TECHNOLOGY FUELS NEW ADVANCES AND CHALLENGES IN PREDICTIVE POLICING

WHITE PAPER

CLEAR
March 2013
Policing is experiencing a revolution. Technology is driving dramatic changes throughout the world of law enforcement, from neighborhood police precincts to national security agencies. Technology is giving law enforcement the ability to increase their efficiency and effectiveness by reaching more broadly and drilling more deeply into the crime world. New technology, combined with community policing practices, offers law enforcement greater opportunities to identify crime hot spots based on past and real-time data and the opportunity to develop predictive models that forecast the potential for criminal situations, from large riots to fraud rings.

In this white paper by Thomson Reuters, we explore the growth and acceptance of predictive policing methodology and the use of technology in forecasting and investigating crime.
THE FUTURE IS NOW

Crime has not changed. Where there is a will to take objects of value, and people who can be taken advantage of, criminals continue to commit acts of fraud, extortion, theft, trafficking, and terrorism.

But what has changed is how those crimes are being committed, and...how those crimes are being identified and investigated.

Where yesterday’s criminals relied on guns, knives and threats of physical harm, tomorrow’s criminals are likely to be more effective in spreading fear or stealing millions by simply sitting behind a laptop computer at their kitchen table or operating from a coffee shop while using their mobile phone or tablet.

Pointing out the rise of high-tech criminals, Robert S. Mueller, III, Director of the Federal Bureau of Investigation (FBI), noted in an address to the RSA Cyber Security Conference in March 2012, “While terrorism remains the FBI’s top priority, in the not too distant future, we anticipate that the cyber threat will pose the number one threat to our country.”

Mueller added, “We must continue to build our collective capabilities to fight the cyber threat. We must share information. We must work together to safeguard our property, our privacy, our ideas and our innovation. We must use our connectivity to stop those who seek to do us harm.”

Fighting fire with fire has meant adding high-tech teams to law enforcement agencies and investing in a range of new technologies, from sophisticated mapping technology that can help police forecast hotspots of criminal activity, to software platforms that delve deep into the public records of a person of interest, to powerful computing systems that allow police to sift through mountains of video data.
This has meant exploring new approaches to policing. Taking a cue from major retailers and financial services companies that have tapped the power of data analysis to predict consumer purchasing behavior, law enforcement agencies are using data analysis to arm themselves with information that allows them to “anticipate, prevent and respond more effectively to future crime,” according to the National Institute of Justice, as reported in the *NIJ Journal*, June 2010.

This new approach to policing is called Predictive Policing, a concept coined by the Los Angeles Police Department. Charles Beck, Chief of the Los Angeles Police Department, wrote in the November 2009 edition of *Police Chief* magazine, “The predictive policing vision moves law enforcement from focusing on what happened to focusing on what will happen and how to effectively deploy resources in front of crime, thereby changing outcomes.”
Attempting to predict where crime may occur has been part of the policing methodology for decades. Police departments could predict, simply by looking at spikes in arrest records for previous years, when and where certain types of crimes may occur at given points throughout the coming year and put extra police officers in place. For instance, creating a road check on a specific route on New Year’s Eve to thwart DUIs is an example of basic predictive policing.

Powerful data analytics combined with more computing power offer law enforcement personnel greater capabilities to fight more sophisticated criminals, as well as the opportunity to enhance public safety.

While some within the law enforcement community debate about whether predictive policing is actually a new model, arguing that it simply means doing policing more quickly, the reality is that greater reliance on new technologies is profoundly shaping how law enforcement embraces a growing, information-intense age of policing that is forcing departments to rethink how they collect, organize and act upon data.

Along these lines, in a budget-conscious age, the emerging predictive policing model also is forcing discussions about how to invest limited resources. More computer servers or more sworn personnel? More bullet-proof vests or more data analytic training? These are just a couple of the questions being raised as the use of technology and data analytics goes mainstream in today’s police departments.
DATA FUSING

Gathering information to get an edge on the bad guys has always been at the heart of policing. But in a world where predictive policing offers the opportunity to transform how law enforcement professionals do their jobs, fusing data – lots of data – from multiple sources in multiple formats and attempting to make sense of it, is critical.

If that sounds complex, well, it is, according to Ravi Gupta, Chief Technology Officer of enkidu7, a consulting firm based in Alexandria, Va., that offers data analytics and modeling to law enforcement agencies.

