

Coming to Terms with Geographical Information Systems

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Police need more capability from mapping than the ability to plot traditional crime data. Today's law enforcement department is being pressed to use mapping to assess risk, to carry out plans for protecting critical infrastructure, to jointly develop multiagency response strategies, and to understand community capacities and needs to better execute its service-oriented missions.

An increasing number of law enforcement agencies are relying on computerized crime mapping, yet the prevalence of this technology in policing is difficult to gauge in precise terms. Wide

variations exist in the techniques that departments use, the levels of sophistication that police managers possess, and the frequency with which agencies engage in crime mapping. Some agencies are striving to produce simple graphic displays; others are performing complex spatial analysis on a routine basis. In some departments, crime mapping remains the exclusive domain of crime analysts; other departments are making interactive mapping applications available to everyone across the command structure, including patrol officers. In some agencies, interactive crime mapping Web sites are made available to the public. Many law enforcement executives recognize the value of mapping but find it difficult to garner the resources for the software and

training necessary to get started.

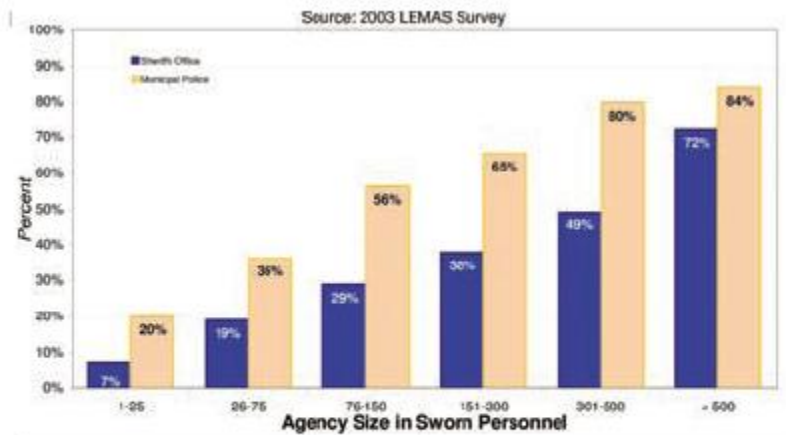


Figure 1: Percentage of police agencies reporting use of computers for crime mapping, by agency size. Source: Bureau of Justice Statistics 2003 LEMAS Survey.

Starting at Square One

This article starts with the recognition that crime mapping is evolving rapidly and is being implemented in diverse ways. Although a growing portion of the state, county, local, and tribal law enforcement agencies in the United States are doing some form of crime mapping, uniformity among agencies implementing crime mapping is not commonplace.

Some standards about the dos and don'ts of crime mapping are emerging. But it can be difficult to find detailed instructions for developing a crime mapping capacity or an independent authoritative checklist of the steps an agency needs to take to get started in mapping.

Given these realities, this article provides an overview of the mapping terrain (a terrain that changes almost daily) and seeks to achieve two objectives. The first is to provide nontechnical law enforcement executives and managers with a basic grounding in what crime mapping typically entails and to identify the implementation challenges they are likely to encounter. The second objective is to present a basic conceptual overview covering key components of mapping and some (certainly not all) trends in mapping.

How Many Agencies Are Mapping Crime?

According to a survey administered in 2003 by the Bureau of Justice Statistics (BJS), in the U.S. Department of Justice, an estimated 17.9 percent of the nearly 18,000 law enforcement agencies in the United States reported using computers for crime mapping.¹ By comparison, an estimated 14.5 percent reported doing so in the 2000 BJS survey. Not surprisingly, as revealed in Figure 1, the percentage of agencies that self-report computer crime mapping capacity generally increases with agency size and varies by agency type.

The Emergence and Growth of Crime Mapping: An Abbreviated History

In his informative, comprehensive, and well illustrated book, *Mapping Crime: Principle and Practice*, Professor Keith Harries dates the onset of standard printed crime maps to about 1830 and the first rudimentary computerized crime mapping efforts to the mid-1960s.² Harries and others have attributed the steady growth of and improvements in computerized crime mapping to several factors, including the following:

- Rapid improvement of desktop computer capacity and related printer and plotter technology
- Specific improvements in records management systems (RMS) used by law enforcement agencies, including enhancements in data storage capacities, progress on justice data standards, better quality assurance practices, and RMS features and operations that are more user-friendly
- Improvements in mapping and database software compatibility as well as increasing integration of mapping and data management functionality
- Benefits of cross-fertilization with other professionals involved in mapping, including military analysts, geographers, urban planners, and public health scientists (particularly epidemiologists)

- A computer-literate generation coming of age and joining the ranks of law enforcement

National Trends and Converging Interests

Although mapping implementations in law enforcement agencies vary widely, national efforts have been under way for at least a decade to promote peer-to-peer information exchanges and establish guidelines. After a planning meeting in 1996, the National Institute of Justice's (NIJ) Crime Mapping and Research Center (CMRC) held its first annual conference in Denver in 1997. Now named the Mapping and Analysis for Public Safety (MAPS) program, conferences are held on an 18-month cycle.

