Computer mapping and geographic information systems (GIS) are used in a variety of criminal justice and public safety settings. Most of the data sets agencies and organizations routinely collect and maintain include location information—police files contain addresses of crimes and arrests, court files contain addresses of offenders, corrections files contain addresses of probationers. Other public agencies manage property databases, street and physical infrastructure files, licensing data, and public health data. The Census Bureau manages block-level demographic information.

Many tools allow these data sets to be viewed and analyzed, but only computer mapping software can create a single map that combines multiple data sets into one display so that public agencies not only can isolate factors contributing to crime and other problems, but also reduce operating costs, manage resources more effectively, and assess the efficacy of interventions.

In the last 10 years, advances in computer hardware, software, and networking have made mapping more widely available. Perhaps the most important of these advances has been the development of low-cost yet powerful mapping software. In 1989, the National Institute of Justice (NIJ) had only one active grant involving computer mapping, although a second, more ambitious program—a five-city Drug Market Analysis Program—was under development. By the mid-1990’s, mapping played highly visible roles in departmentwide transformations at the New York City and Chicago police departments. In 1997, NIJ established a crime mapping program to coordinate research, disseminate information on mapping, and provide training to spur development of new spatial analysis methods and software. (See “For More Information,” page 9.)

Mapping also captured the attention of both the Vice President, who established a Crime Mapping and Data-Driven Management Task Force in 1998, and more recently the President, who highlighted computer mapping of crime data in his 1999 State of the Union Address.

Mapping in Law Enforcement

Mapping in criminal justice agencies started with law enforcement agency crime analysts placing different colored pushpins on paper street maps. Today, automated versions of crime “pin maps” represent the most common mapping application among the estimated 36 percent of law enforcement agencies with 100 or more sworn officers that use computer mapping.¹

Several agencies around the country are following a process, developed by the New York City Police Department’s CompStat (computerized statistics) unit, that adds mapping to the mix of information that flows among the department’s leaders, precinct commanders, and patrol officers. Each week, the CompStat unit prepares a report that is the focal point of discussion at weekly briefings attended by department executives and commanders. The CompStat database is used to create maps depicting virtually any combination of crime and arrest locations.
Mapping Drug Flow into the United States

Research funded by the Office of National Drug Control Policy is examining the use of computer mapping to study how drugs flow from source countries into the United States. One project uses mapping to examine the spatial relationship between drug smuggling patterns and the use of drug-interdiction assets, such as ships, airplanes, radar, Federal agents, and drug-sniffing dogs. Mapping also provides a visual picture of the number of ships, trucks, passenger vehicles, pedestrians, airplanes, and other conveyors entering the country through ports of entry.

Automobiles, for example, often are stolen in one jurisdiction and recovered in a neighboring one. A regional system that includes sophisticated query and mapping tools enables a crime analyst to spot patterns in these and other crimes that otherwise would likely go undetected.

Collaborative Enforcement and Problem-Solving Efforts

To address the many factors that contribute to crime and disorder, communities are forming partnerships between their law enforcement agency and other city, State, and Federal agencies. Because of its ability to merge mappable data from different agencies and organizations, GIS is an ideal information tool for these collaborations.

Risk-Focused Policing. In Redlands, California, the police department has adopted “risk-focused policing,” which systematically focuses on the underlying causes of disorder and the factors that place its youths and families most at-risk for criminal and other problem behavior. The model is based on the extensive research literature on risk and protective factors.

Although Redlands had accurate data on crime, it did not have accurate data relating to risk and protective factors and behaviors of adolescents, such as the extent of substance abuse, delinquent and violent behavior, teen pregnancy, truancy, and weapon carrying. To fill the gap, the city conducted a series of citywide surveys of high school students. The police department then entered the findings into a database and used mapping software to display the results by Census block. Figure 2 (opposite) is a map that the Redlands Police Department used to examine levels of risk factors relative to the locations of community resources that provide an opportunity to develop skills and receive recognition.

The effort enabled various city and county agencies and community-based organizations to better target their resources. For example, neighborhoods where a high percentage of students indicated “there’s nothing for me to do” received additional youth recreation programming. In the future, the city hopes to make the maps and other survey results available to city agencies, community organizations, and the public through a regional Intranet.

Strategic Approaches to Community Safety Initiative.

Over the past decade, the U.S. Department of Justice has funded a number of community revitalization efforts involving multiple local, State, and Federal agencies. Examples include the Comprehensive Communities Program and Operation Weed and Seed. Most recently the Justice Department initiated the Strategic Approaches to Community Safety Initiative, or SACSI, a new strategy that builds from the lessons of these earlier programs. (See “Using Knowledge and Teamwork to Reduce Crime,” page 16.) Each SACSI site is gathering data from its criminal justice and social service agencies and merging them into one database that will be...
accessible to each of the contributing agencies to help the site analyze its crime problem, assess the impact of interventions, and make adjustments in its strategy.