Gupta is cautious about using the phrase “predictive” as it relates to law enforcement. He prefers “forecasting” instead. That’s because Gupta believes “human behavior is very complex and it’s difficult to predict when or where a riot, a murder or a car theft will occur.”

Forecasting, says Gupta, gives law enforcement professionals the opportunity to create a plan in anticipation of a situation that may produce criminal activity, such as a riot, and it allows police to better prepare themselves to gather more information such as evidence or details to broaden and deepen an ongoing investigation. Being in a better position to collect more data can be vital to obtaining deeper, more insightful understanding about criminal patterns as well as to increase the accuracy of evidence.

But technology can be a double-edged sword; while it allows criminals to be a lot more efficient and effective in their efforts, such as stealing tens of thousands of dollars from Medicaid or Medicare within hours, technology also has a way of leaving a sometimes imperceptible trail upon which law enforcement can build a predictive model or forecast.
“Everyone leaves a forensic trail,” says Inspector Les Yeo, of the Vancouver (British Columbia) Police Department, who gained prominence for leading a team that used high-tech methods to track down hundreds of people who committed crimes during a 2011 riot following the Stanley Cup Finals. “If you’re online, you’re leaving a trail. If you walk through a city, video cameras are observing you, creating a trail. If you use your cell phone, there’s a record of your calls and texts. When you use your credit card, your financial transactions are documented.”

The challenge is learning how to process large volumes of data from multiple sources into meaningful data – and fusing all of it together into a useful, accessible format upon which to plan and act, says Yeo.
When it became clear that the seventh game of the 2011 Stanley Cup Finals between the Vancouver Canucks and the Boston Bruins would determine the NHL champion, the Vancouver Police Department put a number of precautionary measures in place in the event that a riot might break out. And, with good reason. While the Vancouver Police Department didn’t predict a riot for that evening, the last time the Canucks were in the Stanley Cup Finals in 1994, a riot broke out in downtown Vancouver when the Canucks lost to the New York Rangers. In that riot, the Vancouver Police Department analyzed more than 100 hours of VHS-format videotape to identify possible law breakers, which took more than a week.

When the Canucks lost 4-0 to the Bruins in the final game, fan frustration erupted into a full-fledge riot. An estimated 100,000 people were in the 12-block downtown core of Vancouver while the three-hour melee took place. While police officers sought to quell the riot, forensics analysts were rapidly gathering video and images from multiple sources, including social media platforms such as Facebook and dozens of video cameras stationed throughout the city.

**VANCOUVER RIOT STATISTICS: 1994 vs. 2011**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>NUMBER OF PEOPLE IN RIOT AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>60,000</td>
</tr>
<tr>
<td>2011</td>
<td>100,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR</th>
<th>VIDEO EVIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>100 hours of video in VHS format</td>
</tr>
<tr>
<td>2011</td>
<td>6,000 hours of video in dozens of formats</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR</th>
<th>TIME TO PROCESS VIDEO EVIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>1 week</td>
</tr>
<tr>
<td>2011</td>
<td>2 weeks (initial processing)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR</th>
<th>CHARGES RECOMMENDED</th>
</tr>
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<tbody>
<tr>
<td>1994</td>
<td>About 100</td>
</tr>
<tr>
<td>2011</td>
<td>1,045 charges against 315 persons (184 currently charged)</td>
</tr>
</tbody>
</table>
Following the riot, the Vancouver Police Department had collected more than 6,000 hours of video (recording at an average of 29 images per second) and other photographic images in multiple formats. To process this incredible volume of data, the Vancouver Police Department sought the help of the Law Enforcement and Emergency Services Video Association (LEVA) lab housed at the University of Indianapolis. Using the lab’s Omnivore System, the data was reconfigured into one digital format allowing investigators to digitally tag riot participants who engaged in criminal behavior, such as looting or property damage.

For example, during one part of the riot, Yeo says, 500 people entered a drugstore and looted it. Every person was tagged, and then the Vancouver Police Department proceeded to use social media, including Facebook and Google, and a specially designed website, riot2011.vpd.ca, to identify individuals involved in riot incidents. To date, the website has received more than 1.8 million visits, and so far, 1,043 charges against 315 suspects have been recommended.

As part of the investigation, the Vancouver Police Department beefed up its computing power by purchasing eight additional interlinked forensic computer workstations to enhance its efforts to investigate future incidents.