Although the MAPS conferences focus on the crime mapping concerns of law enforcement, these multidisciplinary conferences have been remarkably broad in scope. They have brought together law enforcement executives and managers, sworn and non sworn crime analysts, academic researchers from the social sciences, commercial software vendors, computer scientists, and former outsiders such as geographers and epidemiologists, whose expertise and techniques are being adapted to address law enforcement concerns. (Both crime and disease share some of the same spatial concepts and statistics. Both are relatively rare events that are distributed non-randomly, often spatially clustered. In addition, the public health model is being increasingly applied to assess problems like domestic violence and gun violence.)

The next NIJ Mapping and Analysis for Public Safety conference is scheduled for March 28–31, 2007, in Pittsburgh. Readers should watch the MAPS Web site, www.ojp.usdoj.gov/nij/maps/, for further details.

MAPS conference presenters and attendees have come from various countries, and presentation topics have ranged from the most basic (such as fundamentals of crime mapping and introductory training in mapping software) to the highly sophisticated (such as applying geographic profiling techniques to serial offenders or using spatial temporal statistical models to predict where crimes will occur next). Law enforcement executives or managers contemplating

whether to implement mapping can benefit substantially from the training, presentations, and networking opportunities provided at the conference.

International representation at MAPS conferences has brought a wider diversity of perspectives and approaches to light. Maps of carjackings plotted on a national level by federally organized police agencies in such places as South Africa, for instance, provide a perspective quite distinct from the highly localized mapping of UCR crime categories that predominate in the United States. Technological capacity is more common in countries like the United States, the United Kingdom, and Australia, but countries with police departments that cover larger geographic areas can teach the West lessons about the benefits of centralizing and standardizing data.

The MAPS program, including its conference, its publications, and its Web site, has provided needed structure, direction, and collaboration to the field during the past decade. Exchange forums of this type are critically important given the broad and diverse activity involved in crime mapping and considering the rapid pace at which technology is advancing.

Law enforcement must keep pace as geographical information systems (GIS) in private industry, in the sciences, and in other government spheres are becoming more commonplace and more sophisticated. Two popular e-mail discussion lists, one specifically focused on crime mapping and the other focused more generally on crime analysis, have helped spur advancement by providing a forum for advice to novices and by fostering peer-to-peer exchange among accomplished mapping professionals from various disciplines. (These forums have occasionally sparked heated, albeit constructive, debates.)

- The Law Enforcement Analysts mailing list link is www.leanalyst.info/.
- The NIJ-MAPS CrimeMap e-mail discussion list subscription is available under the resources tab at www.ojp.usdoj.gov/nij/maps/.
- Information about the NIJ-CMAP program and training is available at www.crimeanalysts.net/.

Technical assistance and training in crime mapping and GIS is offered through the NIJ Office of Science and Technology's National Law Enforcement and Corrections Technology Center (NLECTC) under its Crime Mapping and Analysis Program (CMAP). Training is provided free of charge to state and local public safety agencies at locations across the United States.

More county and municipal governments are developing enterprise geographical information systems (GIS). Such integrated mapping applications can serve city planners, building inspectors, transportation and sanitation managers, fire services, law enforcement, and residents.

Law enforcement personnel can benefit from these multi-user systems, but they must be more than passive recipients of these technological tools. Active participation in planning and designing these vertically integrated systems, and contributing data to them, is paramount. Without it, multipurpose GIS cannot meet the specific mapping needs of law enforcement.

Mapping and the Changing Police Mission Mapping also holds great potential to help law enforcement leaders as their missions become more diverse and complex. Adoption of community policing and problem solving strategies, for instance, both present clear cases for mapping. In promoting this position, Taxman and McEwen write, "One of the tools that has promoted successful collaboration among the partners is geographical information, which focuses attention on the problems and needs of [a] particular neighborhood or community and uses the target area to garner community and government agency support for new initiatives."³

The emergent demands for homeland security further underscore the necessity for mapping, specifically for mapping that transcends the confines of a single law enforcement agency. Developing effective strategies to address homeland security will require mapping across the public safety sectors and across law enforcement jurisdictions.

As paradigms of law enforcement change, the police need more capability from mapping than the ability to plot traditional crime data. To better execute its service oriented mission, today's law enforcement department must be able to use mapping to assess risk, to carry out plans for protecting critical infrastructure, to jointly develop multiagency response strategies, and to better understand community capacities and needs.

The clear nexus between homeland security preparedness and response and GIS presents both opportunities and challenges to law enforcement. Broadly defined mapping enterprises-including mapping and spatial analysis related to critical infrastructure, terrorist groups, suspicious activity, remote sensing, and closed circuit television cameras-can help bridge gaps between hometown security and homeland security. Embracing this critical nexus and recognizing the associated needs-involving the sharing of technology, data, and intelligence-also should serve to benefit the full spectrum of law enforcement activities, from conducting vacation door checks to investigating serial murders.

