialist for IBM.

most complete and most up-to-date coverage of land information data available on the Internet. We're talking about everything from tax-roll information to parcel/ownership boundaries to updated 6-inch-resolution color imagery.

**David Maguire:** National mapping communities have put a lot of work into data creation and maintenance. Now that these databases exist, people want to exploit them — not just by describing the world, but by analyzing and understanding it.

### Hardware: GPS, Sensors, Wireless, RFID

Our toolbox for data acquisition continues to expand. Participants predict increased reliance on combinations of both new and familiar hardware technologies for spatio–temporal data acquisition.

**George Moon:** We'll see GPS-enabled radio frequency ID (RFID) devices that enable us to scan the contents of a package and know what it is and where it currently can be found or where it has been. Technology has improved to the point where companies, such as Sendum, can embed assisted GPS into sensitive or high-value parcels and track them even in urban canyons or underground garages. Tracking also is gaining importance in fleet management, where customers are now seeing return on their investment in spatial technology.

**Matthew Tate:** The combined technology of sensors, GPS, and wireless connections is opening the aperture for civil and military geospatial applications. Sensors such as cameras and noise detectors capture attribute data while in motion. Our industry's contribution is first to provide the geospatial context for that sensor data, and second, to join it with related data. For instance, if a sensor reports an accident, pulling that accident report into a spatial context can tell us which assets and resources are the most efficient to deploy. We want to avoid sending the wrong crew to an emergency, for example.

**David Buckeridge:** Many pharmacy systems in hospitals make use of bar codes or RFID systems to improve efficiency and reduce medical errors. A major problem for information systems in hospitals and in the community is standardization between the many different vocabularies—some of which use different jargon for the same condition, drug, or symptom. This need has spurred development not of map servers but of vocabulary servers to translate between different jargons.

### Data Management: Spatial Databases

Where and how does today's spatial data administrator store and manage all of these valuable data? Predictions are for ongoing adoption of spatial databases in place of file systems.

**Paul Ramsey:** The technical trend towards database consolidation seems to have continued momentum for organizations beyond a certain size. When an organization decides to go in a database direction, there is an interesting decision point: do they pick a database for its inherent capabilities or for its capabilities in relation to other software? The need for databases to interoperate with desktop software and the pre-existing installed base of ESRI desktop software seems to be driving a lot of database decisions. One of the things that the new flight of open-source desktop software needs to do is provide an alternative deployment platform for organizations that want to centralize data management in a database. Working with the file system is passé.

**David Holmes:** Enterprises still have trouble with many data types from many sources, so pulling them together is still important. Geospatial databases, such as Oracle, offer enterprises a way to maximize the openness and flexibility of their data thanks to the standard of SQL [structured query language]. At Intergraph, we say, "Nothing between you and your data but an SQL statement." Spatial database vendors, such as Oracle, build geometry (points, lines, and areas) into their supported data types, then let customers build their own schemas. They also expose their supporting spatial technologies, such as their versioning infrastructure. Then it's up to the spatial vendors to decide which spatial database features to adopt. Intergraph takes advantage of Oracle's versioning infrastructure, for instance, and will be leveraging Oracle's raster data-management capabilities in 2005.

**Denaro:** ESRI's Spatial Data Compression format as well as Oracle 10g are examples of the fundamental database-structure evolving capabilities that the spatial industry needs. In parallel with this sort of technical improvement, there's been an enormous consumer acceptance of the need for navigation technology. I hear countless examples of people who initially dismissed in-car navigation systems now saying that they can't live without them.

### Distribution: Web Services

Once the data are clean and organized, the challenge of distribution arises. Web services continue to rank high on our experts' lists of important technologies for interoperable data distribution.

**Shanks:** There are several technologies that are critical and emerging in 2005. One is the development of geospatial Web-service standards, such that Web applications can be built, customized, and reused in a highly scaleable manner. At GlobeXplorer, we've begun to launch new Web services and developer APIs [application programming interfaces] based on SOAP [simple object access protocol], Microsoft's Web Services, WMS [Web Mapping Service], and ArcXML. Our telco-style billing and accounting system is expanding the use of these standard protocols by allowing them to become a part of broad commerce, rather than remaining in science.

**Ramsey:** For applications that fall into the right categories (road mapping, most obviously), the Web services vendors should do very well.

**Holmes:** Modern development tools provide the ability to use Web services easily, which enables the next generation of software to talk to each other through SOAP and WSDL [Web services description language] standards. Intergraph will continue to follow this trend in 2005, making system communication less expensive and eliminating "hard-coded" connections in favor of "loose interoperability." Over time, the reduced maintenance requirements of Web services result in a lower total cost of ownership. When both participants in a communication follow industry standards, broken connections are much less likely when either side makes changes to their program.

In 2005, we'll also start to see Web services brokers on the scene. For instance, if a customer needs a set of text addresses geocoded, he can check a "yellow pages" of service providers and choose one based on reliability, price, functionality, or other qualities. Then, through a real-time binding, the service provider acquires the text addresses and returns geocoded points. Such Web service interfaces are already in use, but often not with brokers. When brokers appear, so will standards governing how to describe a service's quality, cost, and so on — what we might call "service metadata."