“One of the upsides of publicly demonstrating our ability to embrace advanced technology in our work,” says Inspector Yeo, “is that it serves as a deterrent to those thinking about committing criminal acts in the future. They know we’re watching and that we have the technology to go after them.”
COMPLEMENTING PROVEN POLICING MODELS

In his role as senior director of Investigative Resources for Thomson Reuters, Daniel DeSimone, who served with the FBI for more than 20 years, says data analytic tools give police investigators unparalleled technological power in comparison to the tools they had to work with just 10 years ago. Even with all of these advances, he says, technology can’t replace the policing experience. But it does offer the opportunity to enhance the instincts of even the most seasoned sworn law professional.

“When I started with the FBI back in the 1980s, we would meet every morning to share threads of information with other FBI agents,” DeSimone says. “Today, the technology available at the fingertips of our agents is light years ahead of what we were doing back then.”

EMBRACING POLICING TECHNOLOGIES

<table>
<thead>
<tr>
<th>TECHNOLOGY</th>
<th>PERCENTAGE</th>
</tr>
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<tbody>
<tr>
<td>Predictive Policing</td>
<td>70%</td>
</tr>
<tr>
<td>In-Car Video Recording</td>
<td>71%</td>
</tr>
<tr>
<td>In-Car Video Recording in All Vehicles</td>
<td>25%</td>
</tr>
<tr>
<td>Wireless Video Streaming</td>
<td>46%</td>
</tr>
<tr>
<td>License Plate Readers</td>
<td>71%</td>
</tr>
<tr>
<td>GPS to track suspects</td>
<td>83%</td>
</tr>
<tr>
<td>GPS to track police vehicles</td>
<td>69%</td>
</tr>
<tr>
<td>Social Media to disseminate information</td>
<td>83%</td>
</tr>
<tr>
<td>Social Media to receive information</td>
<td>70%</td>
</tr>
</tbody>
</table>

SOURCE: “How Are Innovations in Technology Transforming Policing”
Police Executive Research Forum, January 2012
Technology Fuels Predictive Policing

New technology allows police investigators to harness information that is often right in plain sight, such as public records of a person of interest. Threads of information can be found in minutes and linked with other threads for greater context, credibility and investigative momentum, instead of days searching through boxes of county courthouse records.

As DeSimone points out, data tools allow police investigators not only to piece more threads of information together faster, but to more quickly see information that’s not there, or to see abnormal patterns.

From the perception of a former FBI agent, the value of having more data is that it can be critical in developing a plan to approach a person of interest in an investigation.

“If you’re going to approach a suspect, knowing as much as possible about them is crucial,” says DeSimone. “It can make all the difference in the direction and momentum of your investigation. Technology is making this much easier, and criminals are putting their information in our hands via social networking sites and online communities.”
DEVELOPING NEW TECHNOLOGIES

Intelligent software platforms represent just one component of the new wave of technology that law enforcement officials are leveraging to build predictive models and to gather more accurate data.

Tapping the power of artificial intelligence and social media technology to develop new crime forecasting models, Gupta’s firm, enkidu7, studies criminal behaviors through simulations in virtual environments, which in turn allows models to be created to forecast real-life criminal behavior.

For example, enkidu7 wanted to build a forecasting model for law enforcement officials to help anticipate criminal behavior in a riot situation. Using proprietary artificial intelligence technology, the company developed a model highlighting key trigger points leading up to a riot, during the riot itself, when police were introduced to the riot situation, and post-riot, when groups of individuals dissipated. With this model, law enforcement can gain a better understanding of behavior to observe within the community in the days leading up to a major event that offers higher than normal potential to spawn a riot, such as a sporting event, a controversial court decision or an event that attracts international leaders.

While the technology isn’t at a level to forecast criminal behavior six months out, it’s powerful enough says Gupta, co-author of the book Using Social Media for Global Security, to forecast behavior within days and sometimes even hours, allowing law enforcement the opportunity to ready itself to gather real-life intelligence and deploy resources.

“The real gold mine is learning how to make sense of all this unstructured data,” says Gupta. “Knowing where to look is
the first step. For example, if we want to forecast the illegal hacking of a corporate or government website, we know that one place to look is deep inside the hacking community where bets are often placed between hackers on website targets. It’s learning to decipher the signals within all of the noise that leads us to potential criminal behavior.”