The impetus to promote mapping for hometown and homeland security holds great promise. The emerging and potential advances in mapping can bring about many technological and organizational benefits, including the following:

- Better information sharing, collaboration, and data standardization between federal, state, local, and tribal law enforcement agencies.
- Greater efficacy of mutual aid for disaster preparedness and response efforts. Spatially enabled inventories of law enforcement resources-including personnel, equipment, and specialized capacities such as SWAT-at regional or state levels could be extremely valuable components of disaster prevention, preparedness, and response. Such inventories can also promote more effective sharing of scarce resources among agencies in times of fiscal constraint.
- Mapping also could help diminish interagency turf issues. Maps can help identify overlaps in jurisdictional and operational areas. They not only enhance cooperation and identify joint problems but also break down organizational and informational silos.

It is clear that technological development both in and out of law enforcement will require that every law enforcement executive at least be aware of the impact of mapping. Average citizens have become reliant on Internet applications such as Google Maps, MapQuest, and Yahoo! Maps as well as in-car navigation systems. City and county agencies are relying on GIS in growing numbers. Computerized mapping is part of everyday life; law enforcement executives can scarcely afford to ignore it.

Crime Mapping Principles

A map, like any other type of picture, is intended to be a representation of reality. Depending on the tools and data available, maps can be crude representations of reality or they can embody a tremendous amount of complexity and nuance. While maps can make the complex more comprehensible, the usefulness of any map depends on the skills, experiences, and knowledge of the mapmaker. More complex is not necessarily better. Like pictures, abstract maps sometimes portray information more clearly than complex maps. A well-designed map will be worth a thousand words; a poorly designed map will confuse and misinform.

At a fundamental level, maps are a logical extension of the geometry and geography we all learned in elementary school. Broken down to elements, maps are carefully arranged composites of geometric objects. The most basic crime maps are nothing more than a series of points (dots representing locations of crime incidents or arrests), lines (depicting street networks), and polygons (demarking jurisdictional boundaries or precincts). Although the incorporation of aerial satellite images, called orthophotography, can give a crime map an air of sophistication, the photographic image is nothing more than a dense grid of colored squares, or pixels.

The power of maps lies in their ability to combine visualization with integration of information. Depicted in figures 2, 3, 4, and 5 are a series of maps that range from very simple to moderately complex.

Mapping Combines Human and Technical Resources

Crime mapping requires more than data and software; it requires personnel with a diverse set of skills, ideally blending the talents common in cartographers, graphic designers, and data managers. Some employees, whether sworn or nonsworn, will have better aptitudes for mapping than others. Mapping benefits from creative thinking about what data can be mapped and what data can be acquired; mapping requires keen attention to data quality.

Law enforcement managers should be aware that crime mapping and analysis is an emerging discipline. As a result, there is not yet a pool of college graduates who majored in crime mapping. But many of the top police mapmakers and analysts in country today have come up through the ranks, and managers should not discount the benefits of having worked the streets. The department's best resource may be the spatially astute rookie who shows a knack for mapping and analysis. Nurturing this officer's abilities by providing training and resources can make a law enforcement manager look good to superiors.

Most of the data that the police themselves collect include some spatial reference. As agencies move to computerized mapping, they must ensure that their geographic data fields comply with basic standards. Law enforcement agencies that already have a strong track record of collecting a broad range of data systematically--that is, with careful attention to standardization, uniformity, and data quality--will be in a better position to produce valid and effective maps than those agencies that have approached data collection more haphazardly. The quality of maps and spatial analysis, or any crime analysis for that matter, can only be as good as the data from which it originates.

Mapmakers and analysts must be keenly aware of the quality of not only their own agency's data but also any data that are acquired from other government sources and commercial vendors. Placing data in a map implies responsibility for the quality of the data. For instance, if the state provides an agency with a data file of the destination addresses of released prisoners, the crime analyst who integrates these data into agency crime maps should know the age and quality of the data. Whether using the department's own data or data from other sources, mapmakers must identify the source of the data with any map and include any appropriate disclaimers about the timeliness and quality of the data.

The quality and sophistication of the department's CAD and RMS systems and mapping software will influence the quality of the maps and analysis, but the skills of the mapmaker analyst and the quality of the data are of utmost importance.

Setting the Foundation: Awareness of the Spatial Elements of Data

Good maps depend on good data. Law enforcement personnel operate in spatial environments, responding to calls at addresses or locations that are otherwise locatable (such as designated buildings, crossroads, mile markers). They work in precincts and beats and attend community meetings with civilians who live in neighborhoods. Law enforcement managers might deal with concerned residents who want to know whether burglaries have increased on their block or a city alderperson who wants to boast that crime is down in her ward.

