

Crime Mapping News



A Quarterly Newsletter for GIS, Crime Mapping, and Policing

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www.policefoundation.org
or
www.cops.usdoj.gov

The topic of this issue of the *Crime Mapping News* is partnerships between software companies and law enforcement agencies with the goal of developing and/or implementing crime analysis or mapping technology. The articles in this issue cover topics including 1) an overview of three-dimensional modeling technology that has been used in a host of activities to support the law enforcement community, and 2) a program that has been developed to introduce geographic profiling techniques to crime analysts at local law enforcement agencies. Lastly, we present the complete answers, including underlying assumptions and detailed explanations, to the “Crime Analysis Challenge.”

Using 3D Urban Models and Tools to Assist in Public Safety and Provide Law Enforcement Solutions

by Harris Corporation and the Jacksonville, FL, Sheriff’s Office

Imagine this scenario: there is a hostage situation in an office complex located in a densely populated area of your city. Unfortunately, this scenario is not new. Most of you reading this have either heard about, prepared for, or have actually responded to such an event.

In a situation such as this, many questions come to mind: How many people work in this building? How many floors are there in the building? Where are the exits and escape routes located in the building? In a real time crisis situation, there is little time to find the answers to such questions. Familiar tools, including traditional maps, may identify the location of a particular building, but much more information is needed, quickly.

Now, picture this: suppose that in the above situation, the response team had a laptop computer with a three-dimensional (3D) map of the city in which this building was located. This 3D map modeled each building very accurately; you could view each building from any side, and important details such as windows and doors appear as they do on the actual building. Such an application would also allow teams to calculate distances between buildings, rooftop elevations, and sharpshooter range information. Such a realistic, accurate, and affordable tool is finally available today in Harris Corporation’s RealSite™ technology.

The power and utility of 3D visualization is that it is a scenario intelligence multiplier. This article will show how 3D urban models can be used in a host of activities supporting the law enforcement community. Harris Corporation’s Government Communications Systems Division provides highly reliable, mission-critical communications and information systems and processing solutions for military and civilian customers. The company developed RealSite, a technology that produces rapidly generated, very accurate, and photo-realistic 3D computer graphics urban models, and InReality™, a viewer application that allows such RealSite models to be displayed and exploited on PCs and laptops.

Harris Corporation recently teamed up with the Jacksonville, Florida, Sheriff’s Office to build a RealSite model of Jacksonville Landing in downtown Jacksonville. This model, along with viewer software, is being utilized among different departments such as police, fire rescue, 911 dispatch, bomb squad, SWAT team, and even city

planners, to see how this technology can be utilized to improve day-to-day operations for first responders and administrators.

The Jacksonville Sheriff's Office is unique in having a history of being forward-looking and having the vision to adopt new technology to help solve its problems and challenges. Items on display at its headquarters show one of the first call boxes installed in the early 1900s—technology that first made it possible to respond quickly to residents' calls. Over the years, other items such as teletype terminals and equipment for the hearing disabled were brought in as communications technologies that better served the community evolved.

Today, Patricia Welte, 911 Coordinator for the Jacksonville Sheriff's Office, has the same vision of utilizing new technology to help its various departments with day-to-day operations. As seen in the image below, 3D models offer much more information for the user than traditional paper or digital flat maps.

3D graphics such as architectural CAD, simulation, and even special effects from the most recent blockbuster movies have been available for many years but are often too costly, too labor-intensive to produce, and are not able to be displayed in real-time. In addition, most 3D urban models currently available on the market are often too low in resolution and cartoon-like in presentation; not able to accurately convey the real appearance of a building, but rather a multi-replicated façade. Realistic presentation is paramount in scene familiarization. For example, in a dense urban area, similar-looking rows of buildings should not look exactly the same. Accuracy and realism, as well as affordability, are extremely important attributes to consider before undertaking model construction.

This is where RealSite technology enters into the picture. RealSite is a new technology that previously was

not possible or practical because of the amount of work required to build a 3D model of an urban area. As previously noted, traditional production techniques are labor-intensive, often taking many months or even years to produce a large-scale urban model. There are many technical challenges that must be addressed in producing such a model. Harris has applied its experience in the image processing field to develop the technology to create such models, allowing the end user to eliminate the time necessary to construct such data. The user merely specifies the region of interest, and library or custom models can be delivered quickly, allowing the users to focus on the mission instead of spending critical time and limited resources on producing data sets.

Once a 3D model is created, InReality, the powerful and easy-to-use viewer software, allows a user to navigate throughout the scene with ease and accuracy. You can view the city skyline for a quick point of reference, then quickly zoom into a particular close-up. InReality acts much like a virtual GPS receiver, with the software allowing the model to be geospatially displayed, providing latitude and longitude readouts of the viewpoint location and other visual references in the scene.

Recent enhancements and features of the viewer software provide the capability to perform geospatial queries. For example, by merely clicking on a building within the model, the user can retrieve additional information about that building such as its floor plan, fire exits, and utility information. In addition, an entity tracking capability allows vehicles or personnel to be tracked within a scene, offering the capability to locate police cars or monitor the oxygen level in a firefighter's pack.

InReality software allows the user to see the scene from the entity's vantage point, as well as the ability to easily switch scenes (see images on the following page). Models can be dynamically updated by video cameras mounted on

police or fire department helicopters, providing another possible use for infrared (IR) or visible systems. These capabilities are being developed for a first responder's command and control system, helping law enforcement departments and emergency response teams as well as their associated agencies to better plan for public safety concerns and improve preventative measures.

RealSite and InReality are extensions of proven Harris technology. In this case, a RealSite model was used by the Canadian government for



Jacksonville Landing RealSite model.

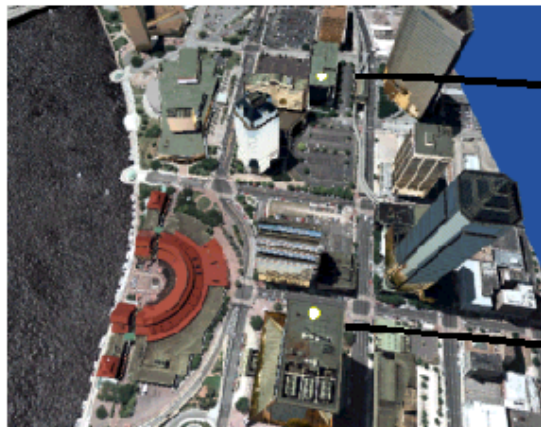
security purposes during the 2001 Summit of the Americas in Quebec City, Canada. Harris Corporation and the Canadian Defence Research Establishment Valcartier (DREV) collaborated to showcase next-generation 3D visualization tools to the agencies in charge of security during the summit, held April 20-22, 2001.

