
**CRIME MAPPING IN POLICE
DEPARTMENTS:
THE CHALLENGES OF BUILDING
A MAPPING SYSTEM**

by

Lorraine Green Mazerolle
University of Cincinnati

Charles Bellucci

and

Frank Gajewski
Jersey City Police Department

***Abstract:** This paper identifies the challenges facing police departments that seek to implement computerized crime mapping systems. The first part of the paper highlights the importance of police departments identifying primary "end-users" and then designing systems that accomplish the tasks specific to the needs of their end-users. Data transfer, geocoding, data integration, system customization, and confidentiality issues are discussed. The second part of the paper illustrates the practicalities of implementing geographic mapping systems drawing from our experiences with the Drug Market Analysis Program. We profile the Jersey City, NJ crime mapping system to highlight some of the*

Address correspondence to: Lorraine Green Mazerolle, Division of Criminal Justice, University of Cincinnati, PO Box 210389, Cincinnati, OH 45221-0389 (e-mail lorraine.Mazerolle@uc.edu).

difficulties encountered in implementing a computerized crime mapping system for street-level use. The paper concludes that police departments planning to implement computer crime mapping capabilities need to think carefully about who, what, where, when and how the system will be used and then design the system data sources and interfaces accordingly.

INTRODUCTION

Mapping crime in police departments has emerged as a popular means to display, *analyze*, and understand the distribution of crime problems (see McEwen and Taxman, 1995; Maltz et. al., 1991; Rich, 1995). Crime analysts and police department planners use computerized maps to examine crime trends, identify emerging crime patterns, and present graphic representations of crime data to management, line officers, and the community. Street-level problem-solving officers use computerized crime mapping capabilities to map out the locations of specific crime problems on their beat, search the regularity of locations where a suspect is arrested, and display patterns of crime activity at the local level.

For many types of inquiries, crime analysts and street problem-solvers need similar computerized crime mapping systems: they both merge Census data and land use data (such as percent of residential properties versus business properties) with police calls, arrests, and field investigations. Crime analysts and problem-solvers also use computer maps to identify emerging patterns of crime activity. In many ways, however, crime analysts and street-level problem-solvers demand different types of inquiry systems for their different purposes. Crime analysts typically create thematic maps that help them to analyze the distribution of crimes against important population, land use, and household data at the Census-tract level. By contrast, street-level problem-solvers typically create point maps that plot the exact locations of arrests, for example, against specific types of environmental characteristics such as the locations of bars, pay phones, and video arcades on a beat.

This paper examines the challenges that confront police departments in designing and implementing computerized crime-mapping capabilities. The paper begins by identifying some of the factors that police departments need to consider when they decide to build a crime mapping system. We contrast the different needs of crime analysts and street-level problem-solvers, the needs of rural versus city

police departments, and the capabilities of mainframe versus personal computer (PC)-based mapping systems. The second part of the paper discusses the specific challenges confronting departments that plan to implement PC-based crime mapping systems. In the third section we profile the Jersey City (NJ) Drug Market Analysis System as an example of a PC-based computerized mapping system that was designed and implemented for operational use by street-level problem-solving officers.

DIFFERENT SYSTEMS FOR DIFFERENT PURPOSES

Crime mapping systems provide police departments with a powerful tool with which to examine a vast array of data. Police data (arrests, calls for service, and crime incidents) can be mapped with Census data and any other information for which an address is available (e.g., bars, fast-food locations, pay phones). While the opportunity to map crime appeals to many police agencies, the practicalities of purchasing, installing, customizing, and using crime mapping systems are far from straightforward. Moreover, without having a clear picture of who (in the department) is going to use the system, many enthusiastic ventures into crime mapping end up as frustrating experiences that fail to live up to early expectations. We propose that different police agencies need different types of crime mapping systems. Moreover, even *within* a police agency, different police functions will most likely demand different types of applications. Consistent with this proposition, we examine several factors that police agencies may want to consider in building their crime mapping systems.

Mapping Systems for Crime Analysts and Problem-Solvers

In this section we identify and discuss two primary crime mapping system "end-users": crime analysts and street-level problem-solvers.¹ These end-users have different interests and functions within the police organization. As such, their respective demands of a crime mapping system can be divergent. This section contrasts some demands of crime mapping systems that are typical from crime analysts and street-level problem-solving officers.

Computerized crime maps provide crime analysts and departmental planners with a means to spatially relate crime conditions, patterns, and trends. For example, an analyst can search for places where high levels of crime correlate with relatively low levels of patrol

assignments. Patterns can be explored within a mapping system by searching places with elevated levels of crime against patrol deployment patterns across temporal dimensions. Trends can be uncovered by using past patterns to predict the locations of emerging hot spots of crime.

