GPS/GIS — GeoResearch Pioneers the Birth of an Industry

In the grand scheme of things, the integration of GPS and GIS to perform real-time mapping applications is quite a recent phenomena. In retrospect, one company stands out as a true innovator and pioneer of early developments in GPS/GIS technology and applications. That company is GeoResearch, Inc. of Billings, Montana, a once small natural resources service company, which early on recognized the revolutionary potential of marrying these two technologies. Guided by the vision of company founder and geographer, Dr. Douglas Richardson, GeoResearch proceeded to develop GeoLink®, the world’s first commercially available GPS/GIS system. The company has been leading the way ever since.

By the mid 1980’s, when the DoD sponsored GPS satellite constellation was only partially deployed, GeoResearch-trained personnel were busy driving along U.S. Interstate 90 mapping the location of highway infrastructure for the Montana Department of Highways with GeoLink. This marked one of the many early uses of GPS/GIS technology pioneered by GeoResearch for commercial mapping projects. By the end of 1991, the company was supporting a proliferation of GeoLink users performing field mapping projects for organizations such as Florida Power & Light, Denton Country (TX), Southwestern Bell, Exxon, the Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Forest Service; and a host of state DOTs. By late 1992, GeoLink was the uncontested product leader in an industry that was still trying to define itself.

History of Innovative Applications
GeoResearch has never been a company to rest on its laurels. The evolution of GeoLink as a product has been one of continual improvement to meet an ever-expanding spectrum of new GPS/GIS applications and technologies, many of which were pioneered by GeoResearch itself.

Although GeoLink is recognized as the first commercial system to display a “live” trace of the GPS path of travel, it was the system’s rapid entry of attribute data at any time during the mapping process that attracted the most GIS customers to this new technology. GeoResearch understood the field data collection process well and was quick to integrate “hot” keys and “picklist” functions to the field mapping and attribute collection process. GeoLink literally set the standard for collecting attribute data while mapping from a vehicle traveling at 60 mph. By 1995, GeoLink systems were in use at utility companies across the U.S. to locate and map outside plant infrastructure in support of a growing list of AM/FM/GIS projects. It was in that year that a GeoLink utility pole mapping project performed by Bob Bricker of Independent Inspection Company for Montana Power Company won first place in the GPS application contest sponsored by GPS World magazine.

GeoResearch was also one of the first companies to integrate laser rangefinding equipment and digital cameras to a field mapping system. Early success using GeoLink and laser rangefinders to map electric transmission infrastructure at Florida Power and Light paved the way for the adoption of this technique by other product vendors and end user organizations. Capturing digital photographs with GeoLink as part of the GPS/GIS digital mapping process came into its own during the Mississippi River flood damage assessment operations.

In 1994, GeoLink was one of the first GPS/GIS systems used in the mapping of radioactive hot spots, in this case at the Department of Energy’s Hanford nuclear facility in Washington state. GeoResearch integrated an Eberline SRM 300 Smart Radiation Monitor with GeoLink to create a radiation survey system later named RadRover™. The unit saved DoE over $5 million on this project alone. GeoLink was also used quite effectively by emergency planners in the aftermath of civil unrest in Los Angeles during 1992. In the course of three days, a GeoLink-equipped field team recorded over 1,500 damage sites in a 95 square mile urban area to provide data for disaster relief that would normally have taken weeks to collect.

Mississippi Floods Authenticate Technology
It was the tragedy of Mississippi River floods in the summer of 1993, and the subsequent rapid deployment of GeoLink systems to document and map flood damage in record time that really brought GPS/GIS technology into its own for commercial applications. Just as experiences in the Gulf War proved the utility of GPS in support of military operations, successes using GeoLink for Mississippi flood damage assessment brought prompt recognition that GPS/GIS was not only a viable commercial technology, but an unprecedented one.