Thus, whether or not an agency engages in crime mapping, it still behooves managers to ensure that data are maintained carefully and at a high level of detail. Even without mapping software, managers will be required to present and analyze data in reference to geographic regions. Standard data collection methods will allow analysts to tabulate how many robberies occurred in a designated area last year. But GIS capability, coupled with reliable incident data, would be able to determine how many robberies occurred within 1,000 feet of a certain ATM during a certain period. Using this type of detailed data enable better policing.



Figure 2: All reported burglaries, residential and commercial, during a particular period.

Standardized Addresses Translate to High Geocoding Rates

The computer equivalent of a human being placing a pin on a wall map is the foundation of most maps. Computerized pin maps require some type of geographic reference for positioning a dot. Most often this reference is a conventional street address. Occasionally it is a set of cross streets. The computer process for converting standard references to longitude and latitude coordinates is called geocoding. Most geocoding in U.S. crime mapping efforts involves interpolation along a line segment for which information is stored in a base map. If, for example, a burglary was reported at 125 Madison Street, a geocoding program would determine that the dot should be placed in the middle of the left side of a line segment representing the addresses 101 to 149. The dot is typically offset from the street centerline at a determined distance (25 feet, for

example). The logic of interpolation, however, does not always match reality. Not all streets are set up with evenly spaced land parcels of equivalent sizes and not all locales follow the same addressing logic.

Consistent and standardized addresses are paramount to successful geocoding. Developing standards at the point of data capture is essential for data quality and will pay dividends when it comes to mapping. Consider how different officers might write the same street name on standard agency report forms:

- Burglary at 123 Martin Luther King Dr
- Simple assault at 128 King
- Lost child on the 200 block of MLK Drive
- Abandoned vehicle in the alley behind 205 ML King Drive



Figure 3: Symbol size distinguishes locations with a single residential burglary from those with multiple burglaries.

The variation in these examples illustrates the need for standardization of street addresses. If these addresses were transcribed into a standard RMS verbatim, a basic geocoding engine embedded in typical mapping software would only geocode the first of these four addresses (a meager 25 percent geocoding hit rate). Some sort of editing or human intervention (such as interactive geocoding where the addresses can be corrected on the fly or data-scrubbing routines that replace nonstandard address strings with standard ones) would be necessary for geocoding at a higher rate.

Moving beyond Address Geocoding

Standard address geocoding has its limitations. Some municipalities and counties have had the good fortune to digitize their property parcel plots—that is, they have developed detailed computerized maps that indicate property lines and in some cases footprints of buildings on those properties. With proper data links between standard

addresses recorded in an RMS and CAD system and the property parcel (or building base maps), crime incident dots can be placed more precisely, often in the middle of the property parcel (or building) polygon. As GIS technology improves, this may become more the norm. In the meantime, spurred by the proliferation of aerial photography and the focus on homeland security, efforts to map critical infrastructure at high levels of geographic precision are becoming more common.

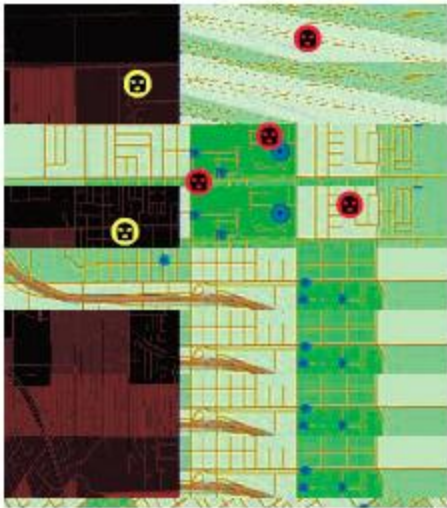


Figure 4: Home addresses of recent residential burglary arrestees (red) and persons with residential burglary warrants (yellow).

Crime analysts must be vigilant of both the geocoding rate and the positional accuracy of the points they plot. An agency that asserts an impressive 98 percent geocoding hit rate may nonetheless produce misleading maps if the data do not accurately reflect where events should be. Allowing relaxed geocoding tolerances in automatic geocoding routines (allowing geocoding to fall back to zip code centroids when address fields are invalid, for instance) or using inaccurate street base maps are common culprits.⁴ Analysts should routinely check geocoding accuracy by inspecting points representing known addresses (the police station, for instance, or the analyst's home). Many geocoding programs or services provide some sort of assurance regarding average positional accuracy (say, plus or minus 25 feet). There may be some street segments or sections of town where geocoding imprecision is well above the average positional accuracy.

Global Positioning Systems

GPS technology is at the heart of commercial in-car navigation systems and fleet-tracking software, and it is increasingly being incorporated into monitoring bracelets that are issued to probationers, parolees, and sex offenders. As offender-monitoring technologies proliferate, law enforcement will be provided with greater abilities to track crime and, in partnership with probation and parole officers, determine where offenders are residing. With proper equipment and with adequate data storage and retrieval capabilities, it is even possible to determine where and when these releaseses violate conditions of supervision by failing to return to their residences after curfew, by entering restricted zones, or by consorting with other felons. The staggering volume of geographic data that this new technology will produce provides another reason law enforcement agencies will be pressed to institute mapping.

