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Data-Driven Policing: How Geographic Analysis Can Reduce Social Harm

Earl Hardy, Senior Highway Safety Specialist
Office of Safety Programs
U.S. Department of Transportation
Washington, DC

Communities with high crime rates and traffic crashes suffer a lowered quality of life. Law enforcement agencies within these communities must work collaboratively with local stakeholders to reduce social harm. Problematically, today's increased demands for law enforcement services are coupled with rising operating costs and limited resources, leading many law enforcement agencies to allocate tax dollars with greater efficiency and intelligence. To find a resolution, law enforcement executives must integrate technological advances and data-driven strategies into their decision-making processes.

This issue of *Geography and Public Safety* discusses initial results of a new operational initiative that uses modern statistical analysis and geographic software to help law enforcement executives deploy resources effectively and efficiently. The initiative, called Data-Driven Approaches to Crime and Traffic Safety (DDACTS), was developed through a partnership between the National Highway Traffic Safety Administration in the U.S. Department of Transportation and the Bureau of Justice Assistance and National Institute of Justice in the U.S. Department of Justice. It emphasizes using geographic mapping to locate crime and traffic crash hot spots and target these areas with highly visible traffic enforcement.

DDACTS was created as a nationwide initiative to help local communities improve public safety by both reducing their crime rates and decreasing their traffic crashes. The initiative began in the summer of 2008 with seven demonstration sites,[1] each of which has used timely and accurate data to create localized policing strategies and tactics.

Find out more about the Data-Driven Approaches to Crime and Traffic Safety initiative by visiting www.ddacts.com.

DDACTS offers guidelines for communities that want to implement this type of data-driven law enforcement operational model. These guidelines suggest including the following components:

- **Data collection.** Law enforcement agencies should collect current, location-based crime, crash, and traffic data, including data on Part I and Part II crimes as described in the Uniform Crime Reports.[2]
- **Data analysis.** Law enforcement agencies should create maps that merge crime, crash, and traffic data to identify hot spots.

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- **Local partnerships.** Law enforcement agencies should partner with local stakeholders and community organizations.
- **Strategic operations.** Law enforcement agencies should use hot spot analysis to realign workflow and direct resources efficiently.
- **Information sharing and outreach.** Law enforcement agencies should share results, promote community participation, and document accomplishments.
- **Monitoring, evaluating, and adjusting operations.** Law enforcement agencies should regularly collect and assess crime and crash data and adjust their operations accordingly. Additionally, agencies should evaluate and optimize their current procedures.
- **Measuring outcomes.** Law enforcement agencies should create goals during planning and analysis and assess whether new strategies help meet these goals.

Using the DDACTS model can help law enforcement agencies cultivate long-term change in their communities. Currently, many communities face serious public safety dilemmas. Calls for services have increased, and because of a weakened economy, policymakers often need strong justification to increase funding for public safety efforts. Law enforcement executives must find a way to justify their budgetary needs and spend the resources they have wisely.Law enforcement executives can easily justify their needs if they collect local crime and traffic data and use them to target community hot spots. Using spatial statistical techniques to identify clusters of crime and crashes can provide conclusive evidence about where both are occurring in the same places. Creating strategies that target these hot spots helps guide workflow and increase efficiency. By consistently monitoring and evaluating their agencies' progress, they can determine which methods work and how strategies should be revised in the future.

In addition, visible officer presence in high-crime or traffic-heavy areas lets citizens maintain a sense of safety and well-being. Officers can improve community relations by partnering with community stakeholders and sharing information. In this way, officers keep citizens directly informed about safety and crime prevention, and enhance media relations.

Law enforcement agencies must face today's challenges with dynamic strategies that employ technological resources to solve problems efficiently. Community-focused, place-based law enforcement practices have emerged as an effective way to reduce social harm and improve public safety. Intelligent policing improves citizens' lives.

Notes

[1]The seven DDACTS demonstration sites include: Baltimore County, MD, Lafourche Parish, LA, Nashville, TN, Oakland, CA, Rochester, NY, St. Albans, VT, and Washoe County Sheriff's Office, NV.

[2]For more information about the Uniform Crime Reports, see www.fbi.gov/ucr/ucr.htm.

Place as the Focal Point: Developing a Theory for the DDACTS[1] Model

Ronald E. Wilson, Program Manager
Mapping and Analysis for Public Safety Program
National Institute of Justice
Washington, DC

Law enforcement has long been aware that where a concentration of crime exists crashes often tend to concentrate as well. To date no research adequately explains this phenomenon. Currently available research only discusses the relationship between criminal behavior and reckless driving behavior.[2] It focuses on the individual as the nexus between crime and crashes and uses psychology as a structure to support theories of crime. The basic premise underlying these studies suggests that individuals who commit crimes are also likely to commit traffic violations that lead to crashes. This research states that these individuals exhibit one or a combination of behavioral problems, which include a lack of self-control, a persistent risk-taking behavior, or a lack of moral development. Simply put, an individual who engages in risky behavior in one activity will likely engage in risky behavior in other activities.

These theories, though, do not adequately explain why crime and crashes cluster in geographical space. The psychological theories above work to explain a person's behavior, but do not address why a person would both commit crimes and be involved in traffic crashes in the same geographic area. For theories to adequately explain the clustering of crimes and crashes in space by an individual, that person would have to consistently commit crimes and have crashes in the same places. That is, in order for crimes and crashes to form clusters (for example, as in repeat and near repeat victimization theories), a frequent number of incidents must have occurred in the same space over a certain time period. In reality, both crime and crash incidents are committed by many people, not by one person or a small number of individuals. Although the above behavioral theories may explain a tendency to commit crimes or drive recklessly, they do not account for geographic location, or explain why a certain place may attract or "generate" crime and disorder.

To discern the geographic connection between these incidents, place-based theories are needed. Place-based theories can help examine the aspects of place, and why certain places attract the same types of people who have the above behavioral problems. Such an approach must incorporate theories from environmental criminology and geography to adequately explain this phenomenon. For example, these theories may provide ideas for what factors may lead a large number of individuals to frequently engage in criminal activity or reckless driving in certain neighborhoods. This kind of theoretical analysis helps police refine their countermeasures, incorporating contextual characteristics that will alleviate the problem and inform local policy using place.

A Place-Based Theory for DDACTS

There are a number of criminological and geographic theories that can augment the psychological theories that have been used in the past to explain the coincidence of crimes and crashes. Many studies show that some places attract individuals who commit crimes regularly (crime pattern or deviant place theory). Many of these individuals travel through and visit these places on a regular basis, as part of their normal daily activities (routine activities theory). These trips often involve the use of a personal vehicle. One can theorize that because these individuals already tend to engage in risky behavior their propensity to drive recklessly will increase and as a result the probability for crashes increases. From this perspective, the engagement in criminal activity or reckless driving is the result of the interaction of three factors: a motivated offender, a suitable target, and the absence of a capable guardian.[3] Again, place becomes the common denominator for the convergence of the three factors. Thus, characteristics of the place cause it to attract crime and disorder (spatial organization and interaction theories).

