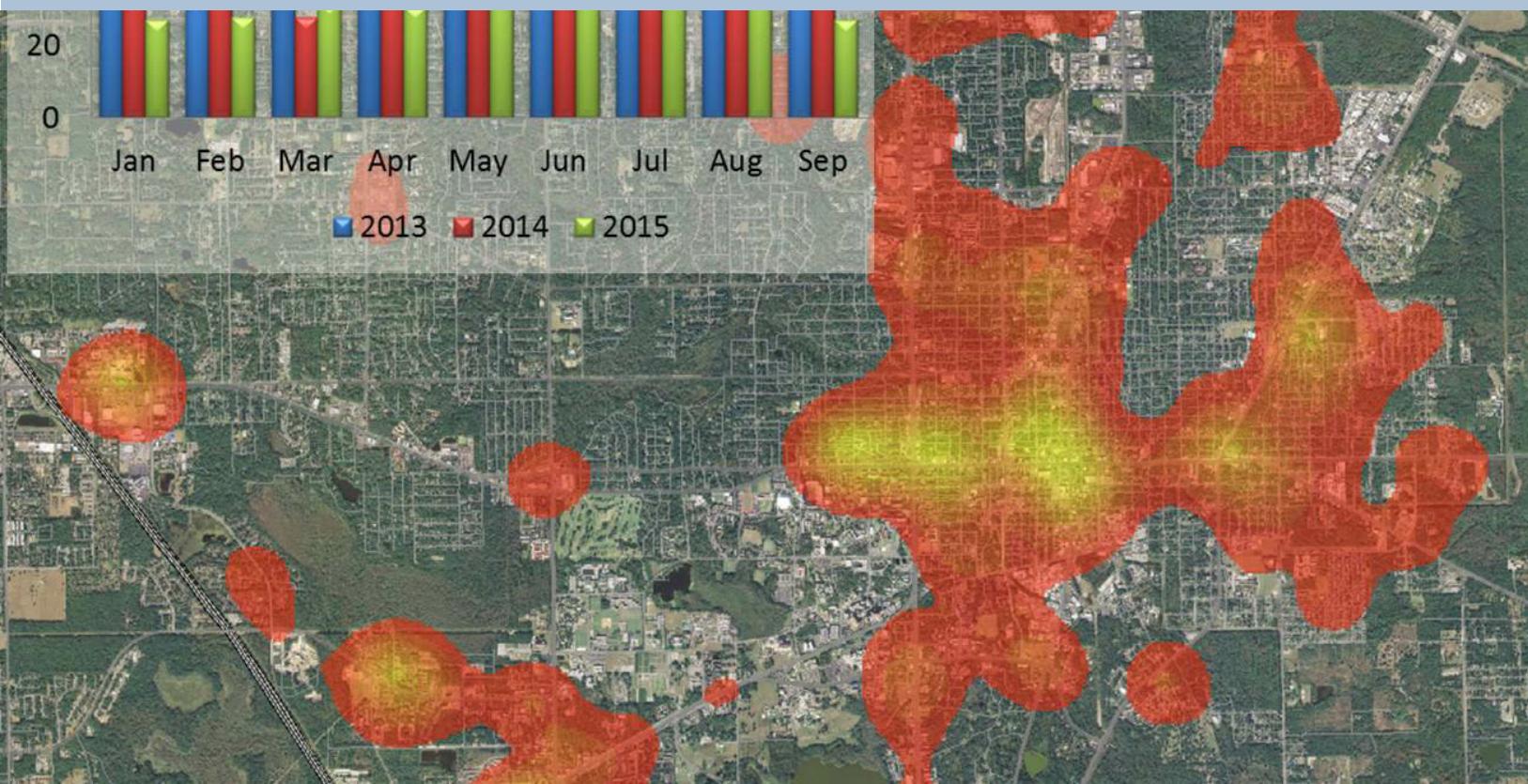


Crime Mapping & Analysis News

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Issue 4: Fall 2015



Front cover art provided by Shefali Tripathi, Gainesville Police Department, FL.

Mapping Smoking Violations on a College Campus: Implications for Prevention

The Importance of *Places*

A Case Study on License Plate Recognition (LPR): Coral Springs Police Department

Lumen: Leveraging Unstructured Data to Enhance Crime Analysis



Editor's Note

Greetings everyone! Welcome to the fall issue of the Crime Mapping & Analysis News.

Our fall issue explores practical examples of the use of crime mapping to prevent on-campus smoking problems. This issue features an article on Crime Prevention through Environmental Design (CPTED) that discusses the role and significance of CPTED in crime analysis and crime mapping. Also included in this issue is an article on License Plate Recognition (LPR) technology; and a brief summary of latest software and resources available in crime analysis and crime mapping for utilizing the vast unstructured data associated with case narratives. The articles included in this issue are:

- Mapping Smoking Violations on a College Campus: Implications for Prevention
- The Importance of Places
- A Case Study on License Plate Recognition (LPR): Coral Springs Police Department
- Lumen: Leveraging Unstructured Data to Enhance Crime Analysis

I hope you will find this issue interesting. I am always looking for articles on innovations and practical examples of the use of crime analysis and crime mapping in policing to include in the newsletter. I would like to call all professionals working in the area of crime analysis and crime mapping to share your work with your colleagues. Please visit our website for submission guidelines: <http://crimemapping.info/submit/>.

I would like to thank our authors for their articles, and also our editorial team for publishing this excellent issue. As always, we welcome your comments and suggestions. You may reach us at editors@policefoundation.org.

Sincerely,

Shefali Tripathi, Editor-in-Chief

Note from IACA President

Greetings Colleagues –

This is a very exciting and busy time for the International Association of Crime Analysts (IACA). Our first conference ever was held in Denver, Colorado. This year we are celebrating our 25th anniversary, where we returned to Denver for our 2015 Annual Training Conference, September 19-23, 2015. It was a fantastic success, with just over 480 attendees from all over the world. Members from Austria, Belize, Canada, Chile, Columbia, Hong Kong, The Netherlands, Switzerland, Trinidad and Tobago, U.S. Virgin Islands, and the United Kingdom all traveled to attend the conference.

The conference committee members are in the early planning stages for the 2016 Annual Training Conference to be held in Louisville, Kentucky, September 20-23; pre-conference training on September 19, 2016.

The IACA will again be participating in the International Association of Chiefs of Police (IACP) Conference in Chicago, Illinois, October 24-27, 2015. The IACA will be set up as part of the vendor exposition and will have a group of IACA members at the booth to interact with attendees and to impress the importance of the profession of crime analysis. Each year, the number of chiefs and executives that want to talk about how they can use crime analysis to be more efficient and effective in their respective agencies and countries has increased.

IACA elections for the new executive board came to a close on October 1, 2015. The results of the election will come from the Elections Committee Chair Sheila Hargis on November 10, 2015. The newly elected board will take office January 1, 2016, and with it means the continuation of current projects, along with new ideas and new projects. The IACA plans to continue its partnership with the Police Foundation and believes the next administration will be able to continue the success we have had and launch new projects and develop innovative ideas to encourage continued efforts between the Police Foundation and the International Association of Crime Analysts. The transition between the current board and the incoming board will begin prior to January 2016.

We are seeing many innovative ideas, new approaches to crime analysis, and new partnerships. This is a very exciting time for all!

Speaking as the president from this administration, we would like to thank you all for the support you've offered and it has been a great experience working with the Police Foundation.

Sincerely,

Carolyn Cassidy, President
International Association of Crime Analysts

Mapping Smoking Violations on a College Campus: Implications for Prevention

By Steven Pires and Ronald Belance

College campus police departments face a number of crime problems that are uniquely common to campus environments. Apart from the typical crimes faced by many communities, such as larceny-theft, campus police departments are more likely to respond to alcohol-related problems (Sloan et al., 2000), such as underage drinking and drunk driving, as well as assaults, sexual assaults, and rape. Such problems often consume many of their resources, particularly at nighttime. Recent research has begun to use GIS to map the relationship between alcohol outlets and unwanted behavior in college communities, such as car accidents, violence (Rich, 1999; Gruenewald et al., 1996), and overall crime (Nobles et al., 2010, Lugo, 2008; Brownell & Carroll, 2007). Such geographic analysis has been able to illustrate how problems cluster in space and time, which can aid campus police departments in preventing such incidents in or around campuses through proactive policing and other policy changes.