The sophisticated suite of tools, which include realistic scene visualizations of Quebec City for situational awareness, was demonstrated to security forces in charge of protecting 34 international leaders and other diplomats attending the Summit.

The Harris 3D model and associated tools were instrumental in the management of resources and real-time situational assessment, enabling timely and efficient response to unfolding events within the city. The software allowed the capability to place symbols in the scene to identify potential problem spots. For example, if protesters attempted to breach a secure area or otherwise engaged in violent or destructive behavior, relevant symbols could be placed in the scene to note threats such as breaches and fires.

The icons then functioned as visual aids in assessing the developing scenario, facilitating the deployment of appropriate security forces to address the emerging situation. InReality software enabled the “big picture,” providing the capability to view the whole city, quickly and easily zooming into and out of particular areas of interest. This capability is extremely valuable in the planning of events and the advanced identification of possible vulnerabilities. These types of models are also very useful for scene familiarization, mission rehearsals, and for coordinating the activities of multiple security teams.

“The Summit was the largest-ever National Security operation in Canadian history,” said Major Michel Gareau, military



InReality viewer software and multiple viewpoints of tracked entities.

advisor for DREV. “DREV is proud to have been given such a venue to demonstrate the potential of advanced command and control systems in collaboration with Harris and SGI Canada. Situation awareness is critical to operational success, and the security-related events that occurred during the Summit illustrated the problematic nature of conducting operations in such a complex urban environment. The concepts and technology that DREV and Harris showcased were designed to provide a better understanding of the evolving situation.”

In the days following September 11, 2001, NBC expressed interest in a RealSite model of lower Manhattan. The Harris team volunteered its time for the development effort, creating a model of the entire lower Manhattan area over the following weekend.

The Manhattan model was aired on MSNBC in November 2001 and early 2002, during a special feature titled

“Out of the Rubble.” The feature focused on the construction of the World Trade Center and the extent of the damage inflicted by the terrorist attack. The RealSite model (pictured on the following page) was used to illustrate the damage zones in a fly-over animation.

In the summer of 2001, Harris began construction of a 3D model of Salt Lake City, Utah, for use by the network during its coverage of the 2002 Winter Olympic



RealSite model of Quebec City.

Games. Further work was done on the Salt Lake City model in December and January in order to capture images to include snow coverage of the Olympic venues and outlying urban area. The resulting model was quite large, covering 35km² of downtown area, and requiring over 3GB of memory. Although data sets this large are typically too large to display on typical PCs (exceeds available resources), the InReality software possesses advanced algorithms and resource management capabilities that allow it to run on regular PCs, and even laptops. In the case of Salt Lake City, the realistic Harris model enabled NBC to animate cinematic shots that highlighted sports venues such as downhill skiing and bobsled runs, providing views of the venues impossible to achieve with network video cameras.

As seen in the images of Salt Lake City and the models shown below, a wide variety of locations and structures such as sports stadiums, power plants, and port authority properties can be displayed and analyzed in high resolution, illustrating once again how 3D models can help in the planning and protection of national and local infrastructure. As the needs of law enforcement and public safety turn to new technologies and tools to assist with day-to-day tasks, tools such as 3D urban models and viewer software transcend the traditional flat maps of today and can provide a more accurate, realistic, and dynamic tool for enhanced situational awareness.



Lower Manhattan RealSite model. Imagery provided by EarthData and spaceimaging.com.

support, tactical radio, and government systems. Harris has sales and service facilities in more than 90 countries. Additional information about Harris Corporation is available at www.harris.com.



Salt Lake City: Rice-Eccles Stadium.

Forward-looking organizations, such as the Jacksonville Sheriff's Office, are at the forefront of emerging security technologies by providing their dedicated staff with the modern tools that will help to better serve and protect the population.

Please visit the RealSite Web site, www.realsite.harris.com, to get more information or to request a demonstration visit for your city.

Harris Corporation is an international communications equipment company focused on providing product, system, and service solutions for commercial and government customers. The company's five operating divisions serve markets for microwave, broadcast, network



Salt Lake City: Mormon Tabernacle.

This article was authored by Joe Venezia, with contributions by Kevin Kane, both with the Harris Corporation. For additional information about RealSite, please contact Joe Nemethy, Harris Corporation, at (321) 984-6117, or via e-mail at jnemethy@harris.com.

Geographic Profiling: A New Tool for Crime Analysts

by Ian Laverty and Philip MacLaren,
Environmental Criminology Research Inc. (ECRI)

Introduction

The advanced crime analysis technique of geographic profiling has proven very successful over the last decade in cases of serial violent crime, but until recently, its use has been limited to a few highly trained profilers at large regional and national police agencies. Over the last year and a half, a program has been developed to introduce this technique to crime analysts at local police departments for use on property crime. This article looks at the issues involved in making this transition and the lessons learned to date.

Background: Geographic Profiling

Geographic profiling is a crime analysis technique that uses the locations of a connected series of crime sites to determine the most probable area of offender residence. While the underlying theory is based on the principles of environmental criminology, the mathematical analysis is closely related to that used by commercial retailers to decide where to situate a new store (see the References at the end of the article for more information).

A geographic profiling system produces a probability map of the likely location of the offender's home base (see Figure 1), which would usually be their residence or work place. This probability map can then be used to prioritize suspects by address, search records databases, define intensive patrol areas, etc. Geographic profiling is never used on its own to solve a crime or a series of crimes—it is an input to other investigative strategies (see Table 1).