Working with the Federal Emergency Management Agency (FEMA) and the U.S. Army Corps of Engineers, GeoResearch personnel participated in several major data collection initiatives along the river in Illinois over a two month period. On the ground, GeoLink was used to record inspections, map locations and photograph more than 1,500 damage sites in 75 communities along the river. In the air, GeoLink was used to inventory 200 flooded structures and map swelled river bank shorelines from an Army Blackhawk helicopter. During the helicopter operations, flooded areas were videotaped, and differential GPS techniques were used to improve shoreline location accuracies with great success. The exercise saved federal and local authorities precious time and money. Best of all, GeoLink GPS/GIS technology sped relief assistance to the many flood victims. For the GPS/GIS industry, this exercise was...
nothing less than a watershed event *(no pun intended)*
—It proved the technology worked on a massive scale, and worked well.

**Early Developments Lead to Patent**
In recognition of pioneering work and early innovation in the field of GPS/GIS, GeoResearch was awarded U.S. patent number 5,214,757 in May, 1993. Entitled *Interactive Automated Mapping System*, the patent is the basis of the company’s GeoLink system, covering mobile mapping systems that utilize GPS information to generate or update GIS databases in real-time, or which collect and store real-time positioning and other geographic information, such as feature attributes, for subsequent creation or updating of a GIS database. The GeoResearch patent represents the essence of this new industry which has rapidly emerged and continues to grow out of the company’s early pioneering work. GeoResearch continues to license their patented GPS/GIS technology to other companies, and maintains a policy of working with all members of the GIS and GPS community to offer a wider range of options to the user community.

**Entering International Markets**
Early on, GeoResearch recognized the need in third world countries for a technology that could rapidly and economically create maps in remote areas that may have never been mapped. As early as 1991, fifty percent of the company’s sales revenues were coming from international clients in such places as Latin America, the Middle East and the Pacific Rim. The company’s business continues to grow in these and other world markets.

Examples of GeoResearch’s international engagements are everywhere. As Mexico continues to expand and improve its network of roads, GeoLink is being used to develop a nationwide inventory database of paved roads and associated attributes that will support maintenance efforts long into the future. In South America, GeoLink is supporting dredging operations at the port of La Plata, Argentina, and collecting environmental data in the heart of Brazil. In Asia, GeoResearch conducted USAID sponsored GeoLink training workshops in Nepal, Malaysia and Thailand, and continues to support these countries in their efforts to preserve natural resources and complete urban planning. In Europe, GeoResearch is participating in a study of environmental influences on shellfish production in Laguna di Venezia, Italy. In Russia and Eastern Europe, the company is working with several government agencies to map areas contaminated by nuclear waste. In Africa, GeoLink software is helping governments to define and manage desert encroachment and the spread of malaria. ...And the list goes on.

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**What Is GeoLink?**

- GeoLink connects GPS technology with GIS or CAD data to provide real-time digitizing, map display, attribute entry and data verification. The patented system was developed specifically for building or updating GIS maps and collecting feature attributes in the field. Its GPS/GIS interactive features enable AVL and wireless “GIS in the field” operations as well.

- A “live” map of the GPS path is shown on the GeoLink map display. A background map, created in any of several popular GIS formats, showing previously mapped features can also be displayed. The real-time display, including background map, automatically centers itself as the operator moves in the field. The operator can zoom in or out at any scale.

- Utilizing a laptop, notebook, or pen-based computer, GeoLink provides real-time display of GPS parameters including latitude, longitude, elevation, time, speed, heading, SNR, PDOP and all satellites in view.

- GeoLink displays real-time datum and projection conversions of both foreground GPS data and background files (which can be different) while mapping is taking place. The software supports over 100 datums and most map projections. Air photos and scanned background images can be registered while in the field.

- GeoLink provides field personnel total user-defined attribute data collection capabilities. At any point during field data collection, the operator can enter descriptive information by using the computer’s keyboard or function keys. A powerful set of macros can simplify long text string and numeric entry to a single keystroke.

- GeoLink supports the ability to intermix the collection of point, line, and polygon data. The software allows the operator to average data to improve positional accuracy, as well as reference information as distance and bearing offsets (point, line or polygon) from the current operator position. Years of field-tested GPS and GIS editing and QA features insure quality data in the field.

- Expandable modules enable the user to collect all types of field data — GIS attributes, sensor readings, digital photos, video, or vehicle tracking — all in one integrated system.