The rise of Web services will advance interoperability among vendors. Multiple vendors' products can be queried for various parts of a larger information request. In this regard, OGC's [Open Geospatial Consortium's] compliance standards for Web services will become more relevant in 2005. We also expect the increasing popularity of Microsoft's Web Services to fuel the trend toward Web services.

## Software: Dishing Up Analysis Tools

If data acquisition, storage, and distribution are the meat of our industry, then analysis is the rewarding dessert. Experts highlighted the ongoing and increased importance of commercial and open-source software for cartographic display, geometric comparison, statistical analysis, searching, and 3D flythroughs.

**Maguire:** In response to emerging analysis requirements from national mapping organizations, ESRI has been incrementally improving its framework and tools for spatial analysis and modeling. In 2005, the basic framework is complete with data manipulation tools, such as spatial statistical tools for spatial regression, interpolators that honor breaklines and irregular shapes, better feedback and simulation modeling, and the ability to work with temporal datasets.

Traditionally, GIS software has had good tools for thematic cartography and basic map production, but has not provided the high-quality finishing tools that topographic mapping organizations and high-end cartographers require. Output quality has been sacrificed for strong data-management and analysis capabilities. New advances in GIS-based database cartography and map finishing mean that end-to-end production systems can now be built within a single GIS platform. Together, new data models, finishing tools, rasterizers, and supported print formats will mean that separate flowlines and technologies can be integrated into a single data collection, management, analysis, and production system that is capable of supplying all the needs of a mapping organization.

**Ramsey:** In the world of open source, all the mature software continues to be stacked up at the server side: MapServer (www.mapserver.gis.umn.edu), PostGIS (www.postgis.refractions.net), and GMT (www.gmt.soest.hawaii.edu), for example. On the desktop, there has been an explosion in projects this year (including one of our own, www.udig.refractions.net), with three nontrivial, brand new projects and a couple older projects getting up to new standards of functionality. So 2005 will be something of a shakeout year — what projects will acquire a critical mass of users and developers? Unlike proprietary software, open-source software is not about sales, it's about community, which is the combination of active users and developers.

**Buckeridge:** Some issues in public health informatics that need to improve in 2005 and beyond are the lack of adequate hardware and expert resources to accomplish geospatial computing tasks. Often, people's lack of experience with geospatial tools limits their vision of what's possible. Even when hardware and experts are available, I prefer to use open-source tools such as Vivid Solution's JTL and JUMP Java libraries rather than commercial GIS tools—despite the free access to commercial packages through the academic license. The problem is, when it's time to share my work with public health agencies, they can't afford the commercial licenses. Free open-source products have no affordability issues.

**Shanks:** GlobeXplorer has created highly accurate searching mechanisms such that typing in an address lands on the house itself, rather than somewhere nearby. This is very important to serving the broader land-information markets. 3D GIS is also picking up steam, and we've been doing our part by offering both static and streaming 3D versions of data services—all accessible in a Web browser with zero plug-in architecture.

## Application: Real-Time Tracking

Customizing software tools in support of a specific task results in an application. Several interviewees predicted an expansion of mobile resource management applications in 2005 as they become both cheaper and easier to deploy.

**Moon:** Applications supporting a more mobile workforce are likely to emerge in 2005. Both Microsoft and IBM have signed agreements with Sprint to access location information from E911-enabled cell phones. Any application requiring a spatial reference from the field could take advantage of Sprint's offering. For instance, a utility worker could transmit the location of a ruptured pipe back to the base simply by carrying a cell phone when visiting the site of the rupture.

**Christopher Couper:** My prediction is that we will see the use and deployment of GIS solutions into the first-responder field workers' (not GIS specialists') normal day-to-day operations using local, on-scene capabilities rather than a special incident command post. Using spatially aware applications that are core to their line of business, such as incident command and control, will enable first responders to respond more rapidly. Also, real-time spatial data will be created by multiple individuals and broadcast across the incident in real time.

**Holmes:** Tracking and management of mobile objects and people is a growing trend. Tracking systems enable enterprises to ask, "Where are they, where were they, and where will they be? Are they on schedule, in trouble, underutilized?" The term "tracking" is no longer limited to location. It encompasses tracking progress against an assigned schedule, tracking compliance to business rules, and tracking status of your mobile resources. The collection of this tracking information provides a real-time situational awareness for responding to a changing environment.

Alarms are another trend. Tracking technology combined with mobile communications devices (cell phones, pagers) enables a system to set-off geospatial or other types of alarms — such as paging security — when resources enter or leave a restricted area. Alarms are not limited to geospatial rules, they include time and attribute-based alarms and any combination. For example, if a vehicle or person is idle for too long (for instance, signaling a wounded soldier), it can trigger an alarm. Intergraph is seeing interest in this capability across industries: military, transportation, and almost all others we serve.