Geographic profiling was originally conceived by Dr. Kim Rossmo (now the Director of Research for the Police Foundation) while serving with the Vancouver Police Department and studying criminology at Simon Fraser

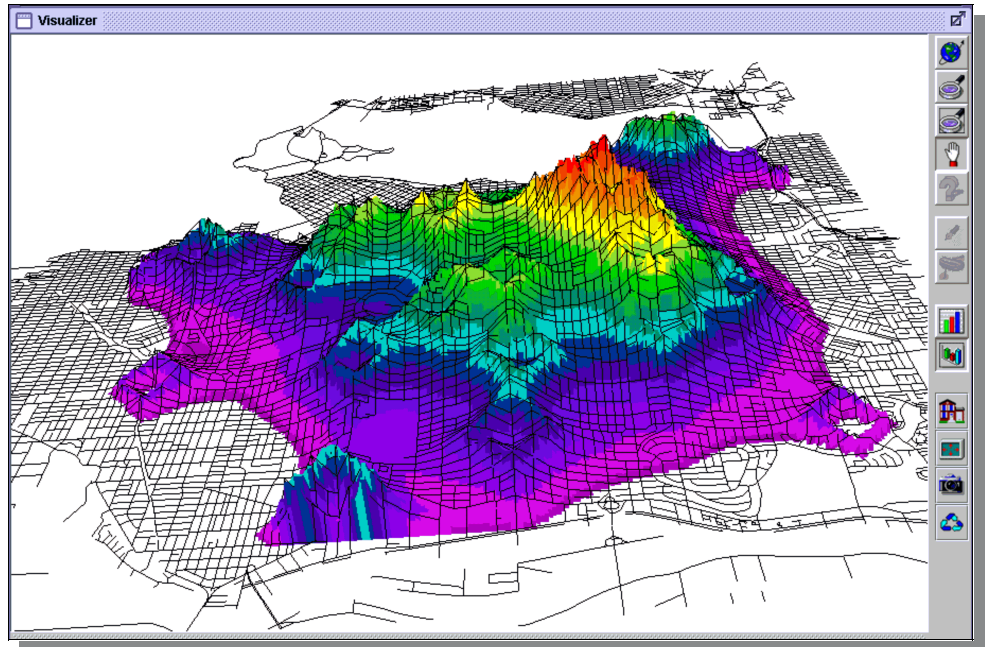


Figure 1: Geographic profile (probability represented by color coding the z-axis).

University in Vancouver, Canada, in the early 1990s. In 1996, he was appointed Detective Inspector in charge of a dedicated Geographic Profiling Section at the Vancouver Police Department. This unit assisted on cases all around the world, and trained geographic profilers from other police forces, who in turn have now trained others. These trained profilers have now used geographic profiling on several hundred cases, many of which have resulted in successful convictions. Environmental Criminology Research Inc. (ECRI) produced the first professional geographic profiling system based on Dr. Rossmo's work in 1997. The third generation of this system, named RIGEL Profiler™ (see Figure 2 on the following page), is used by all of the geographic profilers at the leading police agencies in North America and Europe.

The overall effectiveness of geographic profiling is measured in terms of the "hit score," which is the percentage of the total area covered by the crime sites in which the offender's home base is located by the profile. Chance would produce a hit score of 50%, while the actual average hit score of geographic profiling over all the cases completed to date is under 5%. In other words, geographic profiling can sharpen the geographic focus of an investigation by a factor of ten, potentially resolving the case faster and resulting in a significant saving of resources. Often, this

| APPLICATION | STRATEGIES |
|---|---|
| Prioritizing suspects | Detailed suspect investigation DNA profiling |
| Filtering records by address | Record searches of police information systems, offender databases, government and business Databases, Motor Vehicle Registrations |
| Identifying peak probability areas and entrance/exit routes | Patrol saturation and stakeouts Video surveillance Neighborhood canvassing News media releases |

Table 1: Investigative strategies used with geographic profiling.

benefit is direct and quantifiable, such as when geographic profiling is used to prioritize the order of suspects for DNA profiling and results in a quick "hit."

All of the current geographic profilers were already experienced police investigators before beginning their training in geographic profiling. The standard 12-month training program includes elements of criminal behavioral psychology, environmental criminology, and the mathematics and statistics of the technique. They receive extensive practical training in geographic profiling, continuing through an additional 12-month mentorship program following their formal training. They not only learn the specific technique of geographic profiling and the use of the RIGEL Profiler software, but also a wide variety of geographic and temporal crime analysis methods. This experience and training is one reason why geographic profiling has been so successful to date.

Because of the high investment in training, geographic profilers are dedicated to this job function full-time. Often, they function as part of a team with psychological profilers and forensic analysts. Working on serious cases, they have more time and resources available to them than the average crime analyst. They will typically visit the crime sites, talk to the investigators, and obtain any necessary follow-up data. As officers in senior agencies, they usually have cross-jurisdictional responsibilities, which eases the data gathering process. They take time to analyze the data thoroughly, and write a comprehensive report on the results to the lead investigator. This high level of care and attention to detail is another reason why results have been so good to date.

The Geographic Analyst Program

The use of geographic profiling has, for the most part, been limited to serious cases because of the relatively small number of trained profilers, and the fact that they tend to work in serious crime units at larger national and regional police agencies. Geographic profiling has most often been used on serial murder and rape cases, but also on serial arson, robbery, and terrorism (bombings) crimes that most smaller police departments rarely encounter. Other potential

candidates, which are sometimes included as a peripheral element of a violent crime case, include burglary, auto theft, vandalism, and credit card fraud.

However, there is no good reason that geographic profiling cannot be used routinely on less serious property crime cases—other than the obvious lack of trained profilers and the cost of a high-end geographic profiling system. With this in mind, the National Law Enforcement and Corrections Technology Center (NLECTC-SE) in Charleston, SC, a program of the Office of Science and Technology, National Institute of Justice, has been running a demonstration program in geographic profiling for crime analysts from local police agencies. The NLECTC-SE program is intended to assist local agencies in adopting and utilizing this new technology. It provides a two-week classroom training session in the geographic profiling methodology and use of supporting technology followed by a six-month field evaluation period for which the NLECTC makes available RIGEL Profiler workstations through a virtual private network. To date, eight local police agencies in North Carolina, South Carolina, and Georgia are participating in the NLECTC-SE program.

Crime analysts typically have less investigative experience, but a strong understanding of computer technology, crime mapping and geographic information systems (GIS), and crime analysis tools and statistical analysis in general. The geographic analyst training session