**Sought After Expertise**
GeoResearch’s software engineering capabilities have long been recognized by several major corporations, including Motorola, Rockwell, and Westinghouse. All three of these companies have teamed with GeoResearch to create new field mapping products. In launching its *LGT 1000 GPS/GIS Mapping System*, Motorola integrated GeoLink software into the unit and relied on GeoResearch for software support and training. Rockwell incorporated GeoLink
software into the GeoLink Mapping Companion product for military field mapping. GeoResearch also teamed with Westinghouse during development of the RadRover radiation mapping system used successfully at the Hanford nuclear facility. The company is teaming with Westinghouse yet again to develop a mobile gas leak detection system for the Gas Research Institute. This system will use a new optical methane detector that will enable gas utility vehicles to drive at residential speeds when measuring to detect gas, instead of the 5 to 10 mph required with traditional equipment. The new automated leak detection system will integrate GeoLink recorded map positions with methane leak level readings.

Innovations Keep Coming
Today, GeoResearch is supporting GeoLink in a wide variety of new applications never before thought possible — applications in precision farming, mine reclamation, E-911 emergency response, vehicle tracking, and rural address mapping, to name a few. Enhancements to the GeoLink product keep coming! Some of the latest announcements include:

GeoLink PowerMap™— A new release of the core software module, GeoLink PowerMap for Windows® 95 is designed to use the full range of Microsoft’s Windows® 95 32-bit multi-tasking operating system. PowerMap provides exceptional speed and power while supporting features such as full-screen multiple raster displays, integration of laser rangefinding binoculars, and a built-in macro language for translation of data to most GIS and CAD formats. PowerMap is also an “Open GPSTM”, integrating with nearly all commercial GPS receivers to provide superior real-time tracking.

GeoVideo™— Provides the ability to automatically integrate GPS data and field observed attribute information with high resolution video logging and playback technology. The GeoVideo Module enables a user to automatically integrate video with GPS map data. GPS position and time information are recorded digitally on the video tape so that each frame is geo-referenced. Utilizing the GeoVideo Viewer, a user can point to a previously recorded feature on the map screen and the video tape will automatically move to display that scene.

Raster Background Map™— The Raster Module provides use of raster images, including scanned paper maps, aerial photographs and satellite scenes, as background coverages while mapping with GeoLink. Additionally, the module supports an automated method to select small sections of USGS Digital Orthophoto Quadrangles (DOQ) for use as background maps in the field. GeoLink’s Raster Module automatically creates a “Tilelist” and a set of registered tiled images in a GeoLink TIFF raster format from the DOQ. Users can then choose the tile size appropriate for their system and application.

GeoLink MapTrak™— A GPS/GIS vehicle tracking system that incorporates GeoLink mapping technology, GPS tracking and advanced land mobile communications. At the headquarters location, the MapTrak Fleet Monitoring Module serves as the host controller allowing the display of up to 99 vehicles. Operators can focus on any individual vehicle or poll all vehicles in the fleet simultaneously. Vehicle locations can be displayed on existing raster or vector base maps with the map center either locked or keyed to follow a selected vehicle. The module provides for the recording and editing of vehicle position and attribute information prior to translation to various GIS, CAD and database formats. MapTrak in-vehicle map display terminals, communications controllers and optional differential GPS base station equipment are also available.

Building a Legacy
Doug Richardson and the staff at GeoResearch have not only built a great company. They are on a mission to build an industry around the technology they bring to market. More than any other company in the industry, GeoResearch embodies the paradigm shift that is taking place in the mapping sciences today. The company continues to organize, promote and conduct its Annual GPS/GIS Conference, a forum for organizations and individuals to meet and exchange information about this exciting technology and industry. It is the company’s contribution to moving the GPS/GIS industry forward. This year’s conference will be held in Billings, Montana, on June 23rd-28th.

Rarely in our lifetime does a company come along which creates a product that revolutionizes the way we do our jobs, creating a whole new industry along the way. When GPS/GIS-based real-time mapping technology becomes commonplace and history books about this industry’s early days are written, Doug’s pioneering vision and the achievements of GeoResearch will permeate Chapter One. And this legacy isn’t over.

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