## Architecture: Enterprise Deployment

The most controversial and popular topic for 2005 among this column's participants is whether there will be any architectural trends among large companies that integrate spatial data and processing into their overall information infrastructure.

Observers say our industry's growth started with organizations in which geography and mapping were central to the business's workflow, such as in defense, environmental, transportation, and planning markets. In those markets, spatial technology is often an isolated "backroom" operation.

Some claim this is an artifact of early cumbersome software requiring backroom expertise; others that spatial data's technical sophistication still justifies this separation. But today's analysts (see David Sonnen's opinion in Market Map

2005) claim that those "traditional" spatial markets have reached a plateau, and the new growth opportunities are in enterprise deployments. This new market's core business is not spatial, but they can gain a competitive edge by using spatial technology.

For instance, organizations such as banks, insurers, or large corporations may gain incremental benefits from address geocoding in support of sales or human resources management. Can existing GIS software satisfy the architectural needs of enterprise deployments, in which integration to a complex "stack" of existing technologies (for finance, personnel, logistics) is the greatest challenge? Or are mainstream information technology and database companies better suited to handle such a demand? Or maybe a new breed of spatial components is needed? I believe that answer hides deep within specific technical implementations that may differ from one corporate architecture to the next. As you'll see from the variety of expert opinions, most agree that such deployments are happening, but not all agree on what it means to our industry and our careers.

**Moon:** With MapInfo customers as a litmus test, the spatial user of tomorrow is an "enterprise user." Companies are realizing that they already have spatial data (such as addresses), but didn't realize it until now. When these companies adopt geospatial technology, they embed geospatial data and processing into the overall enterprise rather than as a separate system.

**Tate:** What began as cartography later became digital cartography, then shifted into querying maps — what I call the "GIS era." To get a map, you had to ask the GIS department down the hall. In 2005, we will see more integration of spatial data into overall operations and a decreased need for pure GIS experts — a new "Geospatial era." In recognition of this shift, Intergraph is building componentized products that offer either an end-to-end solution or that can be applied independently.

**Ramsey:** The number one trend of next year will be the continued expansion of spatial applications into realms where they are no longer maintained or controlled by people who might be called "GIS guys." The infrastructure around consumer-grade location services (built into cell phones, organizers, cars) is becoming invisible to the people using it. GIS guys are no longer required. From an open-source point of view, that is good news because the people building this new invisible infrastructure have no preconceived notions about what constitutes GIS software. They are just looking for components that can solve their particular business problem quickly and cheaply. Open-source fits that niche quite nicely.

**Buckeridge:** GIS has been touted a lot in public health as a "killer app" for this or that specific problem, usually in a research setting. I see a greater value in incorporating spatial information and spatial thinking into the underlying public health infrastructure. Talking about populations, one must know them spatially in order to best serve their public health needs. This is similar to a physical exam on a single person.

**Denaro:** As an industry, we're still at the leading edge of spatially enabling the enterprise, but I anticipate increased traction in 2005. At some point in the future, we anticipate an inflection point where your business is no longer competitive unless you are using spatial data. NAVTEQ is seeing such increased business from corporations that have realized the value of spatial information at many levels, such as optimizing and scheduling field services, analyzing sales territories, and optimizing routing.

**Maguire:** Consider two quotes: "Spatial is special; it requires specialist knowledge and technology" and "GIS will eventually disappear and become subsumed into standard information systems." These two quotes characterize the bipolar views of members of the industry about the future of GIS. But are they really in conflict? Creating, maintaining, analyzing, and mapping advanced geographic data is a specialist task requiring considerable training and experience. GIS requires a background in sampling, representation, coordinate systems and map projections, spatial statistics, and cartography. Acquisition of a basic understanding of these difficult topics requires years of study. Some of the people who say that GIS will eventually disappear simply don't know enough to know what they are missing.

On the other hand, creating, maintaining, analyzing, and mapping simple geographic data and exploiting advanced geographic databases prepared by others requires a much shallower understanding of fundamental geographic concepts. DBMS [database management system] software with simple geographic data management and query tools is adequate for capturing and displaying facility assets, tracking telephones, and answering simple spatial queries.

**Robert Uleman:** I anticipate continued expansion of loosely coupled Web services, increased business use of geospatial technology, and continued development of location services. It's more difficult to predict how commoditization of spatial technology will change the market. There's some tension between the business models of the incumbent GIS players (ESRI) and the small but rising component vendors (ObjectFX or eSpatial). All seem interested in the growing business of embedding spatial functionality at all levels of the mainstream IT software stack. How will that tension be resolved? Some of the answers should emerge in 2005.

## Another Interesting Year

With our heads bent over our work, it's sometimes hard to keep a bearing on the distant horizon. Whether your focus is data, hardware, data management, distribution, software, applications, or architecture, these industry visionaries are telling us that there's still a future worth watching. Many thanks to our experts for their perspective on spatial industry trends, and best of luck to all in the year ahead!