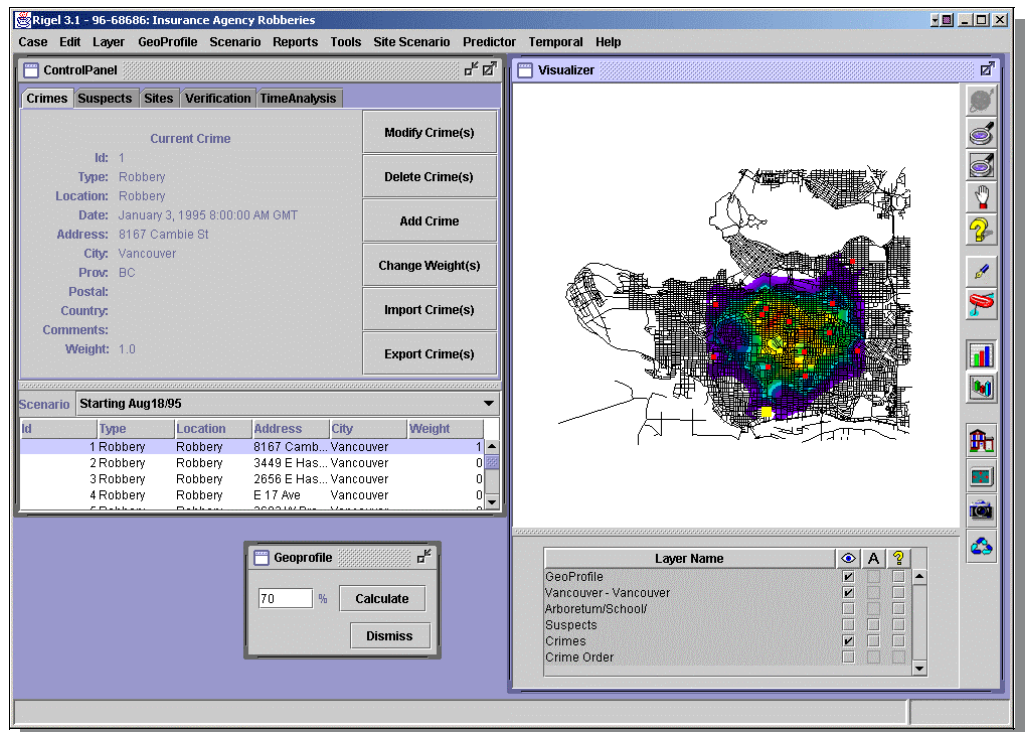


Figure 2: ECRI's RIGEL Profiler™ geographic profiling system.

Note from the Editors: The opinions expressed in the articles of this newsletter are those of the authors and do not necessarily reflect the views of the Police Foundation or the COPS Office. In addition, only light editing has been made to the articles in order to keep each author's voice and tone.

therefore gives only a brief overview in such areas as criminal behavioral psychology, environmental criminology, and the mathematics and statistics behind the technique. It concentrates on the practical aspects of geographic profiling for property crime, where behavioral issues are not as critical.

In general, this approach has been successful, and those participating feel that they have gained a good understanding of the technique. Geographic profilers assisting in the program have recommended, however, that geographic analysts should be restricted to working on property crime cases without complex behavioral issues or multi-site crimes, and that they should seek assistance if a case exhibits complex elements. These restrictions have been followed.

One potential challenge anticipated from the beginning was that crime analysts are often focused upwards in the organization, reporting crime trends to management rather than directly assisting investigations. Investigators can be notoriously resistant to "help" from any new analysis technique if it has not been properly introduced to them. It was therefore considered essential in the introduction of geographic profiling to get "buy-in" from the executive-level and from the investigators who would be using the results. The chiefs and senior officers of the agencies participating in the NLECTC program were briefed on the goals and gave their approval. Each agency sent one crime analyst and one investigator who are or would be working together. These proved to be critical factors in the successful introduction of geographic profiling to these agencies.

Another important factor was that the crime analysts do not have as much time to work on individual cases, since they handle a higher volume of routine cases, and are not dedicated to geographic profiling. Elements of data preparation, analysis, and reporting which were fairly trivial in the context of a serious crime investigation, taking a week or more, become much more significant when the work must be done in a few hours. The analysts were initially given a cut-down version of the full RIGEL Profiler system to work with, but it became clear that they would need a more streamlined system to work with in order to be fully effective. ECRI has been developing a second-generation RIGEL Analyst™ system to meet these needs, and to fit the budget of crime analysts at small to mid-size police agencies. RIGEL Analyst™ 2.0 will be available shortly, incorporating a built-in GIS and U.S. map database, an expert advisory system, and streamlined XML reporting tools linking directly to common office software. It is limited to PC platforms running

Microsoft Windows, but this should not be a limitation for most departments.

Information sharing between jurisdictions and linkage analysis are significant issues in the use of geographic profiling for property crime. Many local police departments do not do any formal linkage analysis on routine property crime, nor do they share information with adjacent departments to look for linked crime series. Geographic profilers working on serious serial crimes with distinctive features have traditionally had much less of a problem with these issues, but it can be a significant limitation for geographic analysts. This situation is improving over time through local initiatives in information sharing and centralized analysis functions. It is also important to realize that the bulk of property crime is due to the most prolific serial criminals, with a small minority of

"However, there is no good reason that geographic profiling cannot be used routinely on less serious property crime cases....With this in mind, the National Law Enforcement and Corrections Technology Center (NLECTC-SE) in Charleston, SC, a program of the Office of Science and Technology, National Institute of Justice, has been running a demonstration program in geographic profiling for crime analysts from local police agencies."

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Rachel Boba, PhD, Director

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approximately 10% of offenders being responsible for about 50% of all crimes. Being able to identify and arrest the worst offenders can make a serious dent in crime even when existing information gathering and linkage systems are not up to the task of identifying all connected crimes.

The early results obtained from the NLECTC program have in general been very good. The NLECTC closely monitors the cases analyzed by the program participants, and reports that the number of cases reaching the stage of final conviction of the offender is still small, but the geographic profiles have proved accurate. The departments most successful in applying geographic profiling are those where the team of crime analyst and investigator trained together has continued to work in partnership.

In the future, it will clearly be important to provide additional avenues of training in geographic profiling for crime analysts, including advanced training for them to enhance their qualifications. Currently, the community of trained geographic profilers is small enough to enforce its own quality standards, but an independent certification body will be needed as numbers increase.

What We Have Learned

In summary, these are a few of the lessons learned from the geographic analyst program to date:

- New crime analysis techniques intended to be used in active investigations require buy-in at all levels, from the chief down. Detectives/investigators must be trained and involved, since they are the end customers.
- Geographic profiling is used the most and proves the most useful when it is part of the department's standard investigation checklist, used routinely on all suitable cases.
- Demonstrable results can be difficult to obtain in the early stages—patience and commitment are essential. It takes a long time for cases to go through the courts and result in conviction. Home site information is often not recorded or is inaccurate/incomplete in records. Analysts may not have time to follow up on the outcome of cases, and investigators do not routinely provide the information on their own initiative.
- Sharing of information between adjacent jurisdictions is essential in the analysis of cross-jurisdictional serial crime. In the past, confidentiality and turf issues or incompatible systems have limited this exchange. Fortunately, this is a well-recognized problem, and the situation is improving through local initiatives in many regions.
- Low levels of automation at small to mid-size police departments may limit the availability of computer records with reliable address geocoding, and routine linkage analysis to identify serial crimes may not be done. Improved systems and better integration of existing systems are required. This situation is also gradually improving over time.