B.F. Skinner's theory of learning[4] can be a foundation that helps explain how individuals become drawn to a place and how these places may invite a number of them to regularly engage in criminal behavior or reckless driving. The theory purports that "the environment not only provides the opportunity for the act, but it also conditions the act through its consequences." What this means is that some places facilitate the engagement of risky behavior and that these actions, especially if they occur frequently, send messages to others that they too can act similarly. Essentially, crime will attract crime, but conversely, consistent enforcement will send a message that crime or reckless driving is not acceptable. Such choice models are developed from learned forms of behavior that are influenced by propensity to a location, opportunity, appropriate situation, and environmental context. Each of these models can be drawn from a combination of the theories outlined above; creating a place-based theory that explains why crimes and crashes may occur in the same neighborhood, even if there is no causal link between the incidences themselves.

Geographic theories also strengthen psychological and criminological theories when providing a comprehensive, place-

based foundation for DDACTS. These geographic theories include the development and change of urban form (spatial organization) and what occurs in and between different neighborhoods that develop through changes in form (spatial interaction). They describe why and how neighborhoods develop as part of a larger metropolitan area and examine the social, political, and economic interactions of people. The theories also provide a platform for examining the flows into, out of, and between neighborhoods. Such geographic analyses can provide insight into policy development, which can prevent and suppress crime or crash patterns from forming.

Using DDACTS in Modern Policing Strategy

Targeting places in order to more efficiently deploy scarce public service resources are becoming benchmarks of 21st century policing. In order to justify this method of policing, law enforcement executives must know why and how these place-based strategies support their decisions. They must understand how geography can affect crime rates, and how strategic enforcement can maximize public safety.

An enforcement strategy in line with the DDACTS philosophy will use high-visibility enforcement to reduce crashes in a target area as well as deter crime. Ideally, these effects also could spread to adjacent neighborhoods. Consistent visibility can work to deter criminal activity because the police are present for extended periods of time increasing the risk of getting caught. If the target area continues to yield high crime or crashes after the period of enforcement, city/county leaders must examine contextual factors that might be the source of the problem and make appropriate changes at the neighborhood level. This may include removing crime generators or attractors (e.g., liquor stores, check cashing stores, or poorly lit alleyways) or making physical changes that reduce traffic congestion (e.g., adding lanes, installing traffic lights, changing traffic patterns).

Place-based perspectives and research provide the grounding to drive more comprehensive changes in law enforcement practice and local policy. Accordingly, law enforcement analysts should use analytic techniques and problem-solving approaches that specifically examine the co-occurrence of crime and traffic incidents. For communities across the country, this innovative research and practice provides good news—they can deliver profound social and economic change, lowering crime rates and making neighborhoods safer by focusing on discrete places in order to have the maximum effect on behavior.

Eliminating opportunities for risk with place-based approaches can augment attempts to change individuals. An emerging body of research suggests that focusing on high-risk places as opposed to high-risk individuals is more effective.[5]

Notes

[1]Data-Driven Approaches to Crime and Traffic Safety.

[2]Brace, C. et. al. (2009). The Relationship Between Crime and Road Safety. Final Report, Monash University Accident Research Center.

[3]As suggested by routine activity theory.

[4]Chapin, F. (1974). Human Activity Patterns in the City: What do People do in Time and Space. Wiley, N.Y. In Golledge, R.G. and Stimson, R.J. *Spatial Behavior: A Geographic Perspective,* 1996, Chapter 8, p. 292.

[5]For instance, Mastrofski, S. D., Weisburd, D. and Braga, A. A., 2009-11-03 "Rethinking Policing: The Policy Implications of Hot Spots of Crime" Paper presented at the annual meeting of the ASC Annual Meeting, Philadelphia, PA 2010-05-17 from www.allacademic.com/meta/p372862_index.html.

Implementing DDACTS in Baltimore County: Using Geographic Incident Patterns to Deploy Enforcement

Captain Howard Hall, Operational Services Section Commander
Baltimore County Police Department
Baltimore, Maryland

Emily N. Puls, Statistical Analyst
Baltimore County Police Department
Baltimore, Maryland

In 2007, the Baltimore County Police Department (BCoPD) began to identify traffic corridors experiencing high levels of vehicle crashes and criminal incidents. When BCoPD visibly increased traffic enforcement in these areas, both crime and crashes decreased. The results of this project led the BCoPD to join the Data-Driven Approaches to Crime and Traffic Safety (DDACTS) initiative.

DDACTS has become a primary component of the BCoPD's overall data-driven policing strategy and has shown promising results in reducing traffic crashes and criminal incidents. It has become part of the department's strategic plan and Baltimore County's Master Plan for 2020. This article describes Baltimore's work with the DDACTS initiative, and how the project has affected crime and crash rates in the community.

Background

The population. Baltimore County is a suburban community with a population of nearly 800,000. The county almost completely surrounds the city of Baltimore. The area is geographically diverse, with rural and suburban areas and residents of all levels of socioeconomic status. No cities or towns have been incorporated within the county; however, many communities exist and are identifiable by name.

Transportation and crime. The transportation network in Baltimore County includes more than 3,000 miles of roadway, and estimates suggest that vehicles travel more than 8 billion miles on these roads each year. Serious crime in the county has been decreasing during the past several years; however, crimes including robbery, burglary, and auto theft remain a primary concern of the BCoPD. Like many suburban jurisdictions, Baltimore County experiences far more traffic fatalities than criminal homicides. Traffic crashes in the county cause a substantial amount of personal injury and property damage and contribute to congestion problems.

The Baltimore County Police Department. The BCoPD is a full-service law enforcement agency with more than 1,900 sworn personnel, making it the 23rd-largest police department in the United States. Ten police precincts around the county provide most police services. The Operational Services Section, a centralized unit that is responsible for several specialized functions, coordinates DDACTS for the county. This section works with the department's Crime Analysis Section, which produces detailed maps and statistical analyses of criminal incidents and traffic crashes. These analyses and informative maps allow department leaders to deploy available resources based on these geographic patterns.

Implementing DDACTS in Baltimore County

Phase I: The Crash Crime Project

In 2008, the BCoPD began implementing Phase I of its DDACTS initiative, called the Crash Crime Project. In this phase, analysts identified road segments as traffic crash hot spots and identified overlapping reporting areas[1] that were crime hot spots. Police leadership then directed patrol units to these areas to conduct high-visibility traffic enforcement.

To determine the impact of Phase I, analysts generated statistics and compared rates of crime and crashes before and after implementation. With an increase in traffic stops, the county saw a decrease in both traffic crashes and robberies. Robberies decreased 13.6 percent, but this was not statistically significant. Overall traffic crashes decreased 6.0 percent and injury crashes decreased 14.7 percent, both of which were statistically significant. Burglaries increased 2.4 percent, but this increase was not significant. Shifts in hot spots observed between 2007 and 2008 indicated potential crime displacement.