Graphic presentations of search findings provide a powerful medium to communicate conditions, patterns, and trends, often creating an avenue for analysts to bring about significant policy changes. In Jersey City, for example, computerized crime mapping capabilities have been used by departmental planners to develop beat boundaries and to help match community service officers with particular ethnic and racial neighborhoods. In another project, the Jersey City Police Department crime mapping system was used to merge crime data with neighborhood characteristics. Boundaries were created to match Census data with police data aggregated to the beat level of analysis. In this project, workload data were merged with indicators of crime (such as emergency calls and arrests) and then mapped along with Census data showing population densities, proportions of youths by district, and other community-level factors that correlated with high or low work loads. Using these maps, the police department embarked upon a restructuring project that precipitated widespread changes to the organizational structure and function of the department.

While police department planners and crime analysts are typically interested in using computerized crime mapping systems to answer broad-based policy questions, street-level problem-solvers use crime mapping to answer different types of questions. Street officers still require mapping tools to examine conditions, patterns and trends in crime problems, but the units of inquiry and their data needs are often quite different from crime analysts' demands. For example, street-level officers tend to explore crime maps to identify the environmental features that are consistent with different types of problems. Bars are often found to be focal points for open-air drug sales (Eck, 1994; Roncek and Maier, 1991; Weisburd and Green, 1994); assault and robbery problems tend to occur along main thoroughways and, in particular, near bus stops; and prostitution problems are often found along main thoroughways. Knowing the unique distributions of crime problems for specific categories of crime is critical for street-level problem-solving officers.

While crime mapping systems can be used by both street-level officers and citywide crime analysts, many police departments customize their inquiry system to meet the specific demands of one

group over another. For example, crime analysts will typically demand a mapping system that can routinize the creation of thematic maps describing the changing patterns of crime across the city over the last six months. By contrast, beat officers will typically demand that their mapping system help them to pinpoint crime patterns for specific categories of crime. For example, the Jersey City Violent Crimes Unit used their mapping system to identify robbery incident patterns over a two-week period when they suspected that one particular group was involved in a spate of crimes.

A mapping system designed to routinize thematic maps using six-monthly or yearly blocks of data will frustrate a beat officer asking very different questions and needing more specific time-frame data. Therefore, we suggest that police departments need to identify the primary end-user from the outset, and then prioritize the customization of crime mapping systems accordingly.

Rural, Suburban and City Crime Mapping Systems

Crime mapping systems will be used differently depending on whether the police department is a rural, suburban, or city department. Rural departments face very different crime problems than suburban and city jurisdictions. As such, crime mapping systems need to be customized around the types of questions that are most pertinent to particular departments. For example, rural departments may want to search for a stretch of road where most traffic infringements are given against the locations of traffic accidents by time of day and day of week. By contrast, city departments may want to search for drug-selling clusters or pinpoint the exact locations of robberies by bus stop locations.

The geocoding challenges of rural, suburban, and city departments are also quite different. For rural departments, pinpointing the exact location of an incident may be impossible for many incidents due to vague location descriptions within the data, as well as the existence of roads that do not exist in the map files. Therefore, thematic mapping may be more pertinent at the block-group level of analysis for rural departments. By contrast, pinpointing crime locations and identifying clusters of crime activity (hot spots) will be highly relevant for city and possibly suburban departments.

Over all, finding solutions to geocoding problems and developing customized mapping systems are very different processes for city, rural, and suburban police departments. Therefore, a crime mapping system that may be useful for a city agency may have limited rele-

vance for a suburban department and even less applicability for a rural department.

Different Platforms

Some police departments have purchased sophisticated mapping systems (such as ArcInfo) that run off UNIX or VAX systems. Others have purchased less expensive mapping software (such as MapInfo and Atlas) that can be easily installed and run off PCs. While software is available that allows for easy conversion of files back and forth between different platforms (e.g., ArcLink), police departments need from the outset to make up-front commitments regarding which platform they wish to "house" their mapping system. The following issues are raised regularly while police department are choosing between different mapping platforms:

- (1) *Cost* PC mapping software such as MapInfo, Arc View or Atlas are considerably cheaper than mainframe mapping software systems such as ArcInfo.
- (2) *Training:* PC mapping software such as MapInfo is generally regarded as requiring considerably less training than mainframe software such as ArcInfo. ArcInfo systems are often dependent on specialized computer personnel to produce maps, whereas MapInfo requires a shorter learning curve and less start-up expertise to produce useful maps.
- (3) *Capabilities:* One question often raised by police departments centers on the relative capabilities of different mapping software. While most police departments tend to underutilize their system capabilities, ArcInfo generally provides more analytic capabilities than MapInfo. However, for thematic mapping and basic crime analysis in police departments, PC mapping systems will provide most of the capabilities needed by police.
- (4) *Technical Support* One question that is raised by many police department personnel is access to (or lack of) technical support. Police departments need to talk with other departments that have recently purchased similar software to ensure that they will have adequate access to technical assistance.