- It is challenging to give analysts a sufficiently thorough grounding in geographic profiling in two weeks. The geographic analyst program is gradually being refined from experience, and it should benefit greatly from the introduction of the streamlined RIGEL Analyst 2.0 system.

Conclusion

Geographic profiling is proving to be a valuable tool for crime analysts to use in property crime cases. Proper training is essential to ensure the selection of appropriate cases and the proper application of the technique. The current geographic analyst program appears to be working well, but improvements are ongoing. Those police departments that embrace the new technique and have a program of supportive policies, techniques and tools, benefit the most. The new RIGEL Analyst 2.0 system will further help by bringing the cost of a professional geographic profiling tool within the reach of all police departments.

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www.ecricanada.com

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This article was written by Ian Laverty and Philip MacLaren of Environmental Criminology Research Inc. (ECRI). The authors can be contacted via e-mail at ianl@ecricanada.com and philipm@ecricanada.com.

NEXT ISSUE

The topic of the next issue of the *Crime Mapping News* will be the Community Mapping, Planning, & Analysis for Safety Strategies (COMPASS) Program sponsored by the National Institute of Justice. This issue will feature articles from each of the three COMPASS sites—Seattle, Washington; Milwaukee, Wisconsin; and “East Valley,” California.

If you are interested in contributing to a future issue of the *Crime Mapping News*, please contact the Crime Mapping Laboratory at:

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Crime Analysis Challenge

To follow are the complete answers, including underlying assumptions and detailed explanations, to the crime analysis challenge questions. The challenge was initiated in the Winter 2002 issue of the *Crime Mapping News*, and it is composed of nine questions designed to stimulate thought and discussion among our readers. The questions range in difficulty and complexity, and admittedly some are fairly tricky. But all are based on actual errors or mistakes we have observed in the past. We designed the questions to test knowledge of important underlying theories and methodologies.



In the last issue of the *Crime Mapping News*, we presented truncated answers to the nine questions. We hope that readers have attempted to figure out why these answers are correct, and to challenge and debate them if they disagree. One of the reasons we presented the challenge was to stimulate discussion and debate. Now that the full answers have been published, we encourage readers to once again post their thoughts and responses to NIJ's Crimemap Listserv.

The original nine questions are repeated below. The full answers are printed in bold red type.

Question 1

The homicide count has gone from 0 in 2000 to 6 in 2001. This increase has generated the attention of the local media. A reporter has asked what is the percent change in homicide over the last year. How would you answer the reporter?

It is not possible to calculate the percent change in this situation. Percent change refers to the amount of change from one point in time to another as a percentage of the original value. The formula for percent change is the value at Time 2 minus the value at Time 1, divided by the value at Time 1. Since the value at Time 1 in this example is 0, it is not possible to calculate percent change because a number cannot be divided by 0. Thus, one would tell the reporter that the percent change is not calculable, even though homicides have increased by six. In this case, frequency would be appropriate to report. Additional information that one may provide would be the type and circumstance of each homicide.

Question 2

Analysis of individuals arrested for auto theft during the past year reveals that of the 68 individuals arrested, 60 were known drug offenders. The Chief asks if this is statistically significant. How would you answer?

Based on the information given, you cannot determine statistical significance. A test of significance provides an estimate of how likely a sample is representative of the population from which it is drawn,

and it requires a specific statistical test. There is insufficient information in this question to conduct such a test. However, what the Chief really seems to be interested in is whether there is a relationship between drug use and the commission of auto theft. With the information provided, it can only be stated that approximately 88% of the individuals arrested for auto theft in the past year were known drug offenders, and no conclusion about the entire population of auto thieves can be made. Because the 68 arrestees were not selected randomly from the population of auto thieves, one could say that there is bias since these were only the thieves that were caught. In addition, it may be the case that drug users are likely to be more careless in the commission of the crime, thus making them more likely to be arrested than professional auto thieves or joyriders.

Question 3

A comprehensive and thorough study of the prevalence of burglary in the United States showed that there has been a 40% increase in such incidents from 1960 to 1990. A journalist doing a story on crime and parenting asks you what might be the most important contributing factors to this growth. How would you answer this?

You would answer that there are no grounds, based on these data, for correlating the burglary increase with changes in parenting. The 40% increase in burglary from 1960 to 1990 corresponds exactly to a 40% growth in population experienced by the United States during this time period. Therefore, there has been no change in the burglary rate between 1960 and 1990. Burglaries have remained constant relative to population growth and, on the surface, changes in parenting do not seem to have had an influence. A more detailed analysis, including many more variables concerning crime and parenting, might better address this question.

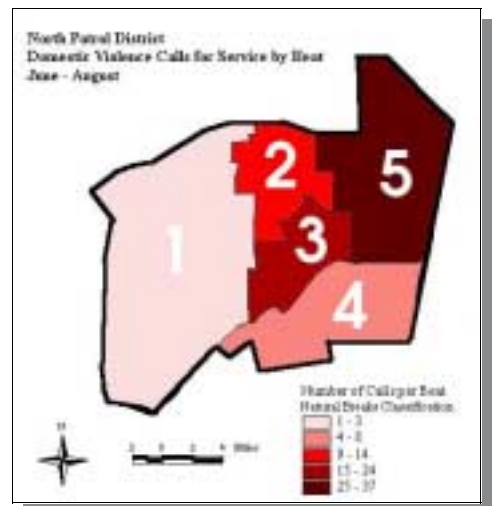
Question 4

You are the supervisor of the North Patrol District in your city. After a high profile domestic violence homicide, the chief asks each of the patrol supervisors to analyze the domestic violence problem in their districts so that the problem can be effectively addressed and chances of a similar occurrence minimized. Your first step is to ask the crime analyst for a map of domestic violence in your district. To the right is the map you receive. Based on this map, what can you say about domestic violence in your district?

Based on this map, you can say that Beat 5 has more domestic violence calls for service than any other beat in the North Patrol District during the months of June through August. You can also say that there is less demand for police service to answer domestic violence calls in the western part of the district during the months of June through August.