GIS-based research used to reduce serious crime can also be applied to other on-campus prohibited behavior. A newer problem facing campus police departments is smoking violations as a result of new policies banning outdoor smoking. Over 1,000 college campuses in the United States have implemented total smoking

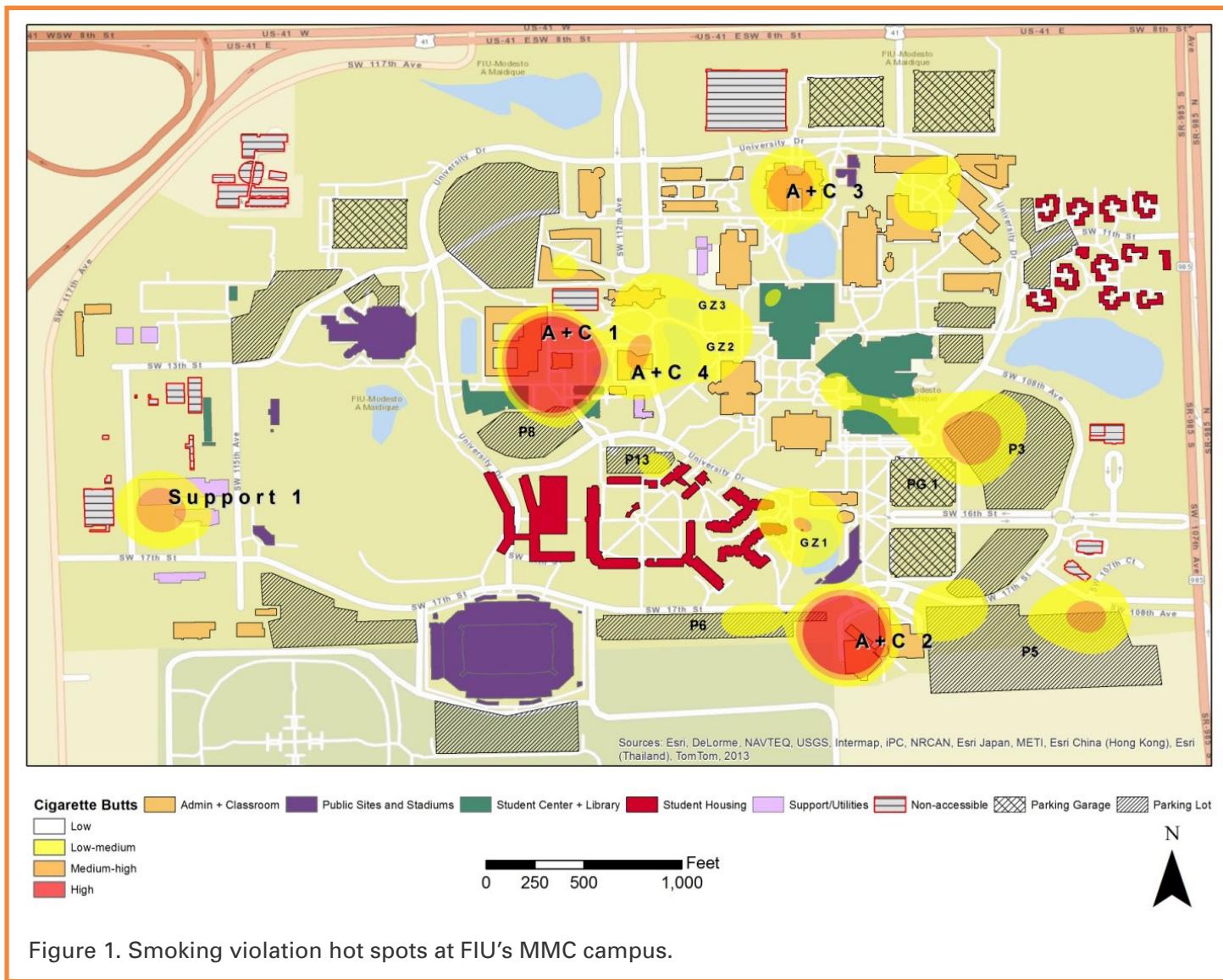
bans as of 2014 (American Nonsmokers' Rights Foundation, 2014), and many others have implemented some form of partial smoking bans where individuals can only smoke in sanctioned areas on campus. This surge of campus smoking bans is a result of the current anti-smoking sentiment. This anti-public smoking trend has rapidly grown over the past two decades and is aimed at reducing smoking prevalence and incidences along with protecting individuals from secondary smoke (Garg et al., 2009).

Research thus far has been mixed on whether smoking bans on colleges work (Gerson et al., 2013; Ohmi et al., 2013; Seo et al., 2011; Borders et al., 2005). Many argue that the lack of enforcement (Fennell, 2014; Procter-Scherdtel & Collins, 2013; Baillie et al., 2011) and awareness (Amerando et al., 2010) have been impediments to reducing smoking on campuses. Enforcement is typically administered by campus police or by university administrators. Colleges can impose fines for violating campus smoking protocol. Campus police also can take a less controversial approach and issue warnings that lead to free consultations on quitting smoking.

If police were tasked with the problem on college campuses, and took it seriously, they would want to use their limited resources efficiently and effectively. One such way is to

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implement hotspots policing to target areas where smoking disproportionately occurs. The assumption that smoking violations will be concentrated in space (and time) like any other crime rests on two premises. The first is that individuals on campuses will disproportionately spend time in certain areas thereby increasing the likelihood of smoking violations in such areas. The second premise is based on a recent study that interviewed non-compliant smokers on campuses and found the location of smoking violations were largely determined by convenience (Russette et al.,

2014). Convenience for smoking may be manifested in areas where there's comfortable seating, dining options, outside classroom buildings, or generally where students congregate.

To measure where smoking violations occur on a tobacco- and smoke-free campus, we decided that the best way was to use a GPS device to collect geo-coordinates of discarded cigarette butts as a proxy for smoking incidents. The co-author on this paper collected the data over an entire day at Florida International University's (FIU) main campus in Miami, FL,

(MMC), and then uploaded the data to ArcGIS. From there, he created a kernel-density hotspot map to examine whether spatial concentrations on FIU's MMC campus existed.

The spatial concentrations of 1,007 cigarette violations on campus, shown in Figure 1, revealed notable hotspots. Two of the largest hotspots on campus were near the administrative and classroom building 1 (A+C 1) by the center of MMC and the administrative and classroom building 2(A+C 2) on the southeast end of MMC. The A+C 1 hotspot ($n=144$) was located near a golf cart holding area in a crevice between the building wall and the carts. Because these carts are primarily used by university staff, this may be an indication that perhaps smoking violations are committed by both students and staff. The second largest hotspot ($n=106$) located by A+C 2, concentrated at the WPAC was found in an ashtray by the side entrance of the building. Both hotspot locations provided concealment from walking patrons. The presence of an ashtray, not provided by the university, by the WPAC building implies that campus police, staff, and students rarely travel through that area. The ashtray is also an indication that violators, particularly in that location, are either unaware of the smoking ban or are not deterred by the penalties for violating said ban.

The remainder of hotspots were located near A+C 3, support 1, A+C 4, and in parking areas P3 and P5. All but one hotspot building, support 1, are categorized as classroom and administrative buildings. Support 1, a staff concentrated building is located in the western part of campus. In addition

to these buildings and lots, three gazebos were hotspots for cigarette butts (GZ1-GZ3).

In addition to identifying hotspots of smoking violations on campus, we also created 25-foot buffers around each building ($n=74$) and parking structure ($n=19$) to quantify the number of violations in or around each structure. Buffers were grouped by type of structure to determine if particular buildings or structures are more likely to be places amenable to smoking violations. Seven structure classifications were created as a result of the buffer groupings that include administrative and classroom; parking areas; student housing buildings; student-concentrated (e.g., student center and library); staff-concentrated (e.g., support/utilities); outsider-concentrated (e.g., public sites and stadiums); and "other."

