



January 20, 2000

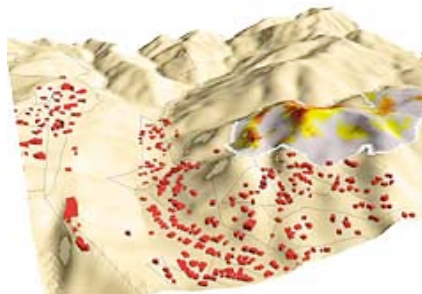
Turning a Map Into a Layer Cake of Information

Linking Geography and Data Can Help Fight Crime, Find Customers and Protect Nature

By CATHERINE GREENMAN

Companies use them to plan store locations, watchdog groups to track discrimination and law enforcement agencies to fight crime.

Geographic information systems, as they are called, are increasingly ubiquitous computerized mapping programs that help corporations, private groups and governments make decisions.



Tim Walsh/Marin County Fire Department
HOT SPOTS A map used to show where controlled burning should take place.

These G.I.S. programs work by connecting information stored in a computer database to points on a map. Information is displayed in layers, with each succeeding layer laid over the preceding ones, like transparent sheets on an overhead projector. The resulting maps often reveal trends or patterns that might be missed if the same information was presented in a spreadsheet.

A series of slashings in a Brooklyn neighborhood several years ago, for example, first appeared to police investigators to have little in common with one another. But when their locations were displayed on a map with other data, like known sites where gang members gather, connections were made. A local gang, it turned out, had been conducting initiations, and part of the initiation process had involved slashing attacks.

Although such programs bring hidden truths to light within countless industries, the technology itself is little known to those who do not work with it. Developed in the early 1960's by Roger Tomlinson, who owns a consulting firm called Tomlinson Associates in Ottawa, it was originally used under a contract with the Canadian government for analyzing data for natural resource preservation.

Geographically based software can reveal trends or patterns that could otherwise be missed.

"Nothing had changed in 3,000 years as far as the ability to look at maps," Dr. Tomlinson said. "But analyzing, reading and getting information out of them was a real innovation."

Newer generations of the software, by companies like the Environmental Systems Research Institute in

Redlands, Calif., Intergraph in Huntsville, Ala., and the MapInfo Corporation of Troy, N.Y., are designed to run on personal computers and cost from several hundred dollars to \$15,000, depending upon the

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application. All told, according to Daratech, a market research company in Cambridge, Mass., the geographic information systems software industry will have sales of \$700 million this year.

Advocacy groups like Essential Information, founded by Ralph Nader and based in Washington, use such software to track the loan activities of financial institutions in major cities. The group correlates the branch locations of major banks with loan activity in specific neighborhoods to determine whether poor neighborhoods have fair access to mortgages.

"It's been very effective in instances when you're mapping patterns of unsatisfactory performance," said John Brown, director of the GIS Project at Essential Information.

"People who have a hard time relating to statistics can instantly grasp the impact of a map."

One hurdle cited by Mr. Brown in the area of public-interest and geographic information systems, however, is that getting access to public information could be difficult.

"The problem isn't in the technology," he said, "but that most advocacy organizations aren't in a position to go out and generate their own data. State and local governments need to invest more in making data sets available to the public."

Business use is one of the fastest-growing areas of geographic information system software, said Scottie Barnes, editor of Geo Info Systems, a trade publication based in Eugene, Ore.

Sears, Roebuck & Company department stores use software from Environmental Systems Research Institute to pinpoint the best places to open new stores. The company pulls up neighborhood maps and uses its customer database to look for areas with large percentages of homeowners, for example, who are likely to spend more on home-improvement items, like those sold at Sears, than renters. "But unless you have good underlying data, it's really nothing more than a fancy map," said Greg Kurfoote, director of store location research and planning.



Dave Chan for The New York Times

Geographic information system software was developed in the 1960's by Roger Tomlinson, who owns a consulting firm in Ottawa.

Meineke Discount Mufflers uses TargetPro software from the MapInfo Corporation to overlay information on a neighborhood map about the car owners in the area. Such information is gathered from the company's customer database and other market research data from car manufacturers. TargetPro's cost starts at \$2,495.

"We can place a store on the map, draw a radius around it, then ask the system how many vehicles are in the area," said Paul Baratta, director of real estate and international development for Meineke. "There might be 75,000 cars in a given neighborhood, but another layer of data might show that 65,000 of those are Lexus brands. How many people are going to put mufflers on a car that they're trading in every two years? It looks at the information in a different way."

Firefighters use geographic information systems to track potential damage along the path of forest fires. The Marin County Fire Department in Northern California deploys helicopters equipped with Global Positioning System receivers to fly over an area of land that is ablaze. The receiver collects latitude and longitude information about the perimeter of the fire. When the helicopter lands, that information is downloaded into a PC, which then connects to a database containing information on land ownership, endangered species and access roads within the area of the fire. Those maps are printed out on mobile plotters at the scene and distributed to firefighters.

"There are still data limitations, but we're so far ahead of where we were, even from a year ago," said Tim Walsh, fire captain specialist at the Marin County Fire Department. Mr. Walsh added that during quieter periods, the fire department also devised maps to chart the potential burning rates of fires in dry areas to inform county officials about where to perform controlled burning.