While GPS technology holds promise, it also presents challenges. For instance, because the locations of those monitored will be recorded at set time intervals, the technology will require considerable resources in terms of data management, storage, and analysis. In addition, law enforcement managers are responsible for using these data wisely. Having access to these data and mapping them imply certain ethical considerations.

Importance of Contextual Data

Computerized mapping leverages the ability of viewers to visually integrate large amounts of information. The human eye can readily detect patterns in crime incident points and make inferences about how these patterns relate to other features of the mapped environment. Even the most casual student of crime mapping will know that shoplifting incidents will be related to central business districts and shopping malls. Thus, using color-coded icons to differentiate types of thefts along with plotting the location of business districts can provide a better understanding of patterns.

Contextual data refers to a broad range of mappable entities that help make sense of incident data. These range from street grids to schools to locations of police facilities. Maps could be used, for instance, to determine whether a series of purse-snatchings tend to cluster around particular types of parking facilities or around subway entrances.⁵ Similarly, maps can be used to determine whether reports of gunshots heard in urban neighborhoods tend to cluster around parks, certain liquor establishments, or neighborhoods known for gang activity.

Mapping software, coupled with good data, can help analysts discover patterns and also can provide the means of empirically validating hypotheses, such as an investigator's supposition that there is a relationship between adult entertainment establishments and sexual assault in the community.

Patrol officers, detectives, and crime analysts may use maps to foster discussions. In this sense, mapping can be used as part of an interactive discovery processes. Some viewers might see patterns that others may miss or might suggest new contextual features that will bring more clarity. Individual map layers may be selectively added or removed to provide for different perspectives. Maps have been described as heuristic devices, or effective tools for stimulating investigatory processes, exploration, and reexamination.

Robust Query Abilities and Detailed Attribute Data

Law enforcement officers are well aware that they collect an abundance of descriptor data about reported events, suspects, and conditions of arrest. Although visual selectivity of layers is a powerful attribute of mapping, so is the selectability afforded by the descriptor, or attribute, data.

Well-designed and standardized databases take full advantage of this robust data and allow analysts to produce effective maps with a high degree of specificity for tactical analysis. Using data fields standard in many law enforcement records management systems, for instance, queries can be made to select and map all residential burglary incidents that occurred between specific times in which certain types of items were stolen. Analysts may create a query that seeks to identify, for example, what burglaries occurred between 1500 and 1700 hours to unsecured facilities that involved theft of music CDs, personal audio equipment, and other pocketable property? Adding a mapping layer of schools to the map provides context. Thus, an integrated mapping of schools and queried data would be helpful in determining whether this particular subset of burglaries is related spatially with juvenile offenders leaving school and performing daytime burglaries to unoccupied and unsecured residences. Thus, the quality and detail of data affects not only the ability to map events but also the ability to define crime types or modus operandi with a high degree of specificity necessary for tactical crime analysis and for solving crimes.

One practice of the Baltimore County Police Department (BCPD) provides an illustrative example of the power of being able to disaggregate data based on key attribute information. When mapping and assessing spatial patterns, BCPD analysts routinely distinguish so-called nondefensible burglaries from other burglaries. Nondefensible burglaries are committed by previous residents of a property, such as the ex-boyfriend who returns to an apartment he had shared with his former girlfriend to retrieve personal items. He entered the apartment without consent, but he had no intent of unlawfully taking property. For the purposes of tactical analysis,

nondefensible burglaries are clearly distinct from other burglaries, either forcible or nonforcible. Without the ability to separate nondefensible burglaries from other burglaries, analysts might not readily detect patterns that exist for conventional burglaries.