Beyond enkidu7’s studies in predictive policing, law enforcement agencies across the U.S., Canada and the United Kingdom are experimenting with a variety of new technologies, such as the following:

• “The Foothill Division, a precinct within Los Angeles, uses software by PredPol, based on computer science and anthropological research conducted by Santa Clara University and UCLA,” which pinpoints hotspots within the city for property crimes, such as burglary, according to David Talbot in an article published by the *MIT Technology Review* (July 2, 2012). The precinct schedules police patrols based on hotspots identified by the software, which takes into account previous property crimes.
• The Carlsbad (Calif.) Police Department uses the new FARO Laser Scanner 3D system, which takes photos of crime scenes in 360 degrees, according to a news report by the San Diego Union-Tribune (Jan. 7, 2013). The imagery allows a jury to view a crime scene almost as if they’re actually there. The new technology can save a police department hours of documenting and measuring a crime scene, and it provides police a digital record upon which they may be able to compare the crime scenes of similar types of crimes.

• The Albany (N.Y.) Police Department has installed laptops in patrol cars and implemented an e-reporting system where officers enter data at a crime scene that is then analyzed in real time by crime analysts. The department also purchased a mobile watchtower, which provides video surveillance in high-crime areas, according to South Source.

• The Washington, D.C., Metropolitan Police Department has placed monitors and sensors across the city to listen for gun shots, according to South Source. The gunshot sound is analyzed in real time by software called Shot Shooter to detect where a shot was fired based on “the actual gunshot sound and the echoes that occur afterward.”
Technology Fuels Predictive Policing

THE FUTURE OF PREDICTIVE POLICING

In the years to come, the use of technology by law enforcement agencies, like the use of technology in major corporations, must face the process of optimization. Technology advances in and of themselves do not guarantee continued improvement. In the corporate world, e-commerce and data analytics exist to generate more sales, enhance profitability and minimize risks. Likewise, in the law enforcement agency, the growing use of technology must be tied directly to the agency’s goals, strategies and operations.

“The ability to anticipate or predict crime provides the unique opportunity to change public safety outcomes and enhance the quality of life within a community.”

“Advanced analytics are used in almost every segment of society to improve service and optimize resources with the overall goal of enhancing customer loyalty,” writes Charles Beck, Chief of the Los Angeles Police Department, and Colleen McCue, President and CEO of MC2 Solutions, in their November 2009 Police Chief magazine article, “Predictive Policing: What Can We Learn from Walmart and Amazon about Fighting Crime in a Recession?”. 
“The technology available to us today has revolutionized the way we do investigations,” adds Inspector Yeo. “However, things are changing so quickly in the world of technology that it’s really essential for police investigators to keep up with the technology.”

Gupta believes the future of predictive policing will be challenging. As more data becomes available, Gupta says the greatest challenge will not be computing power, but understanding what to ask the computers.”

That’s where the intuition of a career police officer will be important, Gupta says. “Gut instincts will still be critical in the new age of policing, but technology can play a key role in confirming those instincts.
“There’s something quirky about people, the way they think and their behavior that computers will never be able to replicate,” Gupta says.

“What may be the greatest challenge facing predictive policing is the law itself, adds Desimone.

“Today’s investigation technology is advancing so quickly that in some cases, the law is having difficulty keeping up,” DeSimone says. “The good news is that technology is making it safer for police investigators, it’s making it more cost-efficient for police departments, and most importantly, we’re able to get to the criminals faster.”

As investigation technology continues to advance, and as law enforcement agencies continue to embrace and incorporate technology into their day-to-day policing strategies, more challenges and opportunities await the law enforcement community. These challenges span a range of issues, from simply budgeting for predictive policing technology to weighing the costs between technology and human resources, to balancing public
perceptions involving privacy and engagement in the community. Because law enforcement technology is dynamic and fluid, law enforcement officials will need to forecast the benefits and consequences of technology several years out (based on the upfront costs of the investment) in anticipation of issues such as these:

- **More Training.** To increase their effectiveness, police departments need to invest as much or more into training investigators in the art and science of using technology to predict and investigate criminal behavior as in the technology itself. According to the High Technology Crime Investigation Association (2011 Report on Cyber Crime Investigation), many law enforcement professionals report being undertrained or hampered in their learning due to budget constraints.