Phase II: Implementing the DDACTS model

Based on the findings from Phase I, the BCoPD implemented Phase II on April 1, 2009, making several modifications. Analysts expanded the targets in Phase II to geographic areas, rather than restricting enforcement to linear roadways. This adjustment was intended to reduce the potential for crime displacement that may have occurred in Phase I and to better follow DDACTS Operational Guidelines.[2]

Acquiring point locations. After running data cleaning programs designed to standardize street names and reconcile inconsistencies, analysts identified geographic locations for all of the selected crimes and traffic crashes for the prior 2 years. The databases were then imported into ArcMap software[3] so that they could be placed on a geographic map of the area. Incidents used in the analysis included: personal injury crashes, robbery, burglary, motor vehicle theft, and theft of property from a vehicle.

Generating spatial statistics and identifying target areas. Analysts assessed crime and crashes separately for each year to identify any geographic congruence between years. They used CrimeStat III[4] software to

identify the intersections[5] of crime incidents in both years, including robberies, burglaries, and personal injury crashes.[6] They then developed composite hot spot areas, where hot spots for each type of incident overlapped (see Figure 1).

Figure 1. Hot spots ellipses: Composite areas.

Next, analysts applied a kernel density evaluation method to each crime or crash location to identify areas with a high concentration of crimes and crashes within each hot spot. The kernel density overlay showed analysts where the crime or crash problems were concentrated within each hot spot. The maps produced using this method helped to identify potential target areas for Phase II.

Large maps for each of the target areas were printed and presented to each precinct. Precinct command staff decided which of the areas would respond best to enhanced enforcement. Once the final selections were made, analysts created a comprehensive "crime and crash profile" for each of the target areas. These profiles included a list of calls for service, crimes reported to the Uniform Crime Reporting System,[7] and traffic crashes for the previous 2 years.

Deployment of Policing Resources in Composite Hot Spot Areas

The spatial and geographic analysis provided to precinct commanders was used to develop deployment plans. Commanders developed specific objectives targeting the problems identified in each target area. Action plans were prepared for each objective, which outlined the strategies and tactics that would be utilized. These plans were finalized and implemented on April 1, 2009.

All of the action plans require the use of high-visibility traffic enforcement. The plans include a goal of spending 1,135 enforcement hours per week in the combined target areas. From April 1 through December 31, 2009, more than 54,000 hours were dedicated to the project, which exceeded this goal by approximately 18 percent. More than 63,000 enforcement contacts and more than 1,400 arrests were made in these areas. Additionally, highway safety grant funding helped provide overtime enforcement efforts in the target areas.

In addition to enforcement, personnel involved in the initiative conducted a variety of crime prevention activities, including completing more than 168,000 business checks; initiating security surveys; and attending many community meetings. The initiative has also emphasized communications within the department, and the department has included DDACTS in its newsletter, at in-service training, and at staff meetings and roll calls.

Evaluating the Project

To evaluate the results of the DDACTS project, the BCoPD's Crime Analysis Section produces a weekly traffic-stop graph that compares the number of traffic stops made before and after the project was implemented. It also compares traffic stops made within the DDACTS target areas to those made outside the DDACTS areas. Additionally, to consistently monitor officers' activity, supervisors maintain an activity database with information from patrolling officers' daily activity reports.

Each month, analysts prepare a DDACTS report that compares the number of crimes and personal injury crashes to the previous 3 years' averages during the same time period. A monthly report is provided for each target area and cumulatively for all 15 target areas.

Results

Outcomes from this project have been promising. From April 1 through November 30, 2009, the following changes occurred in

the combined target areas, in comparison to average rates from the previous 3 years:

- Burglaries decreased by 16.6 percent.
- Robberies decreased by 33.5 percent.
- Motor vehicle thefts decreased by 40.9 percent.
- Thefts from motor vehicles decreased by 1.1 percent.
- Personal injury crashes decreased by 0.2 percent.
- Total crashes decreased by 1.2 percent.
- Traffic stops increased by 42.5 percent.

Conclusion

The BCoPD has seen encouraging results from the DDACTS initiative. Using traffic and crime analysis has provided areas for focused enforcement. The decreases in traffic crashes and criminal incidents have corresponded to an overall increase in traffic stops in the target areas. Moreover, most of the increased enforcement has used existing patrol resources, making officer patrol time more efficient.

BCoPD precinct leaders are reviewing their target areas, objectives, and action plans and adjusting their strategies based on last year's results. Lessons from their experiences with the DDACTS initiative are being used to adjust deployment and officers' activities to achieve better results in the future.

Notes

[1]Reporting areas are the smallest geographic unit that analysts use to aggregate police data.

[2]National Highway Traffic Safety Administration, Data Driven Approaches to Crime and Traffic Safety: Operational Guidelines, DOT HS 811 185, August 2009.

[3]For more information on ArcMap software, visit: www.esri.com.

[4]This software is available from the National Institute of Justice. www.ojp.usdoj.gov/nij/maps/crimestat.htm.

[5]Nearest Neighbor Hierarchical Clusters were constructed for crime and crash incidents in both years. The intersections of those clusters (or ellipses) were used to create the hot spots.

[6]A personal injury crash is a traffic crash that results in an injury to any involved person (e.g., driver, passenger, pedestrian, bystander).

[7]For more information, see: www.fbi.gov/ucr/ucr.htm.

Traffic Safety Initiative Modernizes Resource Deployment in Lafourche Parish

Captain Scott Silverii, Patrol Division Commander
Lafourche Parish Sheriff's Office
Thibodaux, Louisiana

For a small community that once relied on paper maps and colored pushpins to identify crime hot spots, the idea of electronic geographic mapping may seem a daunting task. Thanks to a new program sponsored by the National Institute of Justice (NIJ), seven communities enhanced their traffic safety and crime programs with geographic mapping. The Thibodaux, Louisiana community's experience, described below, shows how a geographic mapping program can have pronounced effects on crime and car crash incidents.

The Lafourche Parish Sheriff's Office (LPSO) in Thibodaux faced a number of common challenges when trying to implement a crime and traffic safety program. These included increased demands for service, low staff numbers, and increases in crime and traffic accidents. To meet these challenges, officers knew they needed to maximize the efficiency of their operations and use all their available resources effectively. However, officers did not have a clear idea of how to reach this goal until they began working with the Data-Driven Approaches to Crime and Traffic Safety (DDACTS) in April 2009. DDACTS challenged the bayou community by updating their geographic mapping system and asking them to modernize their approach to traffic safety.

DDACTS is a program that uses local crime and traffic data to increase traffic safety and lower traffic violations. Communities involved in the DDACTS program can identify areas with high incidents of traffic violations and car crashes using geographic mapping, and use this information to effectively deploy law enforcement and other resources.