PC MAPPING SYSTEMS: THE CHALLENGES

The power of computerized crime mapping is the ability to draw from and organize a vast array of data in a form that can be quickly

digested and understood. Graphic presentation of various types of information on a map allows the user to easily convey a story. However, many police departments become frustrated when they attempt to implement crime mapping systems. This section surveys some of the typical problems encountered by departments in their efforts to implement PC computer mapping systems.

Real Time Versus Archive Data

One technological challenge facing police departments interested in crime mapping is making call, arrest, incident, and other routine sources of police data accessible to the police on a "real-time" basis. As emergency calls are logged, arrest reports typed and investigations recorded, line officers need access to these data. Failure to integrate these data with mapping systems on a real-time basis can lead to officers developing negative opinions of crime mapping systems and perceptions that the systems cannot aid in their problem-solving activities. (See a later section for a discussion of this issue.)

One solution to a demand for "real-time" police data is applying global positioning systems (GPS) technology to policing. This involves installation of receivers in moving vehicles,² on people,³ or on animals⁴ that then transmit information to satellites that pinpoint the position of the receiver at routine or specific points in time. Satellite information is then transmitted to a computer terminal (PC or mainframe) that then uses the real-time data to track the locations of the moving objects.

In policing, GPS systems could be used⁵ to track police vehicle locations periodically throughout a shift, relay arrest locations, identify arrival times at crime scenes, track police responses to emergency calls for service, or pinpoint the locations of police vehicles closest to an emergency call for service. The obvious problem with GPS technology applied to policing, however, is the specter of surveillance by supervisors over line officers (also see Sorensen, this volume).

Data Transfer

Many police departments have opted to purchase and install PC mapping systems. One of the first challenges confronting police departments that have invested in these systems is the retrieval of police data. The problem is that police department data are often stored on UNIX or VAX systems. While the transfer of these data is relatively straightforward,⁶ modifications to the main system interfaces are generally necessary to facilitate easy transfer of the data into the PC

environment. For example, system managers often need to install a menu option and programming routine to retrieve sets of data (by crime type and time period), size the retrieved data sets, and then save the data as transferable ASCII files.

Geocoding

Police departments generally confront many problems in merging police data with computer maps. Even when data transfer problems are solved, police data often comes in a form that is difficult to clean and prepare for mapping. While most police computer-aided dispatch (CAD) systems contain "geofiles" (master lists of addresses linked to a location identifier) that are designed to automatically check and prompt call-takers to enter addresses accurately, incoming police data must still be processed (or geocoded) within the mapping system to enable cases to be mapped. Those departments that do not have address-checking procedures set up at the call-taking stage confront numerous cleaning and geocoding problems when they bring the data into the mapping environment.

There are many ways that police departments can improve their geocoding "hit" rates. Methods to improve the integrity of incoming data include training call-takers, blocking incorrect addresses from entry to the system until they have been checked against the geofile, implementing E-911 systems that automatically record the location of the emergency call,⁷ regularly updating geofiles, and making geofiles fit the format of the mapping system street files.⁸ Other ways to enhance the geocode rate of incoming data are to write routine cleaning programs to process incoming data before geocoding is attempted, and to permanently alter street files to match the form of incoming police department data. One final way to increase the geocode rate of police data is to purchase mapping utilities that attempt to geocode data to a range of alternatives, and then provide "out files" to identify the final match that was made (e.g., MapMarker). Overall, the time taken to retrieve, download, clean, and geocode police data presents challenges for implementing street-level mapping systems whose users often demand real-time data for problem-solving activities.

Managing Data Files

Another challenge for those implementing PC crime mapping systems relates to developing procedures for managing large and evolving data files. PC crime mapping systems have to be set up in a way

that provides system managers with automated and routine procedures that allow for accurate, convenient, and easy methods to: clean incoming data; append new data to master data files; re-index files; purge old data; and allow room on PC environments to store large amounts of data. Investments in automating these procedures at the start of building a crime mapping system will increase the integrity of the data used in the system for street-level problem-solving officers.

Customizing the System

Over the last five years, PC mapping software companies have introduced more user-friendly, windows-based mapping systems that offer easier and more sophisticated inquiry options than older, DOS versions. However, police departments need to either hire outside consultants or develop in-house expertise to take advantage of the programming options of the software to allow users to customize mapping environments, and to allow officers to easily access data and conduct common types of inquiries. The easier the access to system queries, the more often officers will use the system for problem-solving activities.