The buffer analysis revealed the highest percentage of smoking violations was predominantly around buildings (52 percent), while the remaining cigarette violations were in parking areas (28 percent) and on walkways connecting to buildings (20 percent). The largest number of cigarette butts, with an average of 14.1 violations per building, were located by "administrative and classroom" building types. This can simply be explained by the amount of traffic from student and staff in administrative and classroom building types. Other structures such as student housing, public sites, and support/utilities, showed a low concentration of cigarette butts. Campus parking areas had the highest average of smoking violations (14.7), where people tend to smoke in their cars or outside of them as they are leaving or arriving to campus.



Figure 2a: Anti-smoking signage presently at FIU.

In light of these findings, the FIU police department could focus on particular areas of interest that disproportionately account for smoking violations. Such areas are classroom/administrative buildings (1-4), parking areas (3 and 5), and support building 1. This research also suggests that other stakeholders have a part to play in enforcing university protocol aside from the University Police Department. FIU's Department of Parking and Transportation has the authority to issue parking citations and can assist in issuing warnings to individuals who smoke within its premises. In addition, custodians should make sure cigarette butts are removed from campus grounds when cleaning it on a daily basis. Discarded cigarettes and cigarette paraphernalia such as the ashtray, may give the impression to students, staff, and faculty that this

behavior is commonly occurring on campus.

Apart from focusing enforcement efforts in hotspots, other solutions to reducing smoking violations can be as simple as raising awareness. Since arriving at FIU in 2011, I've noticed that many of my undergraduate and graduate students are not cognizant of the smoking ban that was put in place. This is partly a result of FIU not emphasizing the smoking ban since implementing it in the 2011-2012 academic year. At that time, they sent out emails and put up signs around campus (Fig 2a). Unfortunately, many of these signs are faded or have gone missing. More importantly, the signs' messages and appearances could be modified to be more direct and distinct, instead of appearing



Figure 2b: An example of potentially clearer messaging.

similar to other FIU signs on campus. Possible new signs can have clearer messaging (see Figure 2b) and be placed in hotspots to remove excuses of misbehavior. In addition, the university administration should send out an email to all students, staff, and faculty to gently remind members of the community that a smoking ban is in place and the university health services offers resources to quit smoking.

Our data collection strategy of collecting geo-coordinates of cigarette butts is not without limitations. Cigarettes smoked on campus,

but thrown in trash cans, on the lawn, or left within one's car could not be geo-coded (see Pires et al., In Press). That said, our strategy is a far more reliable and valid approach than alternatives, such as surveys or observational methods. Using GIS analysis to identify hotspots for prohibited or criminal behavior has been extremely helpful for police and practitioners who want to efficiently and effectively reduce problem behavior from the most serious to the most common. It is our hope with this research that FIU can think about this smoking problem in a more strategic way.

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Stephen F. Pires completed his graduate work at the School of Criminal Justice at Rutgers University in Newark, New Jersey, under the mentorship of Dr. Ronald Clarke. Dr. Pires is an expert on the illegal wildlife trade with a particular focus on commonly poached species (e.g., hot products), illicit markets, and the organization of the illegal trade. In addition to his work on wildlife crime, Dr. Pires has published several articles on the topic of kidnapping for ransom. In the majority of his research, Geographic Information Systems is applied to understand how deviant behavior is clustered in space and time, and how GIS informs prevention policy.



Ronald Belance completed his graduate studies at Florida International University in Miami, Florida, at the School of Arts and Sciences with a Masters in Criminal Justice. He has also served as a graduate assistant for Dr. Pires. Mr. Belance is a crime intelligence analyst and has served as the crime intelligence analyst with the Boca Raton Police Services Department in Boca Raton, Florida. Mr. Belance uses Geographic Information Systems for crime mapping and for DDACTS (Data-Driven Approaches to Crime and Traffic Safety).

The Importance of *Places*

By Richard Schneider, PhD

The rise of the family of “place-based” crime prevention strategies, including crime prevention through environmental design (CPTED) (Jeffrey 1971, 1977.), defensible space (Newman 1973), environmental criminology, (Lynch, 1960, Chapin 1974, the Brantinghams, 1993) and situational crime prevention (Clarke 1977, 1980) set a predicate for the evolution of modern geographic information systems (GIS) crime mapping, the use of GPS in crime scene forensics, risk terrain modeling (RTM), and related digital systems that locate and predict crime and the pathways of crime. The early authors of place-based CPTED strategies resisted the dominant crime prevention paradigms of the day by stressing the importance of places and times (especially environmental criminology and situational crime prevention) in crime analysis and prevention. CPTED suggests the threats and crime vulnerabilities to look for relative to the uses/designs of places and spaces while crime mapping allows us to overlay incidents (as well as calls for service) on visually intelligible terrains and then statistically compare venues, themes, and virtually any element with another (so long as the data is relatively clean and available).

As digital technology and methodologies continue to advance, the lines between substance--CPTED—and process—GIS mapping—have become increasingly blurred, as

in the case of RTM and predictive policing. In all cases, however, the values of places and times where crimes occur matter a great deal. CPTED principles furthered the idea that criminal events can be understood within spatial and temporal patterns of urban places relative to a city’s physical structure and context. However, the CPTED theory and practice has not kept pace with new advances in computerized crime pattern identification.

As notions of place-based crime prevention slowly gained traction in the 1970s and early 1980s, they were quite different from the dominant crime prevention paradigms of the day, which concentrated on environmental conditions as causative agents, e.g., “slums breed criminals”; on punitive correctional systems that reduced crime, which did not seem to work; and on treatment or punitive models where offenders were considered to be “ill” and their psychological or social maladies could be addressed through treatments or punishment.

Rather, CPTED-related theories concentrated on places themselves as being important. As Sherman, et al., (1997) noted, “wheredunit” was as important as “whodunit.” (p. 36-37). Indeed, C. Ray Jeffrey’s original CPTED conception emphasized the intimate relationship between the physical environment, the learning organism, and behavior, so that the envi-

ronment could be manipulated to prevent or, more likely, deter criminal behavior. Indeed, a basic tenant of CPTED ideologues remains that “the proper design of the built environment can lead to a reduction in the fear of crime and incidence of crime (Crowe, 2000: 1).

In short, places matter a great deal.

But, It was not until the 1950s that a little-known Chicago sociologist named Elizabeth Wood (1961, 1967) suggested that places themselves were important variables (risk factors) in the commission and contexts of crime. Wood’s ideas were noticed by few, although one architect who did pay attention to her insights was Oscar Newman, who built on her research to draw fundamental design conclusions based on place and space. Though scholars and others criticized his work on methodological grounds as too deterministic, his seminal book, *Defensible Space* strongly argued that places and spaces mattered relative to offending. At the time this notion was billed as revolutionary by the *New York Times* (1973).

The introduction of the concept of “defensible space” led designers and politicians to look at the physical contexts of crime and the role that bad or risky design played in its generation. Despite much criticism, Newman’s work influenced generations of US and UK planners and policy makers, including former HUD Secretary Henry Cisneros. Cisneros became skeptical of the dominant practices at the time that supported building taller and bigger public housing projects that stacked poor

people higher and higher within concentrated areas and toxic buildings. Newman deconstructed one such project, Pruitt-Igoe, an AIA award-winning public housing development in St. Louis, to demonstrate the fundamental importance of place and physical design in influencing behavior, and especially bad behavior. He questioned why an adjacent community, Carr Village, which was a low-rise public housing project containing tenants with similar socio-economic and ethnic profiles, had much lower crime rates and numbers of incidences relative to Pruitt-Igoe. The answers, he suggested, had to do with the importance of place, design, and the anonymity produced by large scale, undifferentiated housing. What emerged from his research was a group of themes and strategies that dealt with territoriality, surveillance, access control, boundary-making, and image and milieu (which laid the predicate for the “Broken Window” theory). Other strategies, such as “activity generation” and community consultation have since been added to the basic formulation as time has passed.

The Connection of Places: Routine Activities, Pathways, and Activity Nodes

Following Newman, the advancement of environmental criminology in the 1980s and 90s was of central importance to the development of GIS crime mapping. Its heritage traces back to Lynch (1960), Chapin (1974), the Brantinghams and Rondeau (1995) relative to the delineation of activity nodes, paths, and edges of urban places. It focused on the characteristics



Crime Prevention Through Environmental Design in Seoul.

of the environment in which crime occurs or is likely to occur as distinct from how or where the motivations of offenders originates. It incorporates routine activity and rational choice theory in seeking to explain "criminal events in the context of normal movements through normal settings in the course of everyday life" (Brantingham, 1991, p. 2). To the Brantinghams, crime patterns could be discerned given connections among geographic, environmental, and temporal targets and offenders and not just from social, economic, and cultural contexts. (Brantingham and Brantingham, 1981). Moreover, it places central importance on the movement of offenders through time and places in forming patterns of behavior.