Mapping Local Drug Markets and Treatment Needs. Officials in the 35 metropolitan areas participating in NIJ’s Arrestee Drug Abuse Monitoring (ADAM) program, which tracks drug use trends among adult and juvenile arrestees, soon will have more information about the location and characteristics of their drug markets and the potential demand for treatment and other health services in different neighborhoods. In early 2000, the ADAM sites will begin collecting geographic information, including arrestees’ ZIP codes and arrest locations. When these new data are combined and mapped with other ADAM data—such as the type and quantity of drugs purchased, the purchase price, and the arrestee’s level of dependence on drugs and need for treatment—analysts will be able to better pinpoint where resources are most needed.

Schools. Some communities, including many receiving funding from the Justice Department’s Office of Community Oriented Policing Services’ School-Based Partnership program, have begun to use mapping in conjunction with school-based problem solving. In these efforts, law enforcement agencies and schools form partnerships to develop and use the SARA (scanning, analysis, response, and assessment) model to address specific school-related crime problems. In Akron, Ohio, for example, the School-Based Partnership project is focusing on crimes occurring within a two-block area of a targeted school, and mapping software will plot the precise locations of juvenile crime occurring in the area.

As part of its risk-focused policing strategy, the Redlands (California) Police Department combined crime data with data from citywide surveys on risk factors to determine where resources were needed most.
locations (for example, a particular classroom or section of a parking lot). Temple University researchers recently conducted a pilot test of a high-definition mapping system at the university. Working with the campus police, Temple researchers constructed digitized maps of all campus buildings, including floor plans of multistory buildings. The campus police department modified its records management system to link crimes to one of several hundred specific campus locations. The study included a victimization survey in which students rated the safety of different geographic regions on campus.5

Community Organizations. Community involvement in crime control and prevention efforts is a central tenet of community policing. One effective way of getting the community more involved in community policing is for city agencies—particularly the police department—to share information with the community. Recognizing this, many law enforcement agencies routinely make crime information available to the public, often through the department’s Web site.

A project in Hartford, Connecticut, is providing local crime prevention organizations with basic mapping and analytical tools to create their own maps and analyze incident-level calls for service, crime, and arrest data.6 The mapping system enables community groups to quantify suspected problems, thus confirming—or disproving—the perceptions of neighborhood residents. In turn, this enables community groups to make a stronger case to residents, the police, and other city agencies to focus on particular problems. One community leader noted, “We were somewhat skittish about going after a problem if the only evidence was citizen perception.” Other community leaders say the system improved communication between the police and residents by ensuring that they shared a common platform on which to judge the nature and extent of neighborhood problems.

Mapping in Corrections

Probation and parole departments also use mapping, often in conjunction with community corrections initiatives. Delaware recently undertook a systematic examination of the proximity of probationers’ and parolees’ homes to drug treatment, employment, and other social service centers and used the results to guide future placement of these centers.7 Other uses include electronic monitoring and police-corrections partnerships.

Electronic Monitoring. Electronic monitoring devices have been used for many years to help probation and parole officials enforce home detention, curfew, and restraining orders. A typical arrangement involves a device connected to a phone line and a special ankle bracelet worn by the offender; each time the device is polled, it reports whether the offender is at home or at some other location where he is supposed to be (or not supposed to be).

An alternative approach, one with which some corrections agencies are beginning to experiment, involves continuously monitoring the location of offenders using global positioning system (GPS) technology. Computer mapping software is used in conjunction with GPS to display the location of the tracked offender on a digitized street map and, most importantly, to monitor his location relative to other areas. Thus, a corrections official could be alerted if an offender left a specific area (for example, the 1-mile radius of his house) or if he came within a certain distance of forbidden areas (such as a school, playground, or other location).

Police-Corrections Partnerships. Many cities have implemented law enforcement-corrections partnerships as a way to provide enhanced supervision of probationers, apprehend persons who abscond from supervision, and implement joint problem-solving efforts.8 Information sharing between law enforcement and corrections officials is a key component of these partnerships. In Phoenix, Arizona, for example, local law enforcement and probation officials are implementing a mapping system that links to a database containing both police crime data and information on probationers, including residential...
and work addresses, conditions of probation, and probation history. Teams of police and probation officials working in targeted areas will then use this system to plan and implement strategies for reducing burglary. For example, a map showing the addresses of current probationers convicted of or with a history of burglary might show that there are clusters of these probationers near clusters of recent reported burglaries. As a result, area probation officers might increase the frequency of visits to probationers residing near the burglary clusters.