Conservation groups use the software to assess the potential hazards caused by environmental changes. "As a tool for integrating data across borders and helping to bring people together to problem solve, it's proving very useful," said Dr. Richard Wright, chairman of the education committee at the University Consortium for Geographic Information Science, a nonprofit organization in San Diego.



Ruby Washington/The New York Times

Police officials in New York City use maps of crime data at meetings where they evaluate police performance precinct by precinct.

Dr. Wright is working on a project financed by the National Oceanic and Atmospheric Administration and other organizations to create maps of the Tijuana River watershed, a flood-prone area that spans the border of San Diego and Tijuana, Mexico. The maps incorporate soil and vegetation classifications from each city, which allows planners to see across the borders when forecasting flood hazards. "The technology is

plenty good enough, but the human and institutional differences that you're dealing with can be tough," Dr. Wright said.

Within the last few years, law enforcement agencies around the country have started using geographic information systems to display, analyze and fight crime. In many cases, computer-generated maps are replacing the push-pin maps that used to line the walls of police departments. Whether it is to stay on the trail of drug gangs, locate "chop shops" selling parts from stolen cars or pin down serial sex offenders, such software gives police officers the power to sort and rearrange reams of data to find a pattern.

In many New York City precincts, for example, officers dealing with this technology are tucked away in what resemble makeshift war rooms. The officers compile reports on crimes like auto thefts, arson and residential burglaries onto weekly hot sheets, which they then enter into a computer. The mapping program, in turn, links each incident to map information by giving it latitude and longitude coordinates within a master map of the precinct.

Using maps to visualize spatial relationships is particularly effective when it comes to nabbing serial offenders because studies show that they tend to operate in areas that they are familiar with, near their homes. Officer Tony Logallo of the Suffolk County Police Department in New York, who has used MapInfo since the late 1980's (and who used the program to recreate the seating plan of TWA Flight 800 to assist the National Transportation Safety Board's investigation of that plane's crash in 1997), designed a geographical display of registered sex offenders.

"If we have a cluster of sexual assaults showing up in one area of the map, the first thing we do is pull up the address points of registered sex offenders who live nearby," Officer Logallo said. "Nine times out of 10, it's going to be one of those people."

But some civil libertarians question whether viewing crime activity as a series of lines and dots on a computer screen can put people's rights at risk.

Norman Siegel, executive director of the New York Civil Liberties Union, said that a cursory viewing of the maps led to "aggression and overzealousness that has led to questionable street justice." An officer going on duty after looking at a map that shows a spike in robberies in his area needs to treat this information carefully, Mr. Siegel said, not use it as fuel to go out and perform arbitrary searches.

"The concept of mapping is a good one because it lets the police focus on where and what particular crime is being committed," Mr. Siegel said. "But excessive and arbitrary discretion in an area of high crime creates a dynamic where tensions between New Yorkers and the Police Department are developing, especially along racial lines."

Police Commissioner Howard Safir of New York City said the computer maps were not used to prompt quick judgments by police officers.

"Just because we have blips on the map doesn't mean we're going to take action," he said.

Computerized crime maps rely on correct information about crimes and where they occurred from a city's 911 database, an effort that is both costly and time-consuming. Pinpointing the exact location of a traffic accident or mugging can be difficult, for example, because the victim or witness often calls for help at a distance from the site of the incident.

"Everything stops at the stumbling block of address purification," Officer Logallo said.

"For instance, for years we've had a self-esteem problem with people on the East End of Long Island not wanting to have building numbers placed on their houses. I don't know why folks feel you have a higher status if you live on Old Watermill Road as opposed to 19 Old Watermill Road, but it sure doesn't help us record the incident properly."

Police officials agree, however, that computer maps are a valuable tool for helping officers make educated decisions about resource deployment. Mr. Safir said that the New York City Police Department had recently used computer mapping to track the most concentrated areas of domestic violence and that precincts were using the information to plan visits by domestic violence officers, who follow up on emergency calls. Maps are also being used to pinpoint areas around the city where there are high numbers of traffic accidents, he added.

The Vera Institute, a nonprofit organization that designs and implements public service programs for New York State, is designing a mapping system that will allow police authorities across several jurisdictions to view and exchange information from incident reports according to their locations and to plan strategies accordingly.

"Police departments will be able to view crime in relation to its physical properties, like drug sales that take place in areas around schools between 3 and 4 p.m.," said Meryl Schwartz, special counsel to the Vera Institute. "What makes this most interesting is the ability of the departments to work together."

The system, which Ms. Schwartz said was the first statewide effort at sharing information about crimes, will be accessible in March to several counties near Albany over a private network.

Some police departments use computer mapping to encourage residents to get involved in community improvements. The Charlotte-Mecklenburg Police Department in North Carolina, for example, uses the ArcView mapping program of the Environmental Systems Research Institute to track relationships between criminal activities and community problems like overgrown lots, abandoned trash and broken windows.

"Not surprisingly, crimes are often committed in areas where the community has relinquished guardianship of their surroundings," said Monica Nguyen, a crime analyst for the Police Department. Ms. Nguyen said that holding weekly meetings and opening them to members of the community had prompted people to take initiatives to improve their communities. "By seeing the violations on the maps and recognizing that they're located right next to crime clusters," she said, "they get a firsthand look at what happens when they don't take responsibility."

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