Personalizing the System

Once a mapping system is customized, another challenge to police departments is to build mapping systems that allow officers to introduce new, idiosyncratic data and personalize existing data. For example, some beat officers collect data on the home or business addresses of community members who are cooperative with their problem-solving activities. Others collect information about, and monitor the locations of, vacant lots, abandoned buildings, and other types of environmental factors that they believe contribute to emerging crime problems. These types of data need to be readily accessible to beat officers, and system enhancements must be routinely made to allow for new, idiosyncratic and personalized data to be integrated into the main mapping system.

Documentation

The need for careful documentation on the uses, available data, and typical search routines included in a customized crime mapping system is not usually regarded as a priority for departments building crime mapping systems. However, careful documentation of a map-

ping system can greatly enhance its use and provide access to it by a greater number of people.

Confidentiality

The confidentiality of maps that pinpoint crime locations is an area of concern that is typically neglected in discussions regarding the development of crime mapping systems.⁹ Anytime data are mappable to the address-level of analysis, police departments need to concern themselves with issues of confidentiality. For example, police need to proceed with caution when creating maps that reveal addresses of community members who facilitate problem-solving activities; home addresses of people that have been contacted, but not arrested, in the field; or locations of people calling the police about particularly sensitive crime problems. The problems of confidentiality cannot be easily resolved. Beyond setting up password protections and creating search and query options that block the display of some particularly sensitive fields, police departments need to think carefully about circulating maps that may raise confidentiality concerns.

In sum, building computerized crime mapping systems requires a considerable amount of forethought and planning to ensure both the integrity of the system and its long term usability. Ideally, police departments should consider building in-house skills for system design, creation, and management rather than relying on external consultants. Initial investments in police department personnel will allow departments to develop their systems over time, resolve data problems as they arise, and keep abreast of new technological advances as they emerge.

THE JERSEY CITY DRUG MARKET ANALYSIS SYSTEM: THE PRACTICE OF BUILDING A PC MAPPING SYSTEM

In 1989, the U.S. National Institute of Justice (NIJ) funded five cities (Jersey City, Kansas City, Pittsburgh, Hartford, and San Diego) to be part of the Drug Market Analysis Program (DMAP). DMAP comprised three broad objectives: to develop a systematic process for identifying drug markets (see Weisburd and Green, 1994); to develop a computerized crime mapping system for operational drug enforcement purposes; and to develop, implement, and evaluate an innovative enforcement strategy targeting street-level drug markets (see Weisburd and Green, 1995). This section examines the second objec-

tive of the Jersey City DMAP: building a computerized crime mapping system that was developed as an operational tool for the project.

Building the DMA System

The DMA computer system was envisioned as an independent micro-computer network to be linked to the main computer system in Jersey City through a complex set of mini/micro computer interfaces. The configuration utilized the department's CAD system mini-computers that acted as host servers for seven 386 PCs: one at each of the four police districts located throughout the city, two at the narcotics unit (one for the experimental team and one for the control team) and one at the Center for Crime Prevention Studies at Rutgers University in Newark. The mini-computers were capable of storing data files in MS-DOS format, which assured compatibility with the remote PCs. All PCs were remotely linked to the mini computers via 9600-baud modems utilizing dedicated telephone lines, except for the Rutgers University link that used a 2400-baud call guard dial-up modem with a password and call back feature for security reasons. The DMA system used FoxPro for database management and MapInfo (for DOS) for geographic data analysis.

One of the first major problems encountered was the accuracy of the street files supplied by MapInfo. While MapInfo correctly states that its Topologically Integrated Geographic Encoding and Referencing (TIGER) files are 85% accurate (or better), there was no way of telling which street coordinates were inaccurate or missing. To identify inaccurate location information, we created a database with all the street addresses and intersections in the jurisdiction and then geocoded call and arrest databases in MapInfo. The unmatched locations were then checked and corrected. In Jersey City, the police department's geofiles along with databases from other city agencies (Traffic Engineering and the Department of Urban Research and Design) allowed for accurate construction and checking of all addresses in Jersey City. We also spent time driving the streets of Jersey City and checking the addresses on new streets and on some segments that consistently generated unmatchable addresses during geocoding attempts. With these early efforts to correct the map files we estimate that the Jersey City map files are now about 99% correct.

In the early stages of DMAP, it became apparent that the police department's investigation and arrest data would present a problem for geocoding in MapInfo. The Electronic Data Processing (EDP) Unit keyed arrest and investigation information into a Local Area Network (LAN) system directly from hard copy reports. Since EDP's needs for

these data concerned only Uniform Crime Reports reporting requirements, exact location information was not a priority. Therefore, location information was not standardized, nor was it even considered important. We identified thousands of common names, variations on street extensions, and other idiosyncratic ways of entering incident locations.