A first step in discerning crime patterns is locating them on a map. French criminologist Guerry began to do this in the mid-19th century using pin-maps, which were useful but quickly outdated. A vast leap forward more than a century later was the advent of desktop computer-based geographic information systems mapping, which organizes and automates multiple, seemingly discrete events into

discernable patterns. Moreover, GIS allows for statistical comparison of crimes and easily track them across the broad expanse of urban settlements, which pin maps cannot do.

While place-based crime prevention theories are useful in broadly understanding physical vulnerabilities based on design and placement of structures, most offer, at best, vague intervention and prevention strategies. For example, the advice that entrances to buildings should be well lighted is a prime CPTED surveillance principle. But, even with foot candle measurements conforming to IES standards there is little hard empirical evidence to support this as a life-safety measure. Why are .5 foot candles of light at ground level better than .3 in parking lots? The same issue holds true for other basic CPTED principles, even though they seem to be intuitive, even common sense. This is a point made by Taylor's prescient paper, "Crime Prevention through Environmental Design (CPTED): Yes, No, Maybe, Unknowable, and All the Above (2002)." The fact is we have little good empirical data to support much of the CPTED advice given by police

and criminologists to the public and the development community. Moreover, it is stretch to directly connect design with criminal behavior (i.e., as cause and effect). Probably the best we can say presently is that poor design, however defined, is a risk factor in supporting crime. We argue that the use of CPTED, like crime analysis, needs to move from the macro-scale to the micro-scale relative to geo-spatial studies and crime analysis advice. And it should do so based on empirical evidence.

The fact that it has not done so yet is one reason, we suggest, why CPTED principles are sparsely embedded directly into municipal building and planning codes, unlike fire-protection regulations. The latter are based on a long history of experimental, empirical research that links fire codes closely to exterior and interior design, the use of fabrics and materials, sprinkler systems, and life safety. City and county commissions readily accept the hard science, based on results of on-the-ground fire suppression studies. Stringent fire codes are now incorporated into virtually all building codes. National testing organizations and code agencies firmly support such codes and they are reliable enough to use in court proceedings. Of course, CPTED is based on human behavior and environmental vicissitudes, whose multiple variables cannot be easily, if at all, replicated in laboratories. Nevertheless, despite new technology and methodologies, CPTED recommendations are still promulgated at general, large-grain levels.

This challenges Fosberg's perception that "the

profession of crime analysis seems to have moved from a more generalized mapping of hot spots to a more finely-grained map." (2015, p. 8) CPTED does not offer fine-grained maps but relies on generalized, intuitive principles of what works, tested to some extent by Sherman, et al. in their 1997 groundbreaking work. Lacking scientific evidence or at the least a decent return on investment rationale, such advice is opposed or ignored by local builders and developers who see it as adding unnecessary costs to the building process. This might change if CPTED principles were incorporated into the fundamental structure of local building regulations. Because they are not, with few exceptions (e.g., photometric plans and within some landscape codes) CPTED recommendations are merely that, recommendations that contractors, builders, and other municipal agencies can and do ignore with impunity. The best that can be said about them is that failure to follow police CPTED recommendations might be used by plaintiffs in liability suits, *after* an incident has taken place.

The Future of CPTED and Crime Mapping

My argument, like Noah Fritz's in a recent article in this newsletter (2015) is that what works must be tied to a strong evidence base and honest, *independent* assessments that go well beyond wishful thinking and politics. Using the available digital technology, many CPTED principles can be verified, or not, using the powerful micro-analysis computer tools that we now possess. So, when police advise people to lock

their car doors, they could tell within a range of certainty, maybe 75 to 85 percent, that failure to do so, especially in certain places, will likely lead to a car burglary. Presently, we can only say that locking your car doors is a good way to protect against car burglary, not how likely you'll be to regret not doing so. New crime analysis theory and technology can and should change this.

The argument is not to produce more regulation but to produce more robust advice to the public and to make manufacturers, builders, and developers more attentive. To achieve this, we argue for much stronger empirical rationales for CPTED's basic principles along with the development of honest, independent evaluative systems.

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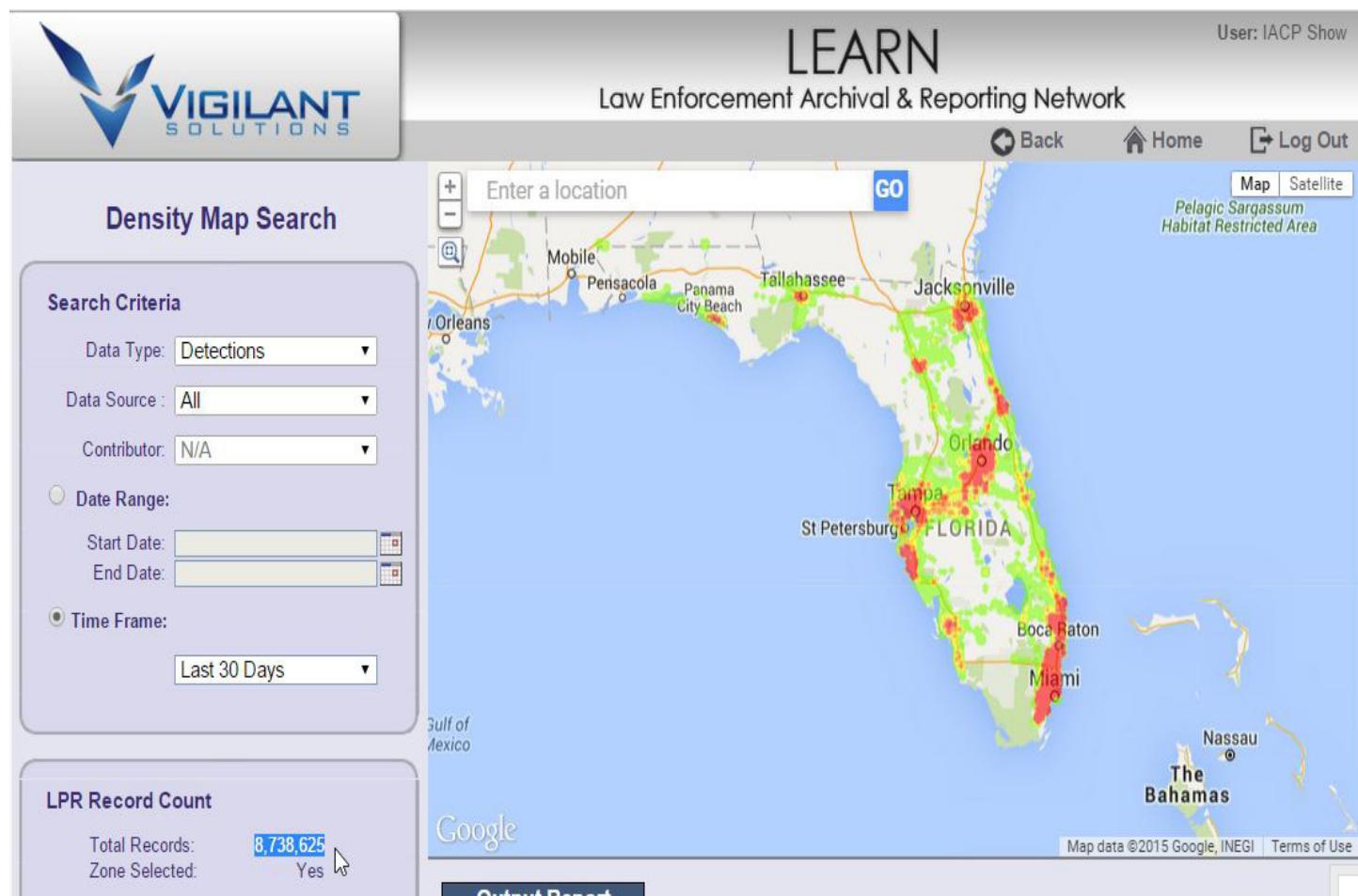
Richard Schneider is professor emeritus of urban and regional planning at the School of Landscape Architecture and Planning at the University of Florida's College of Design, Construction and Planning. He is an adjunct professor in the Department of Urban and Regional Planning. A charter member of the American Planning Association and a twenty-year member of AICP, his research and teaching specialization is planning for crime prevention. In that capacity he has worked with international, national, state and local law enforcement agencies and has published widely in the field. He has taught and lectured at the University of Florida, Arizona State University, University of Manchester (UK) and Sheffield Hallam University (UK).