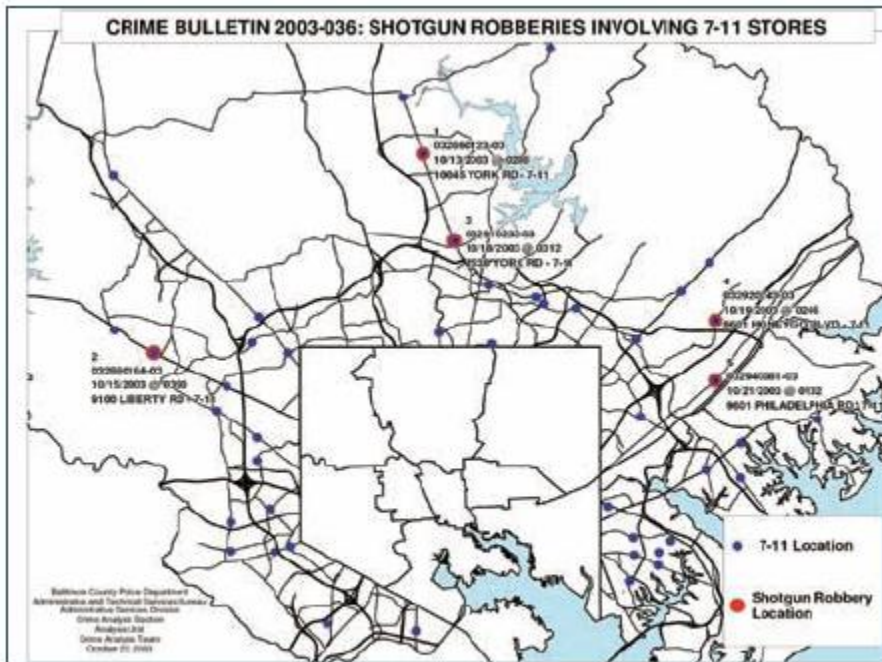


Figure 5: Convenience store robberies with common modus operandi during a particular period, with potential targets. (Low-resolution screen view) Courtesy Baltimore County Police Department.

Mapping More Than Crime

For obvious reasons, most mapping in law enforcement centers on crime. Although contextual factors may be added, the primary focus is typically on standard reactive police activity, mostly calls for service, crime incidents, and arrests. But just as law enforcement is only a portion of what most police officers do, crime mapping is merely one part of mapping by police employees. Police also use mapping for

prevention, community outreach, and accountability.

Law enforcement can also rely on mapping to manage risk proactively and to direct resources more effectively. Mapping technology can help keep track of trouble spots, such as bars named in a large number of noise complaints. Mapping locations of tax delinquent properties, those in serious violation of building codes, and those designated as abandoned can help police identify locations of drug dealing. And, as we've already discussed, mapping can help track the location of probationers and parolees.

Mapping can be an important part of proactive policing and community outreach. For instance, police can create maps using census data to identify areas with high concentrations of immigrants and persons with limited English proficiency. In the case of New York City, police used maps based on such data to help develop outreach strategies to immigrant population groups, who are often vulnerable to victimization but hesitant to call the police. In general, in the last several decades, mapping has developed alongside problem-oriented policing and has been widely adopted by agencies engaged in community policing.

Of course, departments may also use maps to assess traffic collisions or other events that demand police resources. When one of the authors was involved with focus groups about mapping needs in upstate New York law enforcement agencies, participants in one department were most

interested in mapping collisions between vehicles and deer, as this was perceived as a major problem in the area.

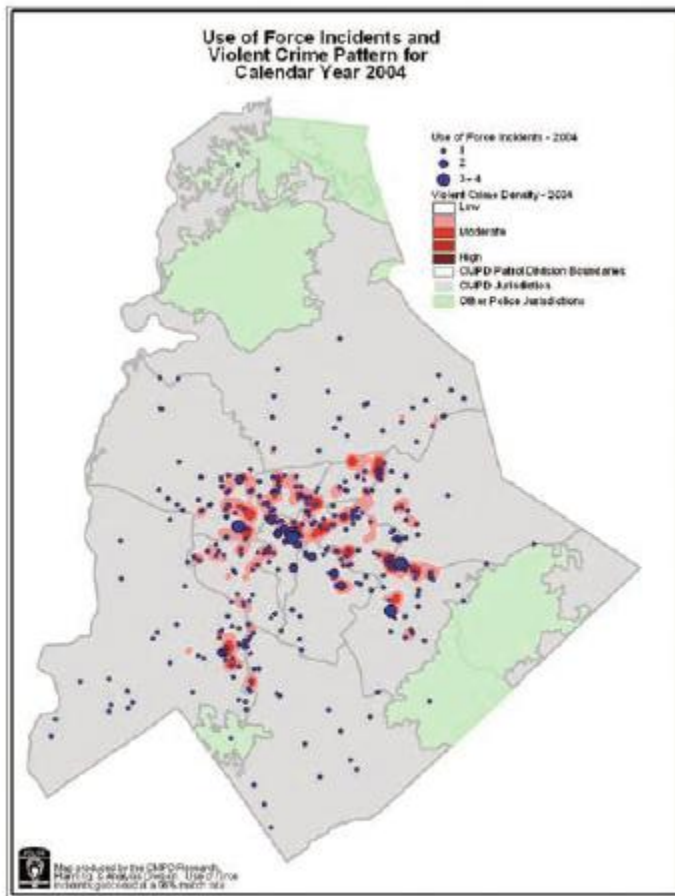


Figure 6: Use-of-force deployments relative to areas of violent crime. (Low-resolution screen view) Courtesy Charlotte-Mecklenburg Police Department.

Mapping for Police Accountability and Public Relations

Departments are also turning the analytic lens of mapping on themselves, using maps to assess where citizen complaints are generated and where use of force is most often exercised. For instance, the map in figure 6, taken from the 2004 annual report on internal affairs of the Charlotte-Mecklenburg Police Department, illustrates the relationship between locations where officers used physical force and areas with high violent crime density. The report is available for viewing on the department's Web site at www.charmeck.org/Departments/Police/About+Us/Departments/Internal+Affairs/Home.htm.