The Need for a New Approach to Traffic Safety

According to the Louisiana Highway Safety Commission, Lafourche is among the highest-ranking parishes[1] for alcohol-impaired and fatal crashes in the state. The LPSO records management system lists annual averages of 2,531 motor vehicle crashes, 803 injury crashes, and 23 fatal crashes. The LPSO lacked the mapping capability to generate visual data displays of locations with high incidences of crime and crashes. Therefore, the office had been forced to identify these hot spots using a traditional paper map and pushpin method. As the DDACTS project progressed, the agency was able to procure a modern records management system and computer-aided dispatch system[2] with mapping and analysis capabilities.

Research Design and Methods

The LPSO reduced crime and crashes by focusing law enforcement resources on local hot spots. The office used a quasi-experimental, quantitative design[3] to examine the data contained in its

records management system. They compared this historical, baseline data to real-time information collected by deputies. From this analysis, the office generated a map of local crash and crime hot spots and focused patrol units on these areas.

Officers determined the agency's progress by comparing and analyzing crime and crash data sets from week to week. Both data sets were also compared to data from the previous year. The office's records management system served as the central repository for all data and was used to extract data for analysis and evaluation.

Creating an Operational Plan

Following initial data collection and analysis, the LPSO put together an operational plan. Deputies were asked to complete a report of self-initiated enforcement actions, which provided consistent data that the office's analyst could use to evaluate the effectiveness of operations. Program results were provided to the sheriff and executive staff during monthly CompStat[4] meetings and used to make decisions about changes in officer tactics or deployment.

Results

The initial analysis of 2008 data showed that the highest incidents of crime and crashes occurred in two patrol areas, known as beats E and J. The highest incidents of crime and crashes in these beats occurred Monday through Friday between 5 p.m. and 7 p.m., within 2-mile perimeters.

Deputies worked a total of 600 hours during the first 6 months of operations while incurring no overtime expenses. Since the inception of DDACTS, self-initiated activities conducted by deputies increased 64.54 percent in Beat E and 74.10 percent in Beat J.

Beat E experienced an 11 percent decrease in crashes that did not result in injuries, a 14 percent increase in crashes that resulted in injuries, and the number of fatal crashes remained consistent at zero. The beat did not experience an increase in personal crimes, but property crimes increased by 24 percent. Burglaries accounted for the majority of this increase, from 53 to 107 burglaries between 2008 and 2009.

Beat J experienced a 13 percent decrease in crashes that did not result in injuries, a 3 percent increase in crashes that resulted in injuries, and a fatal crash reduction of 75 percent. Personal crimes experienced a 22 percent reduction, while property crimes saw an increase of 30 percent. Thefts accounted for the majority of this increase, from 82 to 108 incidents between 2008 and 2009. An analysis of the thefts showed the majority occurred more than 3 miles from the DDACTS hot spot benefiting from increased law enforcement.

The increases in thefts and burglaries in these two beats may demonstrate a geographic limit to the positive effects of DDACTS-directed enforcement activities. When patrols are directed mostly to hot spots, crime may be displaced to other areas within a community.

Lessons Learned

Lafourche Parish resembles many jurisdictions, which means that research from the project may be applicable to other agencies with a similar size and resource capacity. Lafourche Parish learned the following lessons by implementing the DDACTS program:

- Remain focused on the hot spots identified by geographic analysis.
- Restrict efforts to reduce crashes and crimes peripheral to the hot spot.
- Consider deploying additional resources to target displaced crimes.

These key revelations may help provide a roadmap for agencies facing limited staffing and technological resources.

Conclusion

Adding geographic mapping capabilities helped Lafourche Parish by providing data and analysis capabilities that allowed officers to locate and fight crime and traffic problems in local hot spots. The LPSO's experience shows how the DDACTS model is a universally applicable system that is useful for introducing

a community's law enforcement agency to geographically based crime and crash detection techniques. Using modern analysis and mapping capabilities enables an agency to collect accurate and valid information that leaders and officers can use to make appropriate decisions about deploying limited resources.

Notes

[1]Louisiana is divided into "parishes" as the other states are divided into counties. These political subdivisions are based on Roman Catholic ecclesiastical divisions for the church.

[2]A computer-aided dispatch system assesses crime and traffic safety data and automatically sends available patrol cars to areas in need of assistance.

[3]A quasi-experimental design means that this operation was conducted outside of a controlled laboratory environment and is without control and experimental groups. The program's analysis is measured in numeric (quantitative) data.

[4]CompStat is a resource management tool that police departments use to identify crime, crashes and quality-of-life issues. Regularly held meetings make law enforcement staff accountable for lowering crime and public safety problems and use Geographic Information Systems to present visual maps and create comprehensive strategies.

Integrating Crime and Traffic Crash Data in Nashville

Jason Wyatt, Professional Specialist
Michael Alexander, Commander, South Precinct
Metropolitan Nashville Police Department
Nashville, Tennessee

John Battle, an engineer from the 1920s, wrote "The habit of analysis, the ability to get under the surface of things and at the vital essentials, gives a man a tremendous advantage" (Battle, 1920). Battle's emphasis on analysis is as applicable to law enforcement as to engineering. Law enforcement officers must quickly analyze a negative situation, decide on an appropriate course of action, and deploy patrols or other resources to an area. Their response must be both accurate and efficient. In the current economic downturn, many police agencies have faced budget cuts, making efficiency and the effective use of resources particularly important. In turn, agencies have had to rethink their strategies for combating crime and increasing traffic safety.

The Data-Driven Approaches to Crime and Traffic Safety (DDACTS) program is promoting one such strategy. The DDACTS model connects crime and traffic crash data using geographic mapping to target problem areas in a community. Police employ highly visible traffic enforcement in these problem areas to reduce crime, traffic crashes, and traffic violations.[1] In Nashville, Tennessee, the police department has followed this philosophy since 2004. The U.S. Department of Transportation's National Highway Traffic Safety Administration asked the Metropolitan Nashville Police Department (MNPD) to participate in DDACTS as a model agency.

The MNPD combines geographic analysis with a focus on holding department leadership accountable for resource allocation decisions. It accomplishes this goal by integrating geographic data on crime incidents and traffic crashes with officer "self-initiated activity" reports. These officer-performed self-initiated activities include vehicle stops, Terry stops, field interviews, and business checks.[2] By overlaying details about officers' activities on a map depicting crime and traffic crash hot spots, departmental leadership can visualize what is occurring and adjust resources accordingly. Timely and accurate data analysis helps the department ensure that officers are engaging in activities that are effective at reducing crime and traffic crashes, thus holding leadership responsible for the actions of officers on patrol.

New Beginnings in Nashville

MNPD began integrating crime and traffic crash data in its law enforcement strategies when Ronal W. Serpas, Ph.D., became chief of police in January 2004. Chief Serpas introduced an accountability-driven leadership model that improved on the traditional CompStat process.[3] This model uses expanded measures of efficiency and effectiveness to make the entire department accountable for meeting department goals (Serpas, 2004). Using the model, MNPD did the following:

Implementing accountability-driven leadership. MNPD began to meticulously collect and analyze crash and crime data to formulate daily objectives that would help reduce crime incidents and traffic accidents. Department leadership reviewed crime and crash statistics along with hot spot maps at weekly CompStat-style meetings. These meetings facilitated discussions among peers, identifying successful and unsuccessful approaches to crime and crash reduction. As a result, department leaders became responsible for modifying their actions and approaches to solving community problems, targeting hot spots, and reducing traffic incidents. They became accountable for reducing crime in their area of responsibility.