A Case Study on License Plate Recognition (LPR): Coral Springs Police Department

By Brian Shockley

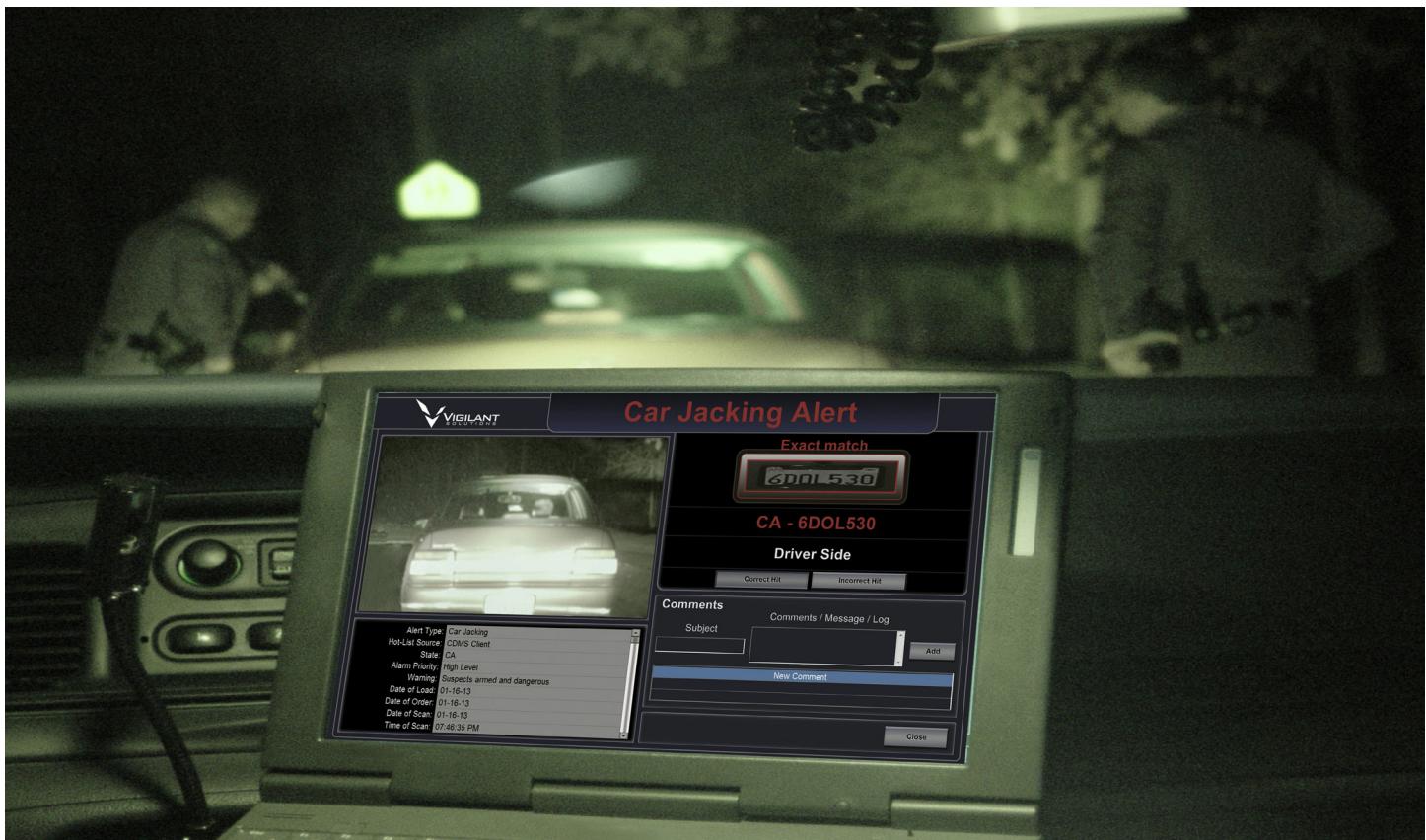
For an agency of around 200 sworn, the staff of the Coral Springs Police Department certainly knows how to leverage available technology to make its officers more efficient and effective. One such technology is license plate recognition (LPR). Coral Springs owns one mobile LPR system and three LPR-equipped trailers, in addition to subscribing to a nationwide commercial LPR database from Vigilant Solutions.

Purchased in 2013, the mobile system is used for proactive patrol operations to generate instant alerts for officers in the field. Officers are automatically alerted when they scan a plate that is a match against a number of hot-lists, including the Florida Department of Law Enforcement (FDLE) hotlist. This improves situational awareness and officer safety, while also allowing them to locate more vehicles of interest than any officer could humanly



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accomplish. LPR cameras are not looking for people or any specific type of car—they are merely reading all plates in the vicinity and determining if any have been flagged on the hotlists. The data collected is anonymous in nature, only showing the alphanumerics of the plate, along with a date, time, and location.

The trailer systems are a more recent addition to Coral Springs' LPR program. Purchasing the first trailer system in April and another two in June, these systems provide fixed location LPR capabilities for alerting dispatch as well as officers in the field. The systems are easily moved from one location to another for special operations and events, and for focused enforcement efforts. As of August 2015, the trailers have scanned 772,165 plates resulting in 21,651 hits or plates of interest.

In addition to the over 21,000 hits generated by Coral Springs' own LPR systems, Coral Springs has also experienced great success with Vigilant's commercial LPR data network, formerly known as the National Vehicle Location Service (NVLS). The Vigilant commercial LPR data network takes copies of LPR detections made by Vigilant's sister operation, Digital Recognition Network, and makes this data available for law enforcement investigative use. These LPR detections, amounting to over 8,500,000 LPR scans per month in Florida alone, are made by DRN affiliates in their efforts to identify vehicles with active orders for repossession. The data from DRN, referred to as commercial data, is available to law enforcement via Vigilant Solutions' LEARN software. However, law enforcement LPR scans are never made available to DRN, its affiliates, or any other en-

tity aside from law enforcement agencies with which the agency chooses to share. The City of Coral Springs currently chooses to share its data with several other Vigilant agencies in the state, including Citrus County, Collier County, Coral Gables, Ft. Lauderdale, Gainesville, Golden Beach, Hillsborough County, Hollywood, Indian Creek, Lee County, Miami Beach, Miami Dade, Miami, Naples, Orange County, Palm Beach County, Polk County, Pensacola, Sunny Isles Beach, Bay Harbor Islands, and others.

The commercial LPR data was credited with saving a woman's life in July 2011, long before Coral Springs ever invested in the Vigilant mobile or trailer systems.

Coral Springs Detective Dan Cucchi reports, "On July 13, 2011, an 84-year-old resident contacted us to report her 49-year-old daughter missing.

There had been a recent death in the family, and after her daughter failed to answer her cell phone for more than a week, the mother became very concerned for her daughter's well-being."

He continued, "We immediately logged into our Vigilant Solutions' account and searched historical LPR data for the daughter's vehicle.

We found three sightings of the daughter's vehicle in just the prior month, captured by Vigilant license plate readers (LPR) deployed on commercial vehicles and shared with law enforcement, and all three were at the same address in Boca Raton. We immediately drove to the location and located the daughter's vehicle. After making contact with the proper-

ty management, we were able to locate the daughter's apartment. We knocked, but there was no answer. Concerned for the woman's safety, and with a key provided by property management, we attempted to enter the apartment. Unfortunately the door was latched from the inside. Our detective called out for the woman and heard a soft moan, at which point—with assistance from property management—we made entry into the apartment."

Cucchi adds, "The woman was found on the floor, sick, severely dehydrated, and unable to care for herself. Emergency personnel responded and stated that the woman had been without food or water for several days. Her condition was critical, and she was very near death. Clearly, the information provided from Vigilant saved this woman's life."