Selecting Software

All major commercially available software packages can produce quality results for most common crime mapping objectives. It is at the more sophisticated end of the spectrum that differences between software packages

can become apparent. Some packages may be rich in features but are challenging to use; others are easier to use but have fewer features. Desktop software common in law enforcement includes ESRI, Intergraph GeoMedia, MapInfo, and Microsoft's MapPoint. Prices vary according to functionality and the amount of base map data that is included with the purchase.

Rather than trying to determine the elusive answer to the question about the best commercial software, law enforcement managers would be better off determining what software their city or county government is already using, if any. They also may determine the software that their agency's prospective crime mapper is most comfortable using. They might make the same determination about potential consultants from the criminal justice or geography programs at the local university.⁶ A discussion with or visit to a department already engaged in mapping—especially an agency of a similar size and mission—would also be advisable.

Before making software purchases, law enforcement managers—or agency information technology staff in agencies fortunate enough to have them—should assess what technology will

work best with their CAD systems and RMSs. Compatibility and ease of data transfer also should be considered when CAD systems and RMSs are upgraded or the department is selecting new CAD and RMS vendors.

Many CAD systems and some RMSs are now bundled with mapping capabilities. Managers need to determine whether these components are flexible enough and have sufficient functionality for the agency's needs. Even when the RMS vendor's literature pro-motes the capacities of its built-in (or add-on) crime mapping module, the capacity most often will not be as full or as flexible as that which standard desk-top mapping software can provide.

A modern-day adage holds that one should purchase more technological capacity than meets present needs, based on the assumption that an agency will grow into it. Experience suggests this certainly holds true for mapping.



Figure 7: All premises with alcohol-sales licenses. Because it doesn't distinguish between off-premise licensees, such as grocery stores, or on-premise licensees, such as bars, this map may suggest a problem where none exists and may needlessly alarm residents.

Defining Organizational Approaches to Mapping

Crime mapping technology may be configured and organized in a variety of ways in law enforcement agencies. Generally speaking, there are two organizational approaches to mapping, which are not necessarily mutually exclusive.

Approach 1 would be to leave mapping to specialists, perhaps crime analysts. Mapmakers and analysts tend to be proficient at both database management and computerized cartography. They will likely employ commercially available mapping software, use its capacities to the fullest, and rely on incident and arrest data from the agency's CAD system and RMS for mapping. They will also readily incorporate other geo-graphic data, such as geographic shape files depicting precinct boundaries, parks, or drug-free school zones, as well as data acquired from outside sources.

Approach 2 is to allow mapping to be accessible to nonspecialists through custom mapping applications.

These approaches tend to deploy access to basic

functionality to a broad cross-section of personnel with graphical user interfaces (GUIs) that are designed to be user-friendly. When Charles Ramsey, now chief of the Metropolitan Police Department in Washington, D.C., was acting superintendent of the Chicago Police Department (CPD), he was reported to have quipped that he wanted CPD to design a mapping application that even he could use. Chicago's in-house mapping system, called ICAM (for Information Collection for Automated Mapping) is highly versatile and designed to be accessible to everyone in the department, from the beat officer to the superintendent. Similar agency-wide mapping systems can be made available through secured intranet (internal Internet) applications or virtual private networks, controlling access through user authentication and passwords. These

customized approaches will require dedicated network resources and personnel to maintain the systems, update software and hardware, and maintain associated data.



Figure 8: All premises with alcohol-sales licenses, with emphasis on on-premise alcohol licensees.

It should be stressed that approach 1 and approach 2 are not mutually exclusive. Many departments can take both. The average patrol officer might rely on a customized interface to be able to produce a standard map of what occurred on his beat in the 24 hours before his shift began. Meanwhile, crime analysts might rely on more flexible desktop software to produce a highly customized map, similar to that depicted in figure 5, to track a series of convenience store robberies.

Public Access to Crime Mapping

Another critical facet of mapping is the decision about what, if any, data should be made available to the public. Many agencies take the posture that the public has a right to view crime data, and these agencies proactively share crime maps with the public, often in the form of static or interactive maps on the Web site. Clearly, not every map that is suitable for internal law enforcement purposes should be shared with the public. Appropriate steps should be taken to prevent mapping information in a format that will permit the identification of victims or suspects. Many departments take care to mask the precise address of crime locations to better ensure privacy and confidentiality. Chicago's interactive Citizens' ICAM Web-mapping application, for instance, reveals information about the incident block only by stripping out the last two digits of an address. For example, an assault and battery at 327 West 35th Street would be reported as "3xx W 35th St."

**Office of Juvenile Justice and
Delinquency Prevention (OJJDP)
Developing Integrated Juvenile
Information System (IJIS)**

Mapping across borders, agencies, and disciplines is becoming more common as GIS applications are moving from local and regional focuses to national coverages. The Office of Juvenile Justice and Delinquency Prevention (OJJDP), a component of the U.S. Department of Justice, is developing a comprehensive Web-based GIS application to integrate information about youth-related grants, promising programs, risk factors, and other resources on a national level. IACP is working with OJJDP to help determine how law enforcement can best benefit from this system and the types of information that they can contribute to it.