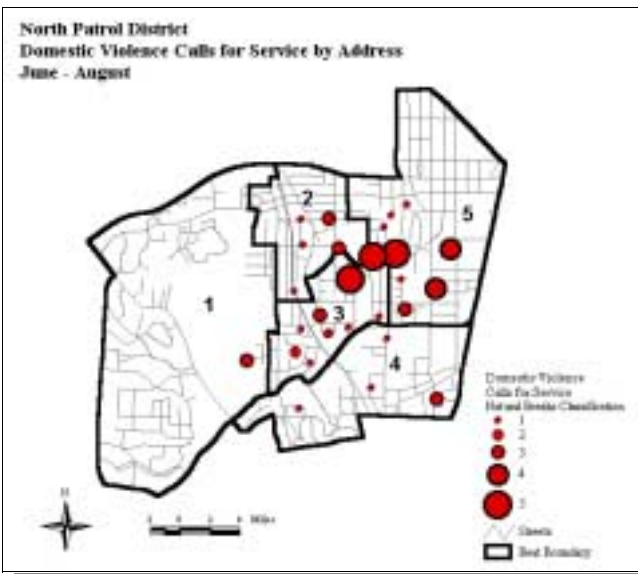
What additional information would be valuable?

The map to the right is not the most appropriate method for depicting the domestic violence problem in the North Patrol District. A rate map may be more useful than a map depicting only the frequency of calls by beat since a rate map normalizes the data across areas. However, in both types of maps,



domestic violence calls for service are aggregated by beat, which results in the loss of specific information about the location of each call and implies that the calls are equally distributed across the beats. For example, the patrol supervisor may interpret this map as indicating that all of Beat 5 has a domestic violence problem and that this area is most in need of a response.

The map to the left, a graduated size point map of domestic violence calls for service during the same time period, illustrates that most of the domestic violence calls actually occur near the intersection of Beats 2, 3, and 5. In this example, a point map is preferable to a choropleth map because it allows analysis of individual addresses, and subsequently, analysis of repeat victimization, which may be important in preventing another domestic violence homicide. This map is one of many that can be used to represent the domestic violence problem in the North Patrol District. Kernel density maps of domestic violence calls can also be used to examine hotspots of activity. We also recommend analyzing more than three months of data to look for long-term patterns in domestic violence call activity.



Question 5

A study of rapists who progress to sexual murder analyzed 106 crime scene variables and found the following characteristics were statistically significant ($p < 0.05$) correlates of future killing: (1) use of a weapon; (2) outdoor attacks; (3) theft from victim; (4) nighttime offenses; and (5) multiple sex acts. A serial rapist responsible for 11 crimes over a two-year period has consistently demonstrated 4 of these variables during his crimes. He does not carry a weapon, but rather uses physical force, sometimes excessively so. What can be said about the likelihood the individual will progress to murder?

There is no reason to believe that this rapist is likely to progress to murder based on the findings of this study. This study of rapists who progress to sexual murder is flawed in several ways. First, it should be noted that, for example, with a 0.05 level of significance and over 100 variables, we can expect at least five of the variables to produce a significant result just by chance. Therefore, we cannot be certain that these five crime-scene variables are statistically significant correlates of progression to murder or have simply occurred by chance.

Secondly, correlation is not the best method for testing the relationships of multiple variables. A multiple regression model is often preferable because it not only provides a test for the relationship of independent variable(s) to a dependent variable, it also controls for other independent variables in the model. Thirdly, this study seems to have taken a “kitchen sink approach” by including a high number of variables (106), some of which seem to be arbitrary. For example, the variable “theft from victim” does not have a common-sense connection to sexual homicide; thus, only variables that have a theoretically meaningful relationship to sexual homicide should be included. This type of approach, including “everything and the kitchen sink” is often used in exploratory research, but such findings are then tested with other datasets for consistency. Lastly, in practical situations, it is wise to be cautious when applying research results based on only one set of data.

Question 6

The following table and map detail are an identified bank robbery series comprising 5 incidents:

| <u>Incident #</u> | <u>Weekday</u> | <u>Time</u> |
|-------------------|----------------|-------------|
| 1 | Monday | 1215 |
| 2 | Tuesday | 1440 |
| 3 | Monday | 1330 |
| 4 | Monday | 1610 |
| 5 | Friday | 1020 |



What prediction about the future events would you make based on these results?

If the offender behaves as he/she has in the past, you can predict that he/she may rob a bank on a weekday, more likely on a Monday, and more likely in the afternoon.

A sergeant wants to deploy surveillance resources on Mondays, from 1100 to 1500 in the area encompassed by the first standard deviation rectangle. Based on these past incidents, what is your estimate of the probability the officers catch the offender during the next robbery through this strategy?

At the most, there is a 24% to 27% chance that the officers will catch the offender during the next robbery through this strategy. Stated simply, the probability of an outcome is the likelihood that the outcome will occur within a given number of observations. For example, the probability of obtaining heads on a single coin flip is 1/2, or 0.50.

In the example above, the sergeant is assuming that all of these events will occur together; that is, the bank robber will strike on Monday, AND between 1100 and 1500, AND in the area encompassed by the first standard deviation rectangle. This assumption invokes the multiplication rule, which states that, for independent events, the probabilities of two or more events must be multiplied together in order to determine the probability that the events will occur simultaneously. Assuming that time of day, day of week, and location are independent of one another, the 0.24 probability is derived from the formula: $0.60 \times 0.60 \times 0.68 = 0.2448$, where 0.60 is the probability that the offender will strike on Monday (3 of the 5 incidents have occurred on a Monday), 0.60 is the probability that the offender will strike between 1100 and 1500 (3 of the 5 incidents have occurred during this time span), and 0.68 refers to the probability that the offender will strike within the first standard deviation rectangle.

The 0.27 probability is derived from the formula: $0.40 \times 0.68 = 0.272$, where 0.40 is the probability that the offender will strike on a Monday between the hours of 1100 and 1500 (2 of the 5 incidents have occurred on Monday during this time span), and 0.68 refers to the probability that the offender will strike within the first standard deviation rectangle.

We do not recommend using statistics to predict future incidents in a crime series, especially when the statistics are based on a low number of cases, as they are much less reliable. All predictions of future behavior are based on the assumption that the criminal will continue to behave in a similar fashion. Thus, we can state that, "based on the offender's past behavior, he/she may rob a bank on a weekday, more likely on a Monday, and more likely in the afternoon." (Note the lack of use of specific statistics.) However, many other variables, such as suspect description, property value, and the availability of targets should be considered in addition to time, day, and location.