Another more recent case this year involves the use of commercial LPR data to assist in a hit-and-run case. Coral Springs Officer Rich Best explains, "We received a phone call from someone who had just observed a woman crash into his parked car. The woman stopped, and the two had a very brief conversation until he insisted on calling the police. She then quickly fled the scene and drove over a median in the process. I arrived on the scene approximately ten minutes after receiving the initial dispatch call. The victim was able to quickly snap a photo of the back of her vehicle with his cell phone. It was easy for me to see from the photo that the vehicle was a silver Audi A6 and had a Texas license plate attached. A records check determined the Texas tag was expired,

assigned to a Honda, and registered out of New York to another individual. Based on this information, it was my belief that the investigation could possibly go unsolved due to a variety of issues and challenges the traffic investigator would face. Unfortunately and as a result, it was also likely that the victim or his insurance company would have to incur the loss."

Officer Best continues, "I decided to give the LEARN database a shot and was pleasantly surprised to see the Texas license plate had been scanned on multiple occasions over the past four months in a nearby apartment complex. I verified the images and confirmed it was the same vehicle and same tag. Because of this data, we were able to locate the vehicle at the apartment complex within one hour of my arriving at the crash location. After speaking with neighbors in three different buildings, the

investigation led to locating and identifying the driver of the vehicle, who was hiding in a rear bedroom of one of the apartments. The same driver ultimately ended up providing a confession to her actions and was subsequently arrested and charged with several crimes (leaving the scene of a crash resulting in property damage, using a tag not assigned to her vehicle, driving with an expired driver's license, and not having any proof of insurance). Additionally, the victim ended up positively identifying the person as the driver of the vehicle."

Officer Best went on to say "The Vigilant system and the data available are a tremendous resource and have proven to be helpful in solving crimes that could possibly go unsolved or take greater lengths and time to solve. I am a firm believer in the power of the system. It solves crimes and saves lives."



Brian Shockley is the vice president of marketing for Vigilant Solutions, a leading provider of license plate recognition systems and data, facial recognition systems, online investigative tools, and more. Prior to being recruited by Vigilant Solutions, Brian has held senior marketing roles with NDI Recognition Systems, PIPS Technology, and Aldis. Other work experience includes product management and marketing leadership positions with John Deere, Valvoline, and Bullard. Brian's educational background includes a BS degree from Carson Newman College, an MBA from the University of Tennessee, and a Strategic Marketing Management Course from Harvard Business School.

Lumen: Leveraging Unstructured Data to Enhance Crime Analysis

By Nick Coulт

I. Introduction to the Problem

Police records contain an enormous amount of unstructured data. For example, one suburban Denver agency has generated an average of 14,000 incident records, with 20,000 written narratives, each year over the last ten years. In many cases (often not by design) critical information such as M.O. details, property descriptions, gang names, and even names of people and organizations appear only in the narrative.

And yet, crime analysis to date focuses almost exclusively on information that is not found in a narrative but rather in structured data. For example, hotspot analysis based on crime types, risk terrain modeling, DDACTS, and all predictive policing methodologies rely exclusively on data ultimately derived from structured fields in a database. While these types of analysis are known to be quite useful and powerful, they are fundamentally limited when dealing with unstructured, contextual information, such as that found in report narratives.

Consider the following examples:

- An analyst has been asked to study the impact of increased enforcement efforts on a particular problematic bar in its jurisdiction. The bar can be associated with incidents in any num-

ber of ways, including type of incident (e.g., assaults), DUI and public intoxication arrests made of people who had been drinking at the bar, and others. Most of this information is not represented in any particular RMS field, but is stated by an officer in the narrative.

- An analyst has been asked to determine any trends and spatial patterns associated with copper theft or backflow devices. This property is often only described in the narratives.
- A police chief is interested in assessing the spread of heroin in the community. Heroin is present not only through actual possession or intent to distribute offenses but also through officers finding signs of heroin use during searches, and during field interviews in which interviewees, witnesses, and suspects discuss their own or others' heroin addiction. This information is contained in fields as well as in narratives.

In all of these cases, critical information resides in multiple places, and the specific locations where the information resides will vary from one case to the next even in the same records management system (RMS) in one agency.

Traditional tools used in crime analysis, whether Microsoft Access, Crystal Reports, and even many crime-analysis specialized tools currently in use, all approach this problem in essentially the same way: through structured query of one or more fields, using query languages such as SQL. The difficulty with this approach is that it cannot easily find data without knowing where to look first. Essentially, the user must enumerate all possible fields where the data of interest might be stored. This is a labor-intensive and error-prone task. In many cases, such analyses are not even attempted due to the level of effort required. This lack of system integration suggests the need for a tool to look at the narrative portions of data where qualitative information is provided in order to get a deeper understanding of the problem or analysis being addressed.

II. Enterprise Search

In recent years, enterprise search has become a tool of great value to many institutions. In the enterprise search model, data from many internal sources is indexed and made searchable, in much the same way that Google or Bing indexes web pages and provides a search interface.

Enterprise search can provide very high performance queries and return search results that would be difficult or impossible to obtain using structured SQL queries. Furthermore, through the use of stemming and other techniques, queries of written text can identify relevant records even if the text does not exactly match what the user is searching for. For example, a user might search for "copper

"theft," and a properly configured enterprise search engine can return documents containing "copper theft" as well "copper thefts" automatically. Typically, an enterprise search engine is also capable of returning results ordered by relevance. This can help when combing through large numbers of records.

The downside of generic enterprise search for crime analysis is that the focus is primarily on search, and there is little in the way of analytical capabilities provided. The users of such systems are left to provide their own analysis. Furthermore, there is a great deal of valuable information in the structured data that should not be neglected, but a generic enterprise search system is incapable of using this structure.

III. Lumen: Hybrid Enterprise Search and Structured Analytics

In order to address these issues, Numerica Corporation developed Lumen, tailored specifically for law enforcement and crime analysis users. Lumen offers the following capabilities related to unstructured and structured search and analytics:

- Full text enterprise search of records from SQL databases as well as documents and files. RMS, CAD, LPR, Intel system, attachments, and even file archives can all be indexed and made searchable with a Google/Bing-like search interface.
- Structured search and analytics of structured data such as SQL databases

es. Unstructured search can be combined with structured search, to provide more accurate and tailored results. Furthermore, analytics based on times, locations, and field values from structured data such as RMS incident records can be combined with unstructured full text searches, providing for a more robust searching capability.

Consider the examples described in Section I. For each example, we show below how Lumen can be used to generate the analysis required.

Example 1: Problem Bar

In this case, the analyst is searching for incidents in which the bar is involved. The name of the bar is unique enough that a search for the name of the bar finds incidents associated with it and not spurious associations that happen to match the name. The name of the bar appears in both narratives and location comments, so a search of a single field would be insufficient. Figure 1 shows the results that were obtained (results have been anonymized). Most of the search results appear