Using vehicle stops. Chief Serpas also focused on using traffic enforcement to address crime and traffic safety issues. The department selected areas for enforcement (e.g., increased vehicle stops) by assessing timely and accurate data. The areas selected have high numbers of crimes, traffic accidents, and driving under the influence (DUI) arrests. Thus, the vehicle stop itself provides the community with many benefits because it places law enforcement officers in high-crime areas, keeps drunken drivers off the road, and prevents accidents.

The benefits are achieved in large part because of the officer's visibility (e.g., blue lights) in the community while conducting the vehicle stop. MNPD tracks many types of data related to vehicle stops that clearly show that these stops are not just for writing tickets. Between January 1 and November 28, 2009, a total of 271,994 vehicle stops were conducted; 61.7 percent of those

resulted in warnings.[4] Arrests resulting from these vehicle stops totaled 24,211.[5] The arrests from vehicle stops represent 26.4 percent of the total arrests during this time period.[6]

Assessing Efficiencies and Effectiveness

Along with the focus on vehicle stops, MNPD emphasizes communication. Officers must communicate information about the precincts they patrol to department leadership. Crime analysts must access crime and crash data and disseminate the information to all involved, from the patrol officer to the chief. Communication is a significant part of effective law enforcement.

Precinctwide communication. In Nashville, each of the six precincts has its own Crime Analysis for Patrol (CAP) officer. This officer is responsible for crime analysis, and he or she must have intimate knowledge of crime and crash trends within the precinct's area. The CAP officer helps prepare daily crime sheets and crime maps, both of which are shared with the officers on the street. The precincts also update large maps daily in the room where roll call is held. Crime and crash hot spots are highlighted on these maps and the information is reinforced at daily briefings. Each precinct holds weekly accountability meetings where the entire precinct leadership team reviews the current and prior week's crimes.

Department-wide communication. MNPD's Crime Analysis Section use ArcGIS7 to create hot spot maps that are displayed at each weekly CompStat meeting. The hot spot data span the previous 4 weeks and include Uniform Crime Reporting (UCR) Part I incidents,8 traffic crashes resulting in injuries and property damage, and vehicle stops. The hot spots are produced from data for the entire county. Figure 1 shows a simple example of integrating crime and traffic crash data. This example shows 2008 UCR Part I violent incident hot spots and represents crashes that resulted in injuries with graduated symbols.

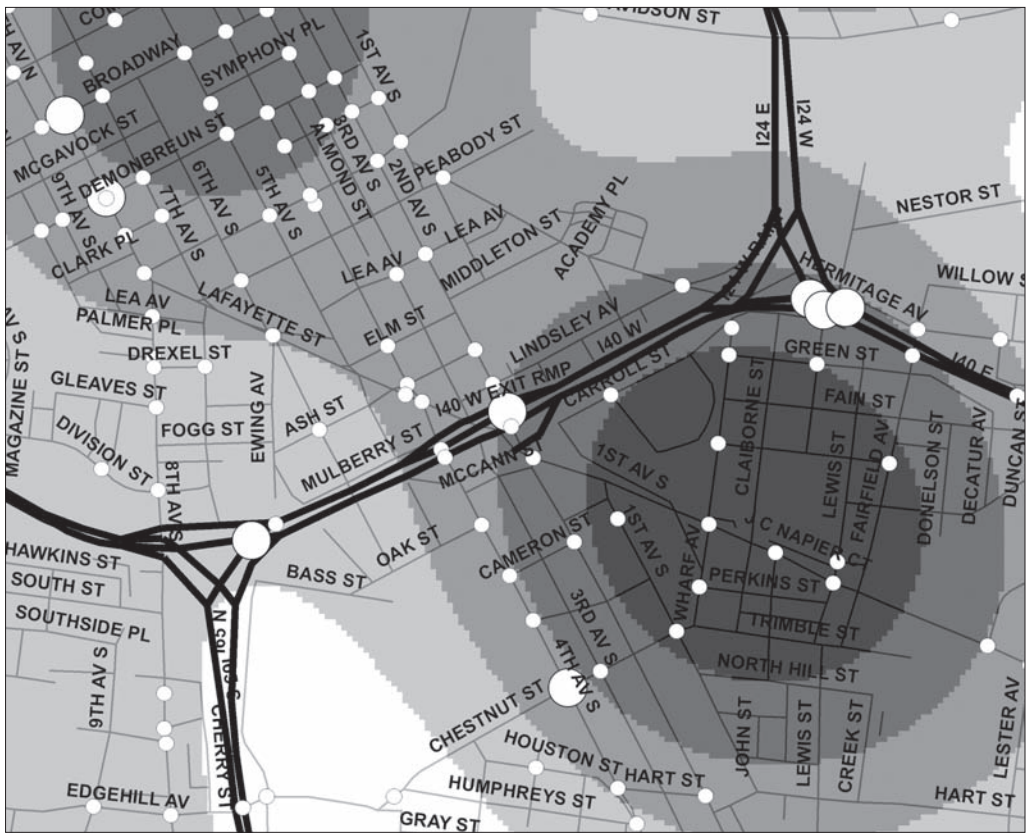

Figure 1. Hot spot map of the southeastern portion of downtown Nashville, showing Part I violent incidents from the Uniform Crime Reports in 2008, with graduated symbols representing traffic accidents that resulted in an injury.

MNPD analysts also create weekly zone intensity maps (i.e., graduated-color or choropleth maps) to visualize changes in crime and crashes. These maps are included in the department's CompStat report. Precincts are divided into zones; the entire city comprises 65 zones. The zone intensity maps show how much a zone's crime and crash rates vary from the mean based on values collected from each of the 65 zones over the last 4 weeks. These calculations allow MNPD leadership to identify zones with crime and crash rates that vary greatly from the mean and pinpoint where further analysis is needed. If a zone has become a crime or traffic hot spot, officers will examine data in greater detail, looking at map layers (e.g., violent UCR Part I incidents, injury or property accidents, DUI arrests) to identify what may be happening and where additional resources are needed.

The hot spot maps shown at the departmental CompStat meetings provide the best insight into what is occurring in Nashville. MNPD leaders can easily identify correlates of crime and crash data by looking at map layers. The appropriate response to these correlations can be determined best when maps also show the officers' self-initiated activities.

Outcomes Since 2003

Integrating crime and crash data, using an accountability-driven leadership model, and placing an emphasis on vehicle stops have helped Nashville decrease the number of fatal traffic accidents, decrease injury accidents, increase the number of DUI arrests, and decrease overall crime (see Table 1). Between 2003 and 2009:

- Fatal traffic accidents have decreased by 15.6 percent.
- Fatalities have decreased by 15.9 percent.
- Accidents that resulted in injuries have decreased 30.8 percent.
- DUI arrests have increased 72.3 percent.