The Integrated Juvenile Information System (IJIS) is intended to help juvenile justice and youth service practitioners—including law enforcement—share promising programs. IJIS, now in the planning stages, is being designed to reduce the cost of data collection and promote data sharing among justice professionals, academic researchers, and the public.

Please write to John Markovic (markovic@theiacp.org) for more information.

Mapping the Location of Sex Offenders

Spurred by state laws requiring public notification about sex offender residences, many states are providing interactive mapping applications that allow community residents to determine whether sex offenders live in their neighborhood or near their children's schools. In Arizona, a statewide application plots offender residences as well as the location of schools and day care centers. It also includes access to profiles and photographs of offenders. The National Institute of Justice provides a Web site, at (www.nsopr.gov/), that allows visitors to gain access to individual states' sex offender registry Web sites. Recently available, yet still under development, is a nongovernmental effort to consolidate and map sex offender data on a national basis. That site can be found at (www.familywatchdog.us/).

Fairness in Mapping

Mapping the location of crime and of offenders can have a tremendous impact on public safety and assist in the law enforcement mission. While mapping provides clear benefits, producing maps carries some potential risks, and consequently certain responsibilities. One responsibility is protecting the confidentiality of victims and suspects. Police managers and analysts also need to remain aware that maps, particularly those made available to the public, can induce fear needlessly and may unintentionally stigmatize certain neighborhoods and the people living in them. Consider the different impressions left by the two maps below created from the same data.

Whether maps are used internally or shared with the public, it behooves managers and analysts to be aware of the messages they are sending. Map content and displays must be carefully chosen. When necessary, analysts should provide appropriate caveats to avoid misuse of maps and misinterpretation of data.

New Frontiers in Mapping

More agencies are gravitating toward mapping, but it remains a data-intensive effort. For many agencies the process requires downloading data from an RMS, converting data files to a format that can be read by GIS software, and then making maps. The process is time-consuming and requires technical proficiency. Departments either need to hire data analysts or mappers or send employees to training. Several promising trends may help lessen these burdens for individual law enforcement agencies.

Mapping-Enabled Records Management Systems: Several major vendors of CAD systems and RMSs now offer mapping functionality as a standard or add-on feature of their products. The extent to which this built-in mapping capacity meets the needs of the law enforcement agency will depend on both the vendor's software and the agency's needs. Agencies that do have mapping-enabled CAD systems or RMSs may still find it necessary to have stand-alone mapping software that allows for greater flexibility in map presentations and more sophisticated analyses.

Cross-Jurisdictional Mapping: The fact that individual criminals do not necessarily confine their offenses to individual police jurisdictions is clear. This recognition, along with the realization that criminal enterprises like street gangs involved in narcotics distribution often are geographically dispersed beyond police boundaries, has led to efforts to develop cross-jurisdictional crime mapping efforts. Some of these efforts are ad hoc attempts to pull together data from different agencies using a combination of techniques and a standard off-the-shelf mapping program. Many federally funded Weed-and-Seed and Project Safe Neighborhood sites have obtained help from university-based researchers in such efforts. Interagency gang and drug task forces have employed similar approaches.

In the last decade, efforts have been under way to develop integrated cross-jurisdictional crime mapping systems in many areas of the United States. One such system is Regional Crime Analysis GIS (RCAGIS), funded by NIJ and developed in 1999 for agencies in the Baltimore and Washington, D.C., area. This system was designed around sharing data, mapping, and crime analysis, particularly to examine crime incident data across jurisdictional boundaries. RCAGIS was designed to run as a desktop computer application using shared data files.

At about the same time RCAGIS was being developed, several regional and state efforts were under way to provide similar functionality through the Internet or secure intranet connections. Examples include the cross-jurisdictional mapping applications in the San Diego area and in New York State. Multiple motivations for regional or cross-jurisdictional mapping applications exist. These include the realization that offenders do not operate within the confines of a particular jurisdiction and the potential benefits of distributing the cost and responsibilities for developing these systems across multiple jurisdictions. At the same time, challenges to creating and maintaining cross-jurisdictional systems remain. These include technical, political, and cultural obstacles related to data sharing as well as problems inherent in joint ownership and organizations sharing responsibility for running the system. An individual agency will often prefer to do things its own way, and its idea of data standardization is to assert the value of its own standards and welcome other agencies to adopt them.

A 2002 publication by John Eck discusses how mapping crime across borders requires making accommodations for variations across departments.⁷ Eck points out that agencies may vary in levels of citizen crime reporting; in agency recording practices; event classification; in degree and classification of descriptive (attribute) information (how one defines a crime as gang-related, for instance); and in geocoding rate and accuracy.⁸ These obstacles present significant challenges, but there are many compelling reasons to continue working toward data sharing and the development of cross-jurisdictional mapping and capacities. Managers and analysts must remain vigilant about interagency variations, some of which can be quite subtle but of enormous importance.