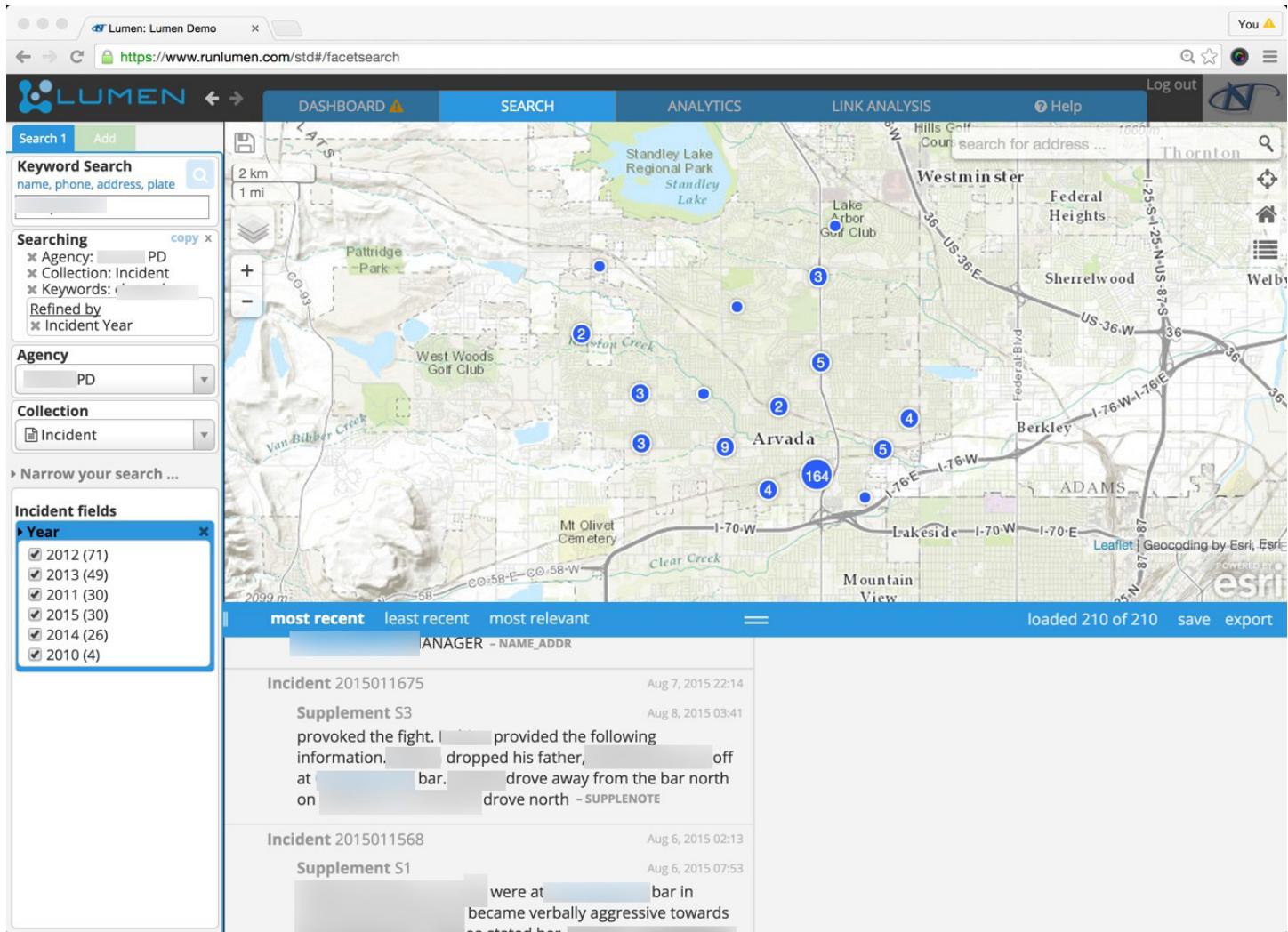


Figure 1. Full text search for a bar name in incidents since 2010.

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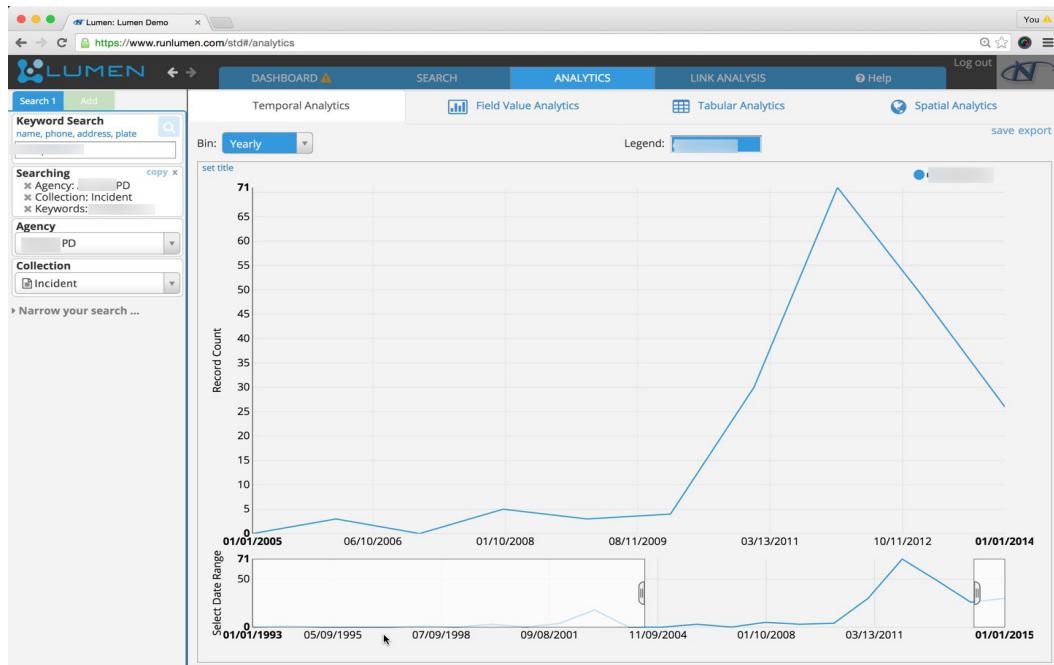


Figure 2. Trend since 2005 showing increased prevalence of incidents related to the bar of interest.

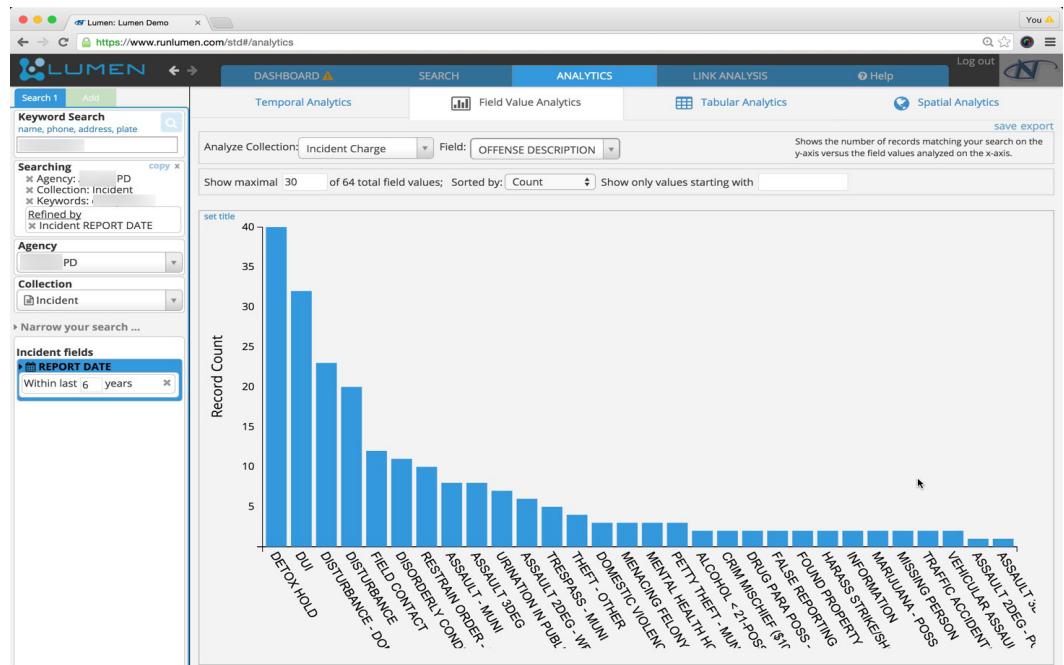


Figure 3. Charges in incidents related to the bar over the last six years.

near the bar, but a significant number are in other locations. Many of these are DUI and other incidents in which one or more people involved had been drinking at the bar previously.

Figure 2 shows the trend over time. The number of incidents matching the search is plotted on a yearly basis. (An important point to note is that,

even though a single incident may contain multiple matches against the search term, it is counted only once in this chart.) The dramatic spike in incidents from 2010-2012 led to increased efforts to deal with the problem; the steep drop off in later years is likely a result of that effort.

Figure 3 shows the nature of the charges in

each incident. In this analytic, there can be more than one charge per incident, and the total number of charges of each type is displayed. Many of the incidents are directly related to alcohol, as expected.

Example 2: Copper Theft and Backflow Devices

In this case, the spatial and temporal trends of two different types of property theft are analyzed: theft or burglary of copper pipes and wires, and theft or burglary of backflow devices. In both cases, the words "copper," "wire," "pipe," and "backflow" can show up in narratives but also in property descriptions. As seen in Figure 4, the number of incidents in recent years for these two searches appear highly correlated. (In fact, both are fairly well

correlated with metal commodity spot prices).