From 2003 to 2008—the last year for which complete UCR data are available—UCR Part I crimes have decreased 13.9 percent. Based on preliminary data that is still subject to verification, UCR Part I crime continued to decline in 2009.

Year	Fatal Accidents	Traffic Fatalities	Injury Accidents	DUI* Arrests	UCR* Part I Incidents
2003	77	82	7,795	3,242	48,488
2004	86	95	7,727	3,477	46,552
2005	83	90	7,283	3,548	45,912
2006	87	97	7,021	3,919	43,666
2007	66	74	6,937	4,732	42,741
2008	67	72	6,362	5,595	41,754
2009	65	69	5,396	5,021†	34,362†

Table 1. Nashville Traffic Accident and Crime Statistics, 2003–2009.

*DUI = Driving Under the Influence; UCR = Uniform Crime Reports.

†Totals as of November 28, 2009.

Note: Data in this table come from the MNPD's Special Operations Division, Crash Investigations Unit; Strategic Development Division, Crime Analysis Section; and Metropolitan Nashville Police Department, *COMPSTAT Weekly* Analysis, December 2, 2009, pp. 42, 60.

The Future

MNPD is currently implementing a new records management system that will increase its ability to analyze data at the precinct and department levels. Leadership will ensure that each precinct's CAP officer has access to mapping and analysis software, including ArcGIS and CrimeView.9 This software will provide the means for more refined analysis of crime and crash trends in each precinct. These changes will help MNPD move forward in reaching a major goal—making Nashville the "safest big city in America!"

Notes

[1]For a complete description of DDACTS, see: www.ojp.usdoj.gov/nij/topics/law-enforcement/traffic-safety/ddacts.htm.

[2]A Terry stop occurs when an officer has reasonable suspicion to believe the individual stopped may have committed or is about to commit a criminal offense. A field interview is an interview or contact made by an officer to gather information, where the officer was not motivated to initiate the stop by suspicious circumstances or by the actions of the individual being stopped. A business check occurs when an officer stops at a business to ensure its safety and security.

[3]CompStat was first implemented by the New York City Police Department in 1994. The program uses geographic information systems to map crime data, identify problems, and direct resources to reduce crime.

[4]Metropolitan Nashville Police Department, *COMPSTAT Weekly Analysis,* December 2, 2009, page 60.

[5]Ibid.

[6]Ibid.

[7]For more information about ArcGIS, see: www.esri.com/software/arcgis/index.html.

[8]UCR Part I incidents include homicide, forcible rape, robbery, aggravated assault, burglary, larceny, motor vehicle theft, and arson. In Nashville, arson is excluded from the hot spot maps. For more information, see: www.fbi.gov/ucr/ucr.htm.

[9]For more information about CrimeView, see: www.theomegagroup.com/police/crimeview_desktop.html.

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TECHNICAL TIPS

Using Geographic Analysis To Direct DDACTS Operations in Rochester

Chris Delaney, Director of Business Intelligence
Rochester Police Department
Rochester, New York

K. Alexandra Schneider, Research Analyst
Rochester Police Department
Rochester, New York

In Rochester, New York, crime mapping and analysis play a central role in driving police operations. Seeking to do more with less, the Rochester Police Department (RPD) has embraced a variety of initiatives that use mapping and analysis to help police executives make more effective use of limited resources.

The RPD joined the Data-Driven Approaches to Crime and Traffic Safety (DDACTS) project as a demonstration site in late 2008. The DDACTS approach in Rochester is a two-step process. First, department crime analysts use geographic mapping and analysis to identify hot spots where both traffic crashes and crime occur at high levels. Second, police leaders use the results of the analysis to deploy officers in a targeted manner to reduce crime and traffic crash levels at those hot spots.

These operations require analysts to play a key role in identifying hot spots and guiding deployment decisions. This article provides methods by which analysts can conceive a project, employ common geographic software to target crime and traffic crash hot spots, and use this information to guide DDACTS initiatives.

Project Planning

Although most analysts have crime data at their disposal, many do not typically analyze traffic crashes and therefore may be unfamiliar with crash data or how to obtain them. Analysts who do not have access to crash data through their department may be able to obtain those data through the county or state department of transportation[1] or regional metropolitan planning organization (MPO).[2] Only a few of the variables contained in traffic crash reports are needed for crash hot spot analysis. These include:

- Location
- Injury type (e.g., death, injury, property damage only)
- Date and time
- Contributing factors (e.g., alcohol, disregarded traffic signal).

Once those data have been obtained, analysts should determine the types of crimes and traffic crashes they want to prevent. A visible police presence can be an effective deterrent, lowering crime and crash rates, because offenders feel a heightened risk of apprehension and punishment and are therefore less likely to engage in crime. Nonetheless, officers should be aware of the circumstances in which enforcement will and will not help. For instance, crashes caused in part by environmental factors like traffic signal problems, slippery pavement, or obstructed views have nothing to do with police activity and will persist until the environment improves. In contrast, crashes caused by human behavior (e.g., speeding, alcohol) can be affected by law enforcement action. When determining which types of crimes and traffic crashes to prevent, analysts should consider whether the target crimes and crash types are affected by behavior or environment.

In Rochester, the department chose to target hot spots of speeding-related crashes and gun crimes, as both can be deterred by visible traffic enforcement. Most drivers are willing to speed when police are absent, but slow down when police are visible, thus reducing the opportunity for crashes. Similarly, as patrol levels increase, the risk of being in a traffic stop increases, so offenders carrying firearms in their vehicles have an increased risk of getting caught with a gun. As their willingness to drive with a

gun decreases, opportunities for offenders to commit gun crimes decreases, thus reducing levels of gun crime.

Identifying Crime and Crash Hot Spots

Crime analysts in the RPD used Environmental Systems Research Institute's (ESRI) ArcGIS software and Spatial Analyst[3] extension to identify hot spots. They collected data from January 1, 2005 to December 31, 2009 on gun crime (including homicides, assaults, robberies, and events where shots were fired) and vehicle crashes (where at least one contributing factor was "unsafe speed").

Analysts performed kernel density[4] estimation (KDE) in ArcGIS to identify crime and crash hot spots and create a layered shapefile (i.e., a map with layers) that showed hot spots where both gun crimes and traffic accidents were common. The technique used was as follows:

- Use the **Spatial Analyst Density** tool to create one kernel density raster layer[5] (each for crashes and for crimes).
  - » Provide appropriate parameters for the search radius and cell size. Typically, parameters used locally for crime density analysis are recommended—the RPD used a search radius of 1,000 square feet and a cell size of 50. To maintain consistency, these parameters should be the same for both crime and crash data layers.
- Apply a classification scheme[6] to each density raster and identify a "threshold" value for hot spots.
  - » Break the incident levels into five classes, using the **Natural Breaks** classification scheme option. Display only the highest two classes on the map. The RPD displayed crashes with a yellow to red color gradient, and showed gun crimes with a blue color gradient (see Figure 1).
  - » Consider the lowest value of the two classes displayed on the map a "threshold." Everything above the threshold is a hot spot, while everything below is not.