Initially, we thought that implementation of the new Management Information System (MIS) would supersede the LAN system of recording arrest and investigation data. Unfortunately, the department was unable to install the MIS during the operational period of DMAP, and we were compelled to correct the problems of the local area network reporting system to gather arrest and investigation data.

To overcome this problem, we wrote a series of programs to "parse-out" location information. These data were then matched to a master street name file or a common place name file. Locations that were unable to be corrected ultimately had to be reviewed one at a time and manually adjusted. Needless to say, this was a very time consuming and tedious task. Initially, locations were successfully geocoded in about 40% of cases. After running through the "cleaning programs," the match rate reached 85%. Finally, after manually correcting the incoming data, over 90% of the arrest and investigation data were geocoded. At times, a 96% match rate was possible. At the same time, a training program was undertaken to impress upon EDP personnel the importance of entering location data in a correct and standardized way. Afterward, the geocode match rate improved substantially.

The CAD data were less complicated. With the geofiles integrated with the CAD system, the match rate for the call data was generally 98%. The two percent errors occurred when the Communication Bureau's call-takers "forced" location information into the system, even though the CAD geofile indicated that the address was not valid.

One of the problems that plagued the DMAP was the lack of ability to transfer arrest and investigation in a timely manner. For the operational component of the DMAP, the lag time in transferring data seriously undermined the perceived worth of the system (see a later section for further discussion of this issue). EDP was responsible for keying information into the LAN system after receiving the hard copies from the various divisions and units throughout the department. The hard copies were prepared by these units and then reviewed by clerical personnel before being delivered to the EDP. This initial process took about five days. It took another two days for EDP to key the information into the LAN. By this time, the data were already seven

days behind. Moreover, the design of the LAN databases made it difficult to download data for DMAP purposes on a daily basis. The central problem revolved around the lack of assigning a case control number to individual records. To guard against downloading duplicate records, we had to wait until the tenth of each month before retrieving the prior month's data. This resulted in the DMA system regularly being at least one month behind in arrest and investigation records.

A second problem emerged when we tried to update data on the DMA system. After the data were retrieved, cleaned, and formatted to fit the DMA system file structures, the master data files had to be updated on a routine basis with new, incoming data. Once again, this required human intervention and time scheduling to ensure data integrity in updating master files.

Experiences with the Jersey City DMA System

The Jersey City DMA system was designed to be an operational tool for the narcotics detectives responsible for carrying out the DMAP experiment (see Weisburd and Green, 1995). For 20 years before the start of the DMAP experiment, the Jersey City Police Department narcotics squad had used traditional drug enforcement tactics to tackle the drug problem in the city. These tactics included surveillances, arrests, search warrants and "street pops." The information that the narcotics squad had about drug activity in the city derived primarily from personal observations, common knowledge about "hot" drug locations, and information gleaned from background checks that could be done manually from the Bureau of Criminal Intelligence suspect files. The detectives tended to think about their jobs in terms of the number of people they could arrest. They spent their time cruising popular drug spots, making arrests, and figuring out ways to get at middle-level suppliers. In this way, narcotics detectives thought of their jobs in a suspect- or people-oriented way rather than in a place- or community-oriented way.

From the very beginning of the DMAP in Jersey City, we wanted to develop a computerized crime mapping system that would become an operational tool for narcotics detectives during the experimental phase of the project. The experimental team of narcotics detectives were to follow a stepwise problem-solving strategy to control drug activity at their allocated drug hot spots (see Weisburd and Green, 1995). The crime mapping system was an important information tool to help them analyze drug activity in their designated hot spots.

The first step taken to design the Jersey City DMA system was to interview every member of the narcotics squad. We asked detectives for their ideas in developing an inquiry system that would help them to control drug market activity. When we examined the detectives' responses, their requests clearly fell into three categories. First, detectives provided logistical requests about the computer system. For example, they requested that the system not be locked up overnight, and indicated that up-to-date information was essential.

Second, detectives wanted the DMA system to allow them to make various types of "suspect-specific" requests. They wanted to review suspects' prior arrest histories, car registration details, vehicle type preferences, social security numbers, employment histories, and aliases and nicknames. Detectives also needed information on whether suspects had registered firearms and names of co-offenders. They also wanted to be able to search for names of people meeting particular profiles.