- **Balancing Crime Prevention with Privacy.** Law enforcement officials are guided by the principle of investigating persons of interest based on the concept of “probable cause.” In a new age of rapidly changing technology, where the actions and whereabouts of just about anyone can be tracked and examined without the knowledge of the person of interest, law enforcement officials will face new levels of legal and ethical challenges in the use of selected technologies. For instance, in January 2012, the Supreme Court unanimously ruled that police violated the Fourth Amendment (ban on unreasonable searches) when they placed a GPS tracking device on a suspect’s car and monitored its movements for 28 days in an investigation of a cocaine-selling operation.
• **Weighing the Costs of New Technology vs. Boots on the Ground.** Increasingly, law enforcement agencies may be forced to prioritize technology investments versus investments in full- and part-time sworn personnel as well as their ongoing development. Politically, state-, county- and city-elected officials may face pressure from various quarters about what offers greater value – adding sworn personnel or buying more computing power.

• **Struggling with Too Much Data.** As technology continues to advance, law enforcement agencies may not be able to invest fast enough to maintain the processing power needed to sort through mountains of data available on the Internet and through numerous other sources. In light of budget constraints, law enforcement agencies may be forced to prioritize the value of certain data, which will require strategic planning on the part of law enforcement leaders.

• **Public Perception of Relying Too Much on Technology.** At the heart of the Community Policing Model is the concept that police officers gain insight and knowledge to reduce crime in a specific area by being seen, and by engaging in a dialogue with the local neighborhood. The temptation of technology is that sworn personnel spend more time behind a laptop (at a desk or in a squad car) and don’t engage as much as they could. As a result, this may create a backlash within a community that demands to see more of its police officers working the streets.
MILESTONES IN POLICE TECHNOLOGY

1854-59 – The San Francisco Police Department becomes one of the first police departments to create a system of photography (i.e., the mug shot) to identify criminals. (Source: Mary Bellis, About.com Inventors)

1878 — The precinct houses of the Washington D.C. police department become the first to install telephones. (Source: Mary Bellis, About.com Inventors)

1901 — Nine years after the first crime is solved with fingerprints, Scotland Yard established a fingerprint classification system developed by Sir Edward Richard Henry. (Source: Mary Bellis, About.com Inventors)

1923 — The L.A.P.D. launches the first police department crime lab in the United States, 13 years after the first crime laboratory is established in Lyon, France. (Source: Mary Bellis, About.com Inventors)

1934 — The Boston Police Department becomes first police department to use the two-way radio. (Source: Mary Bellis, About.com Inventors)

1968 — AT&T announces the launch of 911 for emergency phone calls to police and fire. (Source: Mary Bellis, About.com Inventors)


1962 — The police department of Olean, N.Y., becomes the first police department to use video surveillance cameras to prevent crime. (source: Christopher Godwin, eHow.com)
1990 — The Vancouver Police Department becomes the first police department in the world to use geographic profiling to investigate a crime, invented by Inspector Kim Rossmo. (Source: Environmental Criminology Research Inc.)

1992 — Database Technologies formed creating first online public records system for investigative use.

1999 — The U.S. Justice Department launches CrimeStat, the first spatial and statistical analysis software system for crime investigation.

2002 — *Minority Report,* the blockbuster movie starring Hollywood superstar Tom Cruise, explores the dark world of predictive policing in the future. The movie is based on the 1956 science fiction novel by Philip K. Dick.

2007 — Launch of SpotCrime.com, a website that provides nationwide tracking of crime (assaults, burglary, vandalism, etc.) based on Google mapping technology.

2009 — U.S. Justice Department hosts symposium, awards grants, and forms group to support growth of predicting policing.


Dec. 2011 — First known arrests of U.S. citizens based on the use of the Predator B drone by the Nelson County (N.D.) Sheriff’s Department. Three men were arrested for cow theft. (Source: Los Angeles Times)
Technology Fuels Predictive Policing

SOURCES

Interview, Inspector Les Yeo, Vancouver Police Department (British Columbia), January 2013.

“Criminals Beware: Police Go High-Tech to Fight Crime,” Jerpi, Laura, South Source (South University), January 2013.

Interview, Dan DeSimone, senior director, Investigative Resources, Thomson Reuters, December 2012.

Interview, Ravi Gupta, Chief Technology Officer, enkidu7, December 2012.


“Predictive Policing: What Can We Learn from Walmart and Amazon about Fighting Crime in a Recession?,” Police Chief magazine, November 2009.
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