Analytic Mapping

Computer mapping can be a highly effective technique for presenting data and communicating ideas. However, maps are sometimes difficult to interpret and may appear simply as a jumble of dots. Comparing two maps that depict, say, crime locations in two different time periods can be even more difficult. The development of spatial statistic methods and software tools will expand the ability to interpret spatial data.

Various techniques have been developed to identify clusters of spatial data, the most common example being the crime “hot spot.” Researchers at the Illinois Criminal Justice Information Authority developed one of the first of such techniques, a computer program called STAC (Spatial and Temporal Analysis of Crime) that constructs ellipses around the densest concentrations of crime or other spatial point data. (See figure 3.) STAC has been distributed to more than 200 law enforcement agencies.

Another technique used to show areas of high crime density was developed through a research partnership between the City University of New York and the National Institute of Justice.
Recent Trends in Analytic Mapping

Aerial Photography. Overlaying criminal justice data on digital aerial photographs makes maps appear more “real,” and, hence, easier to interpret. This also provides additional environmental context within which to interpret criminal justice data.

When users of the Baltimore County Police Department’s mapping system were asked what additional information would be most useful, digital aerial photographs were one of the top three choices, along with the last known address of offenders and the addresses to which incarcerated offenders are released.

While only a few criminal justice agencies currently use aerial photographs, it is conceivable that in the future, as more cities commission aerial surveys of their jurisdictions and as data storage costs continue to decrease, map displays routinely will show aerial photographs instead of “stick” representations of streets.

Geographic Profiling. A criminal investigative technique called geographic profiling produces a map that shows the probable home or work address of a particular serial offender. Figure 4 shows the locations of robberies thought to have been committed by a single person. The robber’s likely residence is indicated with a house icon. Based on this map, investigators were able to focus their search for the offender, who was eventually arrested. Kim Rossino, a detective in the Vancouver Police Department, developed this technique in 1990, incorporating findings from the field of environmental criminology, such as the distances offenders travel to commit crimes.* While only three police agencies, all Canadian, currently have full-time geographic profilers, the use of geographic profiling should increase substantially in the future as DNA databases, ballistics identification systems, and other techniques improve investigators’ ability to link crimes.


New York City Police Department. It involves a statistical technique that blends, or “smooths out,” the pinpoints that represent specific incidents to create an image that represents the overall density of crime rather than the specific locations of those crimes.10

Research on hot-spot identification and other spatial statistics methods has applications beyond simply identifying areas where criminal justice resources should be focused. For example, measures of spatial correlation provide a means to judge the relationship between crime and bars, liquor stores, or other geographic features. Spatial statistics also can be used to quantify the extent to which spatial distributions have changed over time. Indeed, law enforcement and problem-solving efforts that focus on a particular geographic area must address two critical questions: (1) Did the interventions change the geographic distribution of crime, for example, by displacing the problem to other areas, and (2) to what extent can the detected changes be attributed to the intervention.

A logical next question to ask is whether it is possible to forecast changes in hot spots or the emergence of new hot spots. Basic research in the area of predictive modeling is investigating whether spatial forecasting tools can be developed for use by law enforcement agencies to improve the targeting of enforcement and prevention efforts.11 One approach involves testing the “broken windows” theory—that signs of physical disorder, such as abandoned cars, graffiti, and litter, will eventually lead to more serious crime—by studying the temporal and spatial relationships between public order and other “leading indicator” crime hot spots and serious violent and property crime hot spots. Another approach incorporates a “rational criminal” model and assumes that criminals search for geographic locations that offer a low risk and high return, such as a particular type of house or locations with easy access to getaway routes.

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These and other research efforts on spatial methods are all attempting to move computer mapping beyond simple pin maps and into analytic mapping. In the near future, it is likely that these tools will be standard features in computer mapping software and will be widely used by law enforcement and other criminal justice agencies.

Notes


5. This project is supported by the NIJ grant Using a High-Definition Geographic Information System To Enhance Community Policing on College Campuses, grant number 98–IJ–CX–0001.

6. This project is supported by the NIJ grant Development of a Neighborhood Problem-Solving System, grant number 97–IJ–CX–K017.


10. The statistical method used in this technique is called “kernel smoothing.” The project to develop kernel smoothing is being supported by the NIJ grant Innovative Crime Mapping Techniques and Spatial Analysis, grant number 97–LB–VX–K013.