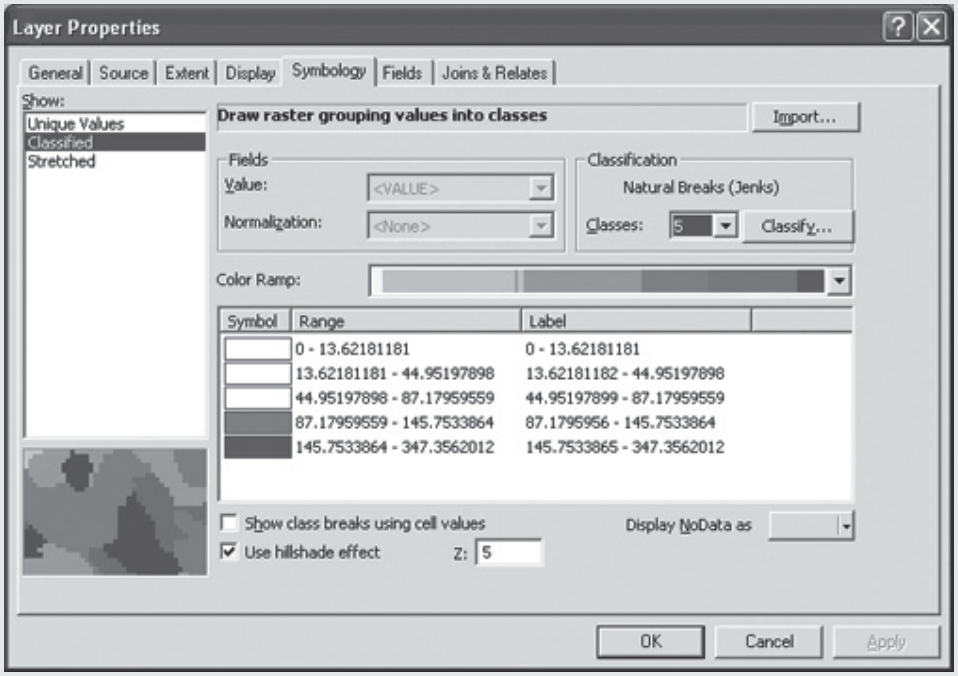

Figure 1. Classification scheme settings for the gun crimes kernel density layer.

- Use Spatial Analyst's **Raster Calculator** to create a "threshold" layer.
  - » Open the Spatial Analyst raster calculator and write a statement that identifies the threshold (e.g., "gun crime is greater than or equal to 489"). The calculator evaluates whether the statement is true or false for every cell in the layer. Areas identified as part of a hot spot are assigned a grid value of 1 (for true); all other cells in the raster layer have a grid value of 0 (for false).
  - » This layer may be saved to a temporary folder rather than with the rest of the main project files. Add this layer to the project when prompted.
- Use Spatial Analyst's Convert **Raster to Features** tool to turn the "threshold" raster layer into an ArcGIS shapefile.
- Use the **Select by Attributes** tool to select GRIDCODE = 1 from the shapefile created in the previous step. After this selection has been made, export the selected features into a new shapefile.
  - » This step produces the final hot spot shapefile, which will be used to identify common hot spots. The hot spots are selected from the converted calculation layer and exported to a new shapefile. The resulting layer includes only the hot spots themselves (see Figure 2).
- Complete all previous steps for both crash and crime data to create two final hot spot shapefiles.
- Use the **Intersect** tool to merge the newly created hot spot shapefiles into a single shapefile of common crash and crime hot spots. To accomplish this task:
  - » Open ArcToolbox.
  - » Open the **Intersect** tool, located in the "Analysis Tools" toolbox, in the "Overlay" toolset.
  - » Add both hot spot shapefiles and set the output location to where the project files are stored.

Figure 2. Example of a calculated raster layer.

Data Analysis and Product Development

Identifying common crash and crime hot spots is the first step of the process. Analysts must then translate their analytical results into tangible information that can help shape a DDACTS operational plan. Working with police commanders, analysts need to answer the following questions:

- Which hot spots should be targeted and why?
- How do the "blob" shapes of the hot spots line up with existing administrative boundaries?
- Where should resources be deployed? Where do the crimes and crashes occur?
- What types of crimes and crashes should police expect in the target area?

To answer these questions, analysts will first need to conduct statistical analysis of crime and crash data in each hot spot. To create the data necessary to conduct this analysis, analysts add the unique identification value[7] of each hot spot to every crime and crash that occurred inside it, using the **Spatial Join** tool in ArcGIS.

- Right-click each of the two layers (crime and crashes) in the table of contents and select "Join."
- In the resulting dialog box, select "Join data from another layer based on spatial location."
- In the first and second dropdown boxes, select the common hot spot layer.
- Select the first radio button in the next section of the dialog box, which will make it so that for any point inside a polygon, all data values[8] associated with the polygon are added to the point.
- Once the hot spot's unique identification value has been joined to each layer, export and open a .dbf of the data for analysis in Microsoft Excel.

Analysts should then conduct further analysis of the data in Microsoft Excel. Types of analysis might include:

- **Crime and crash counts per hot spot.** To compare the intensities of the hot spots, analysts can calculate a simple rate: the number of crimes or crashes divided by the area (in square feet).

- **Type of crime in a hot spot.** If officers know what crimes occur in a hot spot, they can develop appropriate tactics for patrolling and enforcement.
- **Temporal patterns.** If police leadership knows that crashes occur most frequently at a certain time of day or on a certain day of the week, they can align resources accordingly. Police leadership should also be aware of seasonal variation—for instance, although crime and violence often peak during the summer months, coverage by police personnel is often at its lowest during the summer because officers go on family vacations.

Providing Results to Officers

Charts and maps do an analyst no good if they do not clearly communicate findings to the person(s) responsible for acting on the information. Products provided to officers must give them general operational parameters and provide situational awareness regarding each area they are sent to patrol.

To clearly explain the data, analysts in Rochester created a detail sheet for each targeted area. The sheet included a map showing crime and crash hot spots, recent incidents, and problem intersections. It also included descriptions of:

- DDACTS goals
- Why the detail area (or hot spot) was identified
- The types of crime and crash problems in the area (e.g., DUIs, convenience store robberies)
- The most frequently occurring temporal patterns for crashes and crimes
- Violent gang activity in the area
- Parolees and probationers living in the area with a criminal history of gun violence
- Active warrants for persons with gun-related charges
- Locations officers should give special attention to, and why.