Question 7

A study was conducted of street muggings in Centerville, a typical U.S. mid-western city. Census data indicate that Centerville's population is 49% male, 87% white, with a normal age distribution. The study collected a random sample of 100 street muggings, each of which involved only a single offender and a single victim. The results found approximately 7/8 of such offenders were white, and 13% of victims were non-white. What is the most common race of a street mugger in Centerville?

Based on the study finding that 7/8 of street muggers are white, it can be stated that the most common race of a street mugger in Centerville is white.

Two anonymous tips have identified possible suspects in a recent unsolved street mugging: Tom Smith, a white 35-year-old male, and Robert Jones, a black 33-year-old male. Based on the study, who is the better suspect?

It should be noted that 7/8, or approximately 87%, of the street muggers are white, which matches Centerville's percent of white population, 87%. Therefore, while there are more white offenders numerically, whites are equally represented among street mugging offenders relative to their representation in Centerville's population and are not more likely to be street muggers. Any differences are the result of the population base rates.

Regardless of the racial breakdown of offenders, any two individuals have an equal chance of being the offender. As an example, imagine a jar of 100 marbles, 90 white and 10 blue. You are more likely to draw a white marble from the jar (9 out of 10), but if marble number 62 is white and marble number 19 is blue, both have an equal chance of being drawn (1 out of 100). Therefore, both Tom Smith and Robert Jones have an equal chance of being the offender.

Question 8

A child molester is active in Edmonton, Alberta, Canada. His victims have all been school children, 7 to 10 years of age, who were accosted while walking on the street alone in the dark. The attacks lasted less than a minute, and none of the victims was transported. The number of offenses by month are indicated in the graph to the right.

The media claim the molester is escalating his criminal activity. Is this a reasonable conclusion? **Yes.**

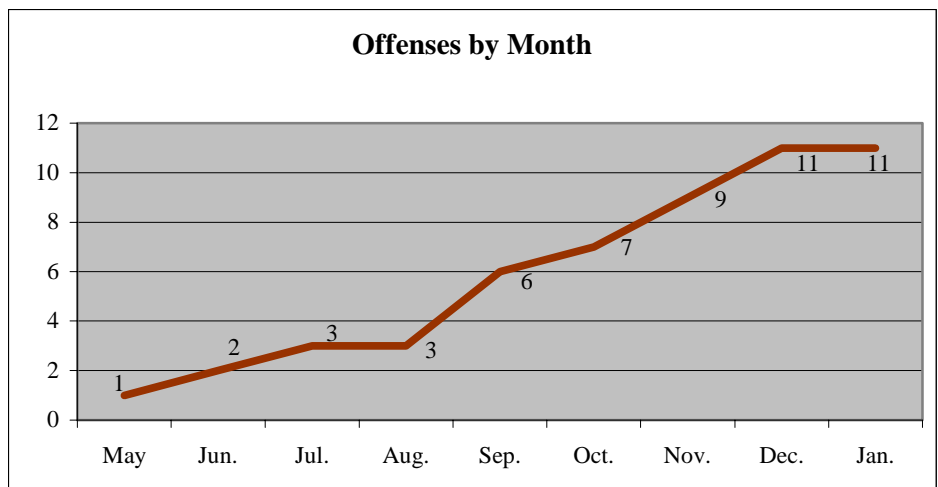
What factors might explain this pattern?

While the offender may be escalating his activity, a number of other factors might explain the apparent escalation. For example, the number of offenses has steadily increased since September, the month when students traditionally return from summer break. Therefore, the increase may be due to greater availability of victims, as more children are walking to and from school. Secondly, the number of incidents has increased during the fall and winter months, when the sun sets earlier in the day, especially in the northern city of Edmonton, and children are walking home from school in the dark. Another possible explanation for the increase may be better reporting by children and parents as a result of media reports concerning the crime series.

While the offender's activity could stabilize or even continue to grow, there are very good reasons for believing that his activity may start to decrease. Media coverage of the case may lead to increased adult guardianship of children, and children may choose to walk in groups, rather than alone. Additionally, as spring and summer approach, there will be more hours of daylight and less opportunity for the offender to approach victims in the dark. In conclusion, a crime is the product of an interaction between a criminal, a victim, and the environment (place, time, and guardianship), and all these influences need to be considered when analyzing changes in crime frequency and offender activity.

What level of offender activity might you expect in the future?

While the offender's activity could stabilize or even continue to grow, there are very good reasons for believing that his activity may start to decrease. Media coverage of the case may lead to increased adult guardianship of children, and children may choose to walk in groups, rather than alone. Additionally, as spring and summer approach, there will be more hours of daylight and less opportunity for the offender to approach victims in the dark. In conclusion, a crime is the product of an interaction between a criminal, a victim, and the environment (place, time, and guardianship), and all these influences need to be considered when analyzing changes in crime frequency and offender activity.



Question 9

Research of non-acquaintance rape victims has demonstrated they have an 80% accuracy rate in describing the correct race of their assailant. A profiling study has shown that Hispanic males are 1.8 times as likely as white males to engage in stranger rapes involving victim transportation. A female visitor to an area comprised of 70% Hispanic males and 30% white males reports such an attack in which she was transported by car approximately 2 miles from the encounter point. The offender is described by her as white. Is this likely to be a correct description?

This is not likely to be a correct description. Based on population alone, the odds that the rapist will be Hispanic are 7:3. Based on the finding that Hispanic males are 1.8 times as likely as white males to engage in stranger rapes involving victim transportation, we then multiply 7/3 by 1.8 (or 9/5). This results in the odds of 63:15, which reduces to 21:5. Thus, Hispanic males of this population are 4.2 times as likely as white males to commit this type of crime. When we convert these odds to a probability, we find that there is an 81% chance $(21/(21 + 5) = 21/26 = 0.81)$ that an offender engaging in stranger rape involving victim transportation is a Hispanic male, and a 19% chance that the offender is a white male. The following chart takes these probabilities and the eyewitness identification accuracy rate into account to determine the probability that the victim's description is correct in this situation:

| | | Eyewitness Accuracy | |
|------------------------------------|----------------|---------------------|------------------|
| | | Accurate (80%) | Inaccurate (20%) |
| Stranger Rapes involving Transport | Hispanic (81%) | 64.8% | 16.2% |
| | White (19%) | 15.2% | 3.8% |

This chart shows that the probability of an accurate identification of a white suspect (15.2%) is slightly lower than an inaccurate identification of a Hispanic suspect (16.2%). The chance that the victim has accurately described the suspect as being white is actually less than the chance of her describing a Hispanic suspect inaccurately. Therefore, the victim's description of a white suspect is marginally more likely than not to be inaccurate.