Finally, several detectives wanted the DMA system to allow for "place-specific" requests. While clearly in the minority of requests compared to person-specific requests, some detectives wanted the system to help them identify the hours of operation at drug markets, the common methods of sales, the type of drugs sold, and the physical layout of a specific drug market area. They also wanted the DMA system to provide general information about the types of clientele who frequented particular drug markets and to generate lists of places where suspects had been known to sell or buy drugs.

Detectives could easily list the types of inquiries that they wanted to generate about a suspect. Most detectives could identify five or six "wish-list" items relating to the types of suspect information they wanted to build into the DMA system. By contrast, when it came to listing information needs about a place, detectives were not so clear about the sorts of information they might need. For example, detectives did not request that the DMA system provide information about community members who might help them to clean up drug problem areas, nor did they request information about block watch groups or other community organizations in a problem area. They also did not request information about other agencies working in problem areas that they could coordinate their enforcement efforts with.

The difficulty that detectives had in thinking of place-specific and community-related information derived from one central issue: in the past detectives had been driven by informal department policy that rewarded those who made the most arrests. From the detectives' point of view, getting specific information about particular suspects

was going to facilitate their work in the short term much more than general place-specific information that could facilitate their problem-solving activities. From the detectives' perspective, working in non-traditional ways to reduce the level of drug activity at problem places was not going to give them visibility or maintain their arrest quotas. Moreover, narcotics detectives in Jersey City felt that non-traditional drug control tactics that decreased their monthly arrest rates would subsequently reduce their overtime payments. These structural factors severely limited our efforts to impress upon the detectives the worth of problem-solving activities.

The DMA system was designed by the Jersey City Police Department and by staff from the Center for Crime Prevention Studies at Rutgers University. The system was driven entirely by the DOS version of MapInfo, with Mapcode applications written to customize inquiry options.¹⁰ The DMA system was programmed by Lieutenant Charlie Bellucci of the Jersey City Police Department, and was built around a series of custom-designed, pull-down menus that provided a series of search facilities designed to focus detectives on activities within drug market boundaries (see appendix). Our system provided an inquiry system that was designed to make users think about drug problems and possible solutions from a geographic perspective. For example, the system would prompt users for a drug market number, zoom on the market and then allow users to display counts of calls and arrests. DMA system users could request searches by market, police district, or for the entire city on the locations of suspects by age, race, gender, aliases, or crime involvements. For each drug market, users could search for information on the type of drug sold, the times of most activity (for arrests or calls), and the hottest corner inside a drug market.

The DMA system allowed detectives to identify the exact locations of drug market activity. It also allowed them to examine the proximity of drug markets to other places of interest such as bars, schools and highway exits, and to undertake inquiries about arrest histories, citizen complaints and social characteristics of drug markets. The detectives could build custom-designed maps of areas of interest where stores, schools and community group locations could be highlighted on the maps, and print out hard copies of maps of any portion of Jersey City.

Before the start of the DMAP, every narcotics detective participated in a series of DMA system training sessions. In groups of three or four, every detective received hands-on training that taught the basics of turning on a computer and the steps involved in each DMA

system module. Many detectives had no experience with computers, and a handful were excited to have the computer age brought to their work environment; others were more skeptical.

To generate at least a base-level of expertise in the DMA system, we initiated a "specialist program" where one detective in each squad self-selected themselves to become the "computer expert" for the squad. In the past, a squad member was designated the "surveillance man," the "sweep man," or the person who generated informants. Selecting one member of the squad to learn the features of the computer system fit well with past task specializations within each squad.

The Jersey City DMA system included several important features. For example, the system was built to be "police proof." Lieutenant Bellucci, understanding the frustrations that narcotics detectives would go through in learning the way the system worked, created a "reset data" feature that allowed a detective who had "zapped" all data from the system to regain control over the computer, reset all the data and maps to the default setting, and begin the search procedure again.

Since the inception of the Jersey City DMA system, problems arose in keeping data up-to-date. This difficulty proved to be a significant drawback for the operational dimension of the DMA experiment, leading to many frustrations among narcotics squad detectives. Although the DMA system allowed detectives to search for suspects, they felt that the geographic overlay of the system merely "cluttered" their inquiries. For example, one detective stated, "We only need to get information about the [suspects]... why are you making me look at this map?" Another commented, "Why do I need to use this map? I know where every street in the city is already." Yet another said, "I can't really see the point of the map — we go where the action is and that means tracking down a suspect, not looking at a map." Apart from highlighting the difficulties of introducing computer technology into police operational units, these comments illustrate the frustrations felt by detectives in changing the focus of their mode of operation. The Jersey City DMA experiment sought to change detectives' activities from being arrest-oriented to being more focused on the problems of a place. The DMA system was the tool of a new approach for controlling drug problems in specific hot spots. As such, the new "tool" was seen as symbolic of change and became a focal point of detective resistance to implementing problem-solving approaches to controlling drug problems.