Conclusion

This article provides an overview of the considerations and methods necessary for an analyst to execute a successful DDACTS project. As agencies seek to improve effectiveness and efficiency through data-driven approaches, they will increasingly look to analysts for guidance and leadership. In offering a role that reaches beyond "just analysis," the DDACTS model offers analysts an opportunity to be more directly involved in strategic planning and delivering effective results to the community.

Notes

[1]To find the state department of transportation web sites for any state, go to: www.bts.gov/external_links/government/state/department_of_transportation.html.

[2]MPOs coordinate and plan large-scale transportation infrastructure projects for metropolitan regions. Links to MPOs are available at: www.bts.gov/external_links/government/metropolitan_planning_organizations.html.

[3]For more information on ArcGIS software and the Spatial Analyst extension, visit www.esri.com/software/arcgis/arcview/index.html.

[4]KDE is a statistical method used to identify concentrations of a variable (gun crimes, traffic accidents) over a continuous geographic surface. KDE is the most commonly used method for hot spot identification.

[5]The product of the Spatial Analyst Density tool is a raster layer, which displays hot spots. Raster layers are analogous to digital photographs in that they consist of cells or pixels, in contrast to Vector data, which consist of points, lines, or polygons.

[6]Classification schemes allow analysts to categorize data values into ranges. For more information on classification schemes, see webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=Standard_classification_schemes.

[7]A unique identification value (usually named ID, OID, or FID in a data table) is a numeric value that is automatically assigned to each individual hot spot polygon.

[8]Attribute data is any descriptive data about a location that is stored within the table of a shapefile.

South Carolina Meeting Teaches New Approach to Traffic Safety

New law enforcement strategies in South Carolina may change police approaches to traffic enforcement.

More than 100 law enforcement agencies gathered in Columbia, South Carolina, in January 2010 to learn about a program that tracks crime and traffic collisions and determines where law enforcement will be most effective. The program, called Data-Driven Approaches to Crime and Traffic Safety (DDACTS), advocates that high-visibility traffic enforcement in local hot spots can reduce crime and crashes in a community.

"Crimes often involve the use of motor vehicles, so incorporating DDACTS could be a low-cost commonsense approach to improving the quality of life in our communities," said Mark Keep, director of the South Carolina Department of Public Safety. "We've long used data to track traffic problems; that's why I'm confident a data-driven approach to crime prevention can be just as successful for law enforcement agencies."

Organizers hope that as a result of the January meeting, agencies will be better educated on how to make data-driven changes to law enforcement strategies that will improve safety in South Carolina communities.

Rochester's DDACTS Initiative Takes Guns Off the Streets

Law enforcement in Rochester, New York, will use increased traffic patrols to stop violent crime in some of the city's most dangerous areas.

The Rochester Police Department (RPD) recently became part of the Data-Driven Approaches to Crime and Traffic Safety Initiative, a program that Police Chief David Moore says may put Rochester on the cutting edge of traffic crash and crime prevention.

Patrol units in Rochester will target two long-term hot spots on the east and west sides of the city, both of which have a 70 percent higher rate of violent crime than other areas in the city. Their hope is that routine traffic stops will help catch offenders carrying guns or those who might commit serious traffic violations, like driving while intoxicated.

Moore told local cable news channel YNNRochester that the RPD considers its greatest successes the ones where they can stop criminals before they act. He said, "Being out there gives us an opportunity not only to prevent crime but also by chance getting an opportunity to catch that person who's coming to and from an area where we're experiencing high crime."

The agency will share effective strategies with the National Highway Traffic Safety Administration and the Governor's Traffic Safety Committee.

Traffic Safety and Anti-Crime Initiative Keeps Roads Safe in Indiana

Using data-based strategies has led to increased calls for service and traffic enforcement in Greensburg, Indiana.

According to department analysts, the Greensburg Police Department received 12,862 calls for service in 2009, a 4.2 percent increase from 2008. Local police officers also made 2,774 traffic stops last year, an increase of 162.1 percent from 2008. Traffic citations increased by 80.6 percent, and arrests from traffic stops increased 25.4 percent.

These increases are a result of the department's application of the Data-Driven Approaches to Crime and Traffic Safety Initiative (DDACTS). Using DDACTS, the department has taken a proactive approach to traffic safety, analyzing local data to direct the department's daily operations.

"Being proactive with traffic enforcement and using the DDACTS method in our daily operations proved to be very effective," Greensburg Police Chief Brian Heaton told the *Greensburg Daily News.* "Police cars out on the streets and officers being visible are the key to this success. The department did a tremendous job with this in 2009. We will continue the same approach and look for more ways to improve in 2010."

Washoe County Police Target Local Hot Spot

Statistically driven policing strategies in Washoe County, Nevada, may reduce theft and burglaries in the area.

On May 26, 2009, the Washoe County Sheriff's Department began increasing patrols to the Sun Valley Boulevard, a local hot spot for crime, as part of a national safety program called the Data-Driven Approaches to Crime and Traffic Safety (DDACTS) initiative. The boulevard was selected after the department reviewed crime and traffic reports from May 2006 to May 2009 and determined that the area would benefit from increased police attention. During that time, Sun Valley Boulevard experienced 345 residential burglaries, 231 vehicle burglaries, and 202 auto thefts.

Police officers say the increased patrols started making a difference in driver behavior within the first week. On May 28, 2009, Sergeant Michael Gross told mynews4.com, "Yesterday, lots and lots of traffic stops. Today, there has already been a huge behavior change in drivers' behavior, a really noticeable change. Hopefully, it's going to have a lasting impact."

DDACTS Lowers Rochester's Crime Rates in 2009

In 2009, major crimes decreased to the lowest reported levels in 25 years in Rochester, New York. The results can be partly attributed to Rochester's participation in the Data-Driven Approaches for Crime and Traffic Safety (DDACTS) program, which uses geographic mapping and statistical analysis to highlight community locations that need increased patrols or other resources.

The city of Rochester observed a number of decreased crime rates, including:

- A 36 percent decrease in homicides from 2008
- The lowest number of motor vehicle thefts in 25 years
- Decreases in robberies and aggravated assaults from 2008.

Rochester's Police Chief David Moore commented on these changes to the *Democrat and Chronicle,* saying, "This is very encouraging. We have a plan, a long-term strategy that is working." Rochester will continue to work with DDACTS strategies in 2010.

Lafourche Parish Police Keep Drivers Safe

A crime and traffic safety program, called Data-Driven Approaches to Crime and Traffic Safety, in Lafourche Parish, Louisiana, is showing remarkable results.

In 2009, the Lafourche Parish Sheriff's Office set up traffic checkpoints in traffic hot spots across the community. Increased patrols in these hot spots helped augment safety measures in the parish. Fatal crashes dropped to 10 in 2009 compared to 27 in 2008; injury crashed dropped to 643 in 2009 compared to 747 in 2008 (a 16 percent decline), and non-injury crashes dropped to 1,971 in 2009 compared to 2,161 in 2008 (a 9 percent decline). Officers in the parish also increased arrests for driving under the influence from 150 in 2008 to 297 in 2009.

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