Based on this description, should suspects be prioritized by race? If so, how? If not, why not?

Yes, white suspects should be prioritized. There is a difference between group percentages and individual odds. The former are influenced by base rates, while the latter are not. The fact that Hispanic males are 1.8 times as likely as white males to engage in stranger rapes involving victim transportation increases the odds of any individual Hispanic male being the offender by 9:5 (or, conversely, decreases the odds of any individual white male by 5:9). However, the eyewitness information increases the odds of any individual white male being the offender by 4:1 because of the 80% accuracy rate. This results in overall odds favoring white males of just over 2:1 $(4/1 \times 5/9 = 20/9)$.

This is actually the reverse situation to Question 7. To make this clearer, imagine a lottery involving 1,000 tickets, 990 with a single number and 10 with two numbers. Clearly, the two-number tickets are the best bet and are to be preferred. But because there are so many more tickets with just a single number, the probability is that the lottery will be won by a holder of one of those tickets $(p = 990/(990 \times 1 + 10 \times 2))$. This is the base rate influence.



ANNOUNCEMENT: CRIME MAPPING NEWS
WINS AN AWARD FOR EXCELLENCE IN
LAW ENFORCEMENT PUBLICATIONS

The International Association of Law Enforcement Intelligence Analysts (IALEIA), an association of individuals dedicated to professionalism in law enforcement intelligence and analysis, recently awarded the Police Foundation a 2002 Professional Service Award for excellence in law enforcement publications. The publication receiving this recognition is the *Crime Mapping News*. This award was presented at the IALEIA Annual Conference in Nashville, Tennessee on June 26, 2002. The members of the Police Foundation's Crime Mapping Laboratory are grateful for this recognition, and we are proud to serve as a resource for law enforcement professionals engaged in the disciplines of crime analysis and crime mapping.



For more information about IALEIA, please visit their Web site at www.ialeia.org.

Upcoming Conferences and Training

August

International Association of Chiefs of Police
(IACP): Crime Analysis Applications Training
August 26-28, 2002
Schenectady, NY
Contact: Tresonya Ball, ballt@theiacp.org

September

California Crime & Intelligence Analysts
Association (CCIAA) Annual Conference
September 18-20, 2002
Monterey, CA
www.crimeanalyst.org

International Association of Law Enforcement
Planners (IALEP) Annual Training Conference
September 22-27, 2002
Long Beach, CA
www.ialep.org

Rio Hondo GIS/GPS Public Safety Training Center:
ArcView Training
September 23-27, 2002
Whittier, CA
Contact: Bob Feliciano,
bfeliciano@rh.cc.ca.us or (562) 692-0921

October

International Association of Chiefs of Police
(IACP): Determining Patrol Staffing, Deployment,
and Scheduling Training
October 7-8, 2002
Yarmouth, MA
Contact: Tresonya Ball, ballt@theiacp.org

International Association of Crime Analysts (IACA)
Annual Conference
October 15-18, 2002
Orlando, FL
www.iaca.net

General Web Resources for Training Seminars and Conferences

<http://www.urisa.org/meetings.htm>
<http://www.ifp.uni-stuttgart.de/ifp/gis/conferences.html>
<http://www.geoinfosystems.com/calendar.htm>
<http://msdis.missouri.edu/>
http://magicweb.kgs.ukans.edu/magic/magic_net.html
<http://www.nsgic.org/>
<http://www.mapinfo.com/events>
<http://www.esri.com/events>
<http://www.ojp.usdoj.gov/cmrc/training/welcome.html>
<http://www.nlectc.org/nlecterm/>
<http://www.nijpcs.org/upcoming.htm>
<http://www.usdoj.gov/cops/gpa/tta/default.htm>
<http://giscenter.isu.edu/training/training.htm>
<http://www.alphagroupcenter.com/index2.htm>
<http://www.cicp.org>
<http://www.actnowinc.org>
<http://www.ialeia.org>

Early Reminders!

American Society of Criminology (ASC) 2002
Annual Meeting
November 13-16, 2002
Chicago, IL
www.asc41.com

2002 Problem-Oriented Policing Conference
November 22-24, 2002
San Diego, CA
www.policeforum.org

Sixth Annual International Crime Mapping
Research Conference
December 8-11, 2002
Denver, CO
<http://www.ojp.usdoj.gov/cmrc>

COPS

Advancing Community Policing in America

The Office of Community Oriented Policing Services (COPS) is the Federal office responsible for advancing community policing, including funding the hiring of additional community policing officers and funding innovative community policing initiatives in agencies throughout America.

Hiring Officers

The Universal Hiring Program provides grants to help law enforcement agencies hire community policing officers. The COPS in Schools program provides grants for the hiring of officers to fight crime and disorder in and around schools.

Technology and Civilians

The COPS Office provides funds to acquire new technologies and equipment, and for the hiring of civilians for administrative tasks. This allows more law enforcement officers to spend their time on the streets pounding the pavement instead of pounding the keyboard in station houses.

Promoting Innovation

The COPS Office provides grants to promote innovative approaches to preventing and solving crime, reducing fear of crime and increasing trust between law enforcement agencies and the communities they serve. Following are a few examples:

- The Tribal Resources Grant Program provides funds to Indian tribes to enhance their law enforcement infrastructures and increase community policing efforts.
- Domestic Violence grants assist communities to fight domestic violence through community policing.
- The Justice Based After-School Program supports police led after-school programs to prevent juvenile crime and victimization.
- The Methamphetamine Initiative targets the production and distribution of "meth" in urban and rural America.
- The School-Based Partnership Program assists hundreds of communities and police to fight school crime.

Training and Technical Assistance

The COPS Office is dedicated to providing the free training and technical assistance necessary to assist agencies, officers and communities to implement and sustain community policing, through a nationwide network of regional community policing institutes and in partnership with the Community Policing Consortium.



For more information on the COPS Office or to receive information regarding funding opportunities visit our newly upgraded website at:

www.cops.usdoj.gov

or call the DOJ Response Center at (800) 421-6770

ABOUT THE POLICE FOUNDATION

The Police Foundation is a private, independent, not-for-profit organization dedicated to supporting innovation and improvement in policing through its research, technical assistance, and communications programs. Established in 1970, the foundation has conducted seminal research in police behavior, policy, and procedure, and works to transfer to local agencies the best new information about practices for dealing effectively with a range of important police operational and administrative concerns. Motivating all of the foundation's efforts is the goal of efficient, humane policing that operates within the framework of democratic principles and the highest ideals of the nation.

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