During the course of the experiment, however, some detectives came to appreciate the system. Some officers offered suggestions as to how the DMA system could be improved. Some of the specific requests from the narcotics officers for DMA system enhancements included adding more custom information to the maps, such as drawing the directions of one-way streets; identifying whether a particular street was one or two lanes; and drawing buildings of choice on the maps.

DMA System Usage

We conducted two surveys, in May and December 1992, of narcotics detectives in Jersey City to determine the usage level and perceptions of the DMA system. A selection of the results appears in Table 1.

Table 1: DMA System Usage

Selected Response	Wave 1 May, 1992 N = 28	Wave 2 December, 1992 N = 29
Never use computer?	10	1
Use it several times a week?	8	12
Use it everyday?	3	3
Used before going out on shift?	11	10
Used to check market boundaries?	12	7
Used to check specific addresses?	10	13
Used to gather information on suspects?	11	24
Print out maps?	2	6
Satisfied with the DMA system?	10	19
Need up-to-date data?	2	10

Table 1 suggests that the DMA system served an important function during the project, at least for some of the detectives. The level of use increased between the first survey, conducted two months after the start of the experiment, and the second survey, undertaken eight months after the initiation of DMAP. The DMA system was both used more frequently and seen as more helpful as the experiment proceeded. At the start of the experiment, ten officers never used the computer system. By December, only one detective claimed to never

use the computer. It was disappointing, however, to note that by December 1992 only six persons were actively printing out maps. This result is most likely because across the six squads of officers, only one person received in-depth training on the DMA system.

Nineteen officers were satisfied with the DMA system by December, compared to only ten in May. An increase, however, was seen in the number of detectives who used the DMA system to gather information about suspects — from 11 detectives in May to 24 by December. There are two possible explanations for this increase: the detectives became more suspect-oriented, or they simply found the information helpful. Based on our monitoring of the DMA experiment activities (see Weisburd and Green, 1995), it is suggested that the latter proposition is the more likely.

Over all, these results are consistent with our field observations of the narcotics detectives' activities during the course of the DMA experiment. One of the biggest hurdles that we had to overcome during the DMA project in Jersey City was coercing narcotics detectives to think more in terms of targeting and cleaning up drug hot spots rather than "bouncing" around the city and targeting the people involved in the drug trade. The DMA system provided a constant reminder and an inquiry tool that encouraged narcotics detectives to think about the problems associated with drug hot spots and the patterns of drug activity within market boundaries. This was in stark contrast to the way they had previously thought about the drug problem in Jersey City.

CONCLUSION

Building a computerized mapping system in police departments presents many challenges. The first challenge concerns the decision whether to build a mapping system for crime analysts and police department planners, or to invest resources into building a tool for street-level problem-solving officers. While there is overlap in the system needs of both "user-groups," many system demands, including data needs and types of inquiries, will be different for these two different end purposes. As such, police departments need to decide where they want to invest their energies and then build their mapping systems accordingly.

A second challenge concerns the ability of police departments to integrate PC mapping capabilities within mainframe computing environments. This requires investments to build links between the storage systems at the mainframe level with the data requirements for

mapping purposes. Some problems include timely download capabilities; building "blocks" in the system to guard against overlapping downloading; and building PC protocols to accept, clean, and append new, incoming data with the existing master files at the PC level. Automatic cleaning, appending, archiving and re-indexing are essential features that must be created to ensure the integrity of the data being mapped.

Building custom menus that are user-friendly and that enable officers to undertake searches and inquiries that fit with their problem-solving activities is a third challenge to police departments contemplating building crime mapping systems for street-level use. Common types of inquiries, that can be easily built, must fit with the types of information that line officers need to facilitate their problem-solving efforts. Custom-built systems must accommodate changes from time to time and be adaptable across a range of problem-solving efforts. For example, detectives in a violent crimes unit need to make different types of inquiries of a mapping system than narcotics detectives.¹¹ Similarly, a beat officer is interested in undertaking searches of quite a different kind from either narcotics detectives or violent crime squad detectives.

Computerized mapping systems have a lot to offer police departments. Whether a police department chooses to implement PC-based crime mapping capabilities for street-level use or to develop more thematic mapping capabilities for crime analysis or policy planning purposes, graphic presentation of crime data provides a means to identify, analyze and communicate problems, priorities and plans in a quick and easy manner. The power of mapping crime, however, is greatly enhanced when police departments invest resources in planning, pilot testing, and solving logistical problems from the outset.



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NOTES

1. There are many other end-users in a police department. For example, specialized detectives will have different demands than street-level problem-solvers; housing unit officers demand a different type of analytic capability than detectives; and district captains are interested in different types of maps compared to headquarters planners.
2. Taxicabs are being fitted with GPS to locate them when a driver is in danger; cars are being fitted with GPS to locate them if they are stolen; and the MacMahon Productivity Monitoring System in Australia is using GPS to track and monitor payloads in earth-moving vehicles.
3. Proposals have been put forth to install GPS receivers rather than electronic monitoring devices on parolees.
4. An application that won the GPS world application of the year was tracking sheep around Chernobyl to determine radiation levels.
5. GPS are currently being pilot tested in several jurisdictions. One department on Cape Cod, MA, for example, is testing a GPS.
6. Some of the problems encountered in building a link between a mainframe system and a PC include: installing the software on the mainframe to create files that may be downloaded, building the physical connection between the PC and mainframe, installing "dial-up" software that is compatible with the mainframe system, and creating data files in the PC-database form that "fit" the records downloaded from the mainframe system.
7. E-911 systems enhance the integrity of the location from where the call is made. However, it does not help to enhance the integrity of the dispatch location (or the location where the event is occurring) if this location is different from the call location.
8. For example, ensure that the geofile and the street files record addresses in the same way (e.g., Ave not Av; E Third Street and not E 3rd or Third Street E).
9. Two important exceptions include an NIJ-sponsored conference held in May 1994, and the NIJ Center for Crime Mapping roundtable discussions in February 1997, where the issue of confidentiality in mapping was the topic of roundtable discussions.
10. The mapping capabilities of MapInfo have evolved tremendously since the original DMA system was created. For instance, MapInfo no longer supports, to any great extent, the DOS version of MapInfo. Instead, it now focuses its support on the Windows-based mapping environment, which includes many features that were unavailable at the time the DOS version of the Jersey City DMA system was created.

11. Since the conclusion of the DMAP experiment in Jersey City, NIJ has funded two additional projects in Jersey City that build upon our experience with implementing computerized crime mapping capabilities at the street level. First, NIJ funded a problem-oriented policing project with the Violent Crimes Squad. As with the DMA project, we built an inquiry system to facilitate their problem solving efforts. One of the interesting features of this new system was the aggregation of data within the violent crime places to enable detectives to "assess" the changes in calls and arrests over the life course of a problem "case." This process follows very closely the recommendations of Eck and Spelman (1987) in their plea for officers to be more sophisticated in their assessment phase of the SARA problem solving model. Second, NIJ recently funded a project to tackle drug and violent crime problems in public housing. This project aims to build a mapping system that allows for apartments and common areas to be systematically linked to police department data.

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APPENDIX: The Jersey City Drug Market Analysis System Menus

Main Menu

Drug_mkt
Count
Search
Info_map
View
Magnify
Zoom User
Reset Data

Inquiry Options

Drug_Mkt	Enter the drug market number
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Count	Provides an aggregate count of narcotics arrests and calls occurring within the drug market boundary
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Search		
	Find Addr	Enter the address you want to locate
	Make Fltr	Enter the details of a person or place that you want to get information on Some of the search options include: first name, last name, nick name, age, sex, race, location type, drug type, time of day, day of week.
	Delete Fltr	Remove the filter that was created for a special search.
	Arrest	Display the (purple) arrests on the map
	Calls	Display the (green) calls on the map
	Streets	Display the (white) street lines on the map
	Report — Arrest	Display the full arrest reports for people arrested at the defined arrest location.
	Calls	Display the full CAD system call reports for calls made about the defined location.

Options for Building a Crackdown Map

Info_Map	Boundary	Label the map with the market boundary number or district name.
	Point	Label an arrest point with the arrestee's last name.
	Street	Label a street.
	Address	Label the address range on a street.
	Clear Labels	Clear all the labels that you put on the map.
	Image Clear	Clear all the labels that you put on the map.

View Options

View		
	City	Click on here and you will see a map of the whole city.
	North	Click on here and you will see a map of the North District.
	East	Click on here and you will see a map of the East District.
	South	Click on here and you will see a map of the South District.
	West	Click on here and you will see a map of the West District.
	Magnify	Click on here and the cross hairs will appear so that you can magnify a target area.
	Zoom User	Click on here and you can change the view (measured in inches per mile) to a size that you want.
	Last View	Click on here and the map goes back to the previous size that you had it.
	Redraw	Click on here and you will get a refreshed picture of the map.
	Printer	Click on here and you can print out a copy of your map.

Magnify	Click on here and you can magnify a part of the map to the size that you want.
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Zoom User	Click on here and you can change the view (measured in inches per mile) to a particular size
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Reset Data	If you zap the data, or do something where you lose all of the information of the map, click on here and it will put it all back for you.
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