Figures 5 and 6 make clear, however, that while there is some overlap in incident locations, there are a number of locations that are different between the two series.

Example 3: Heroin

Heroin use is increasing in many jurisdictions across the United States. Heroin's appearance in an incident can come in many forms, ranging from actual heroin possession, to possessing drug paraphernalia, or even just a suspect admitting to an officer during an interview that he or she is a heroin addict. A full text search can find all of these. Figure 7 shows a breakdown by year and charge description for all incidents

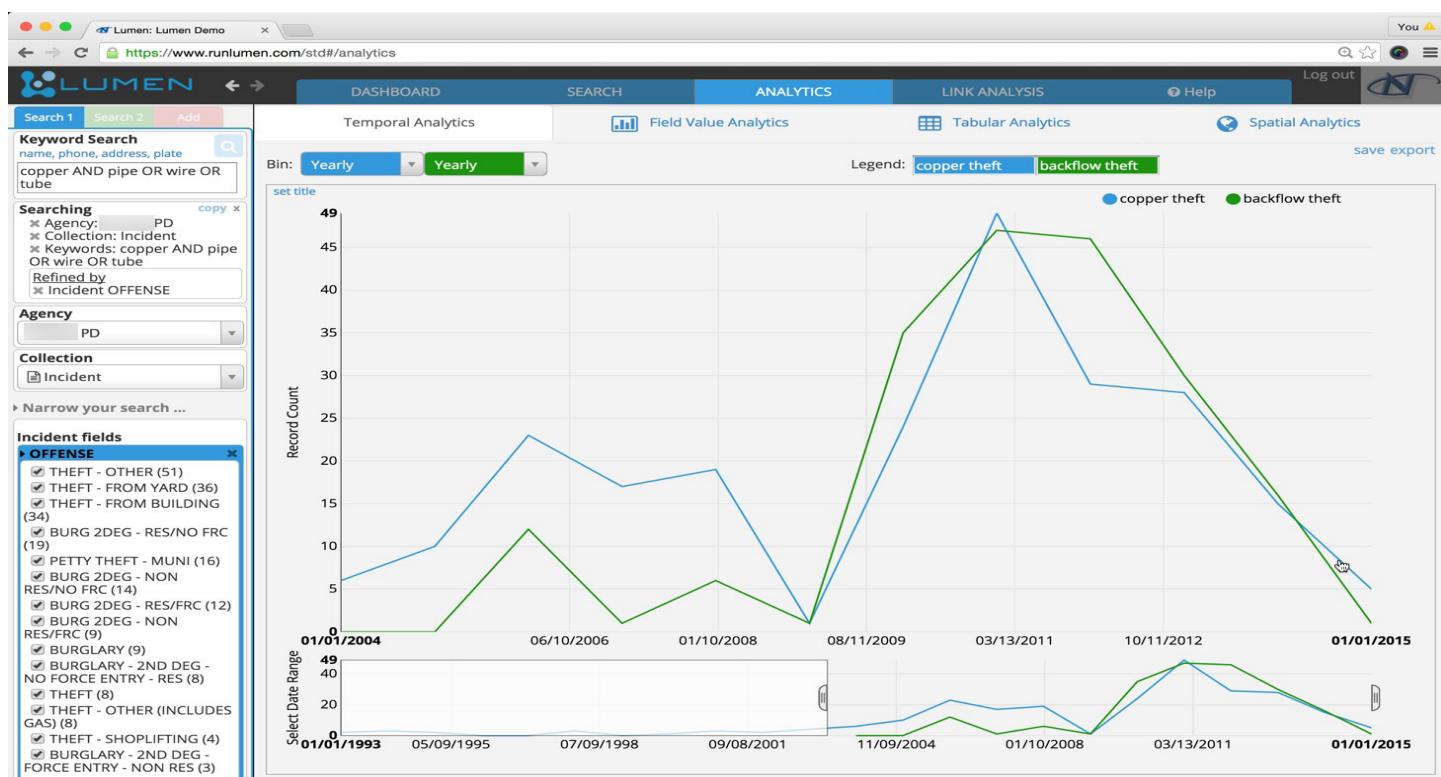


Figure 4. Comparison of copper theft vs. backflow device theft over a 10-year period.

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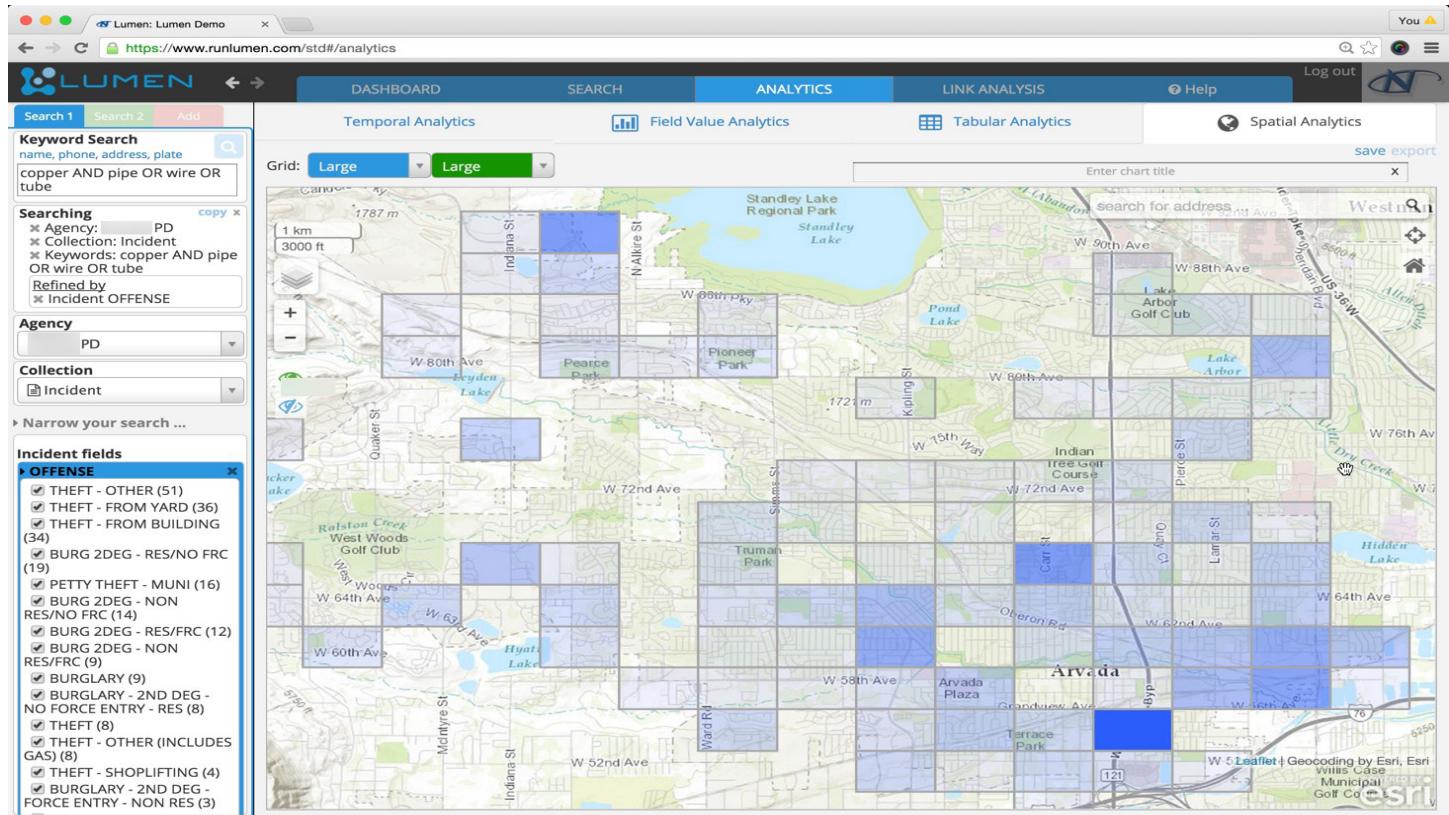


Figure 5. Choropleth map showing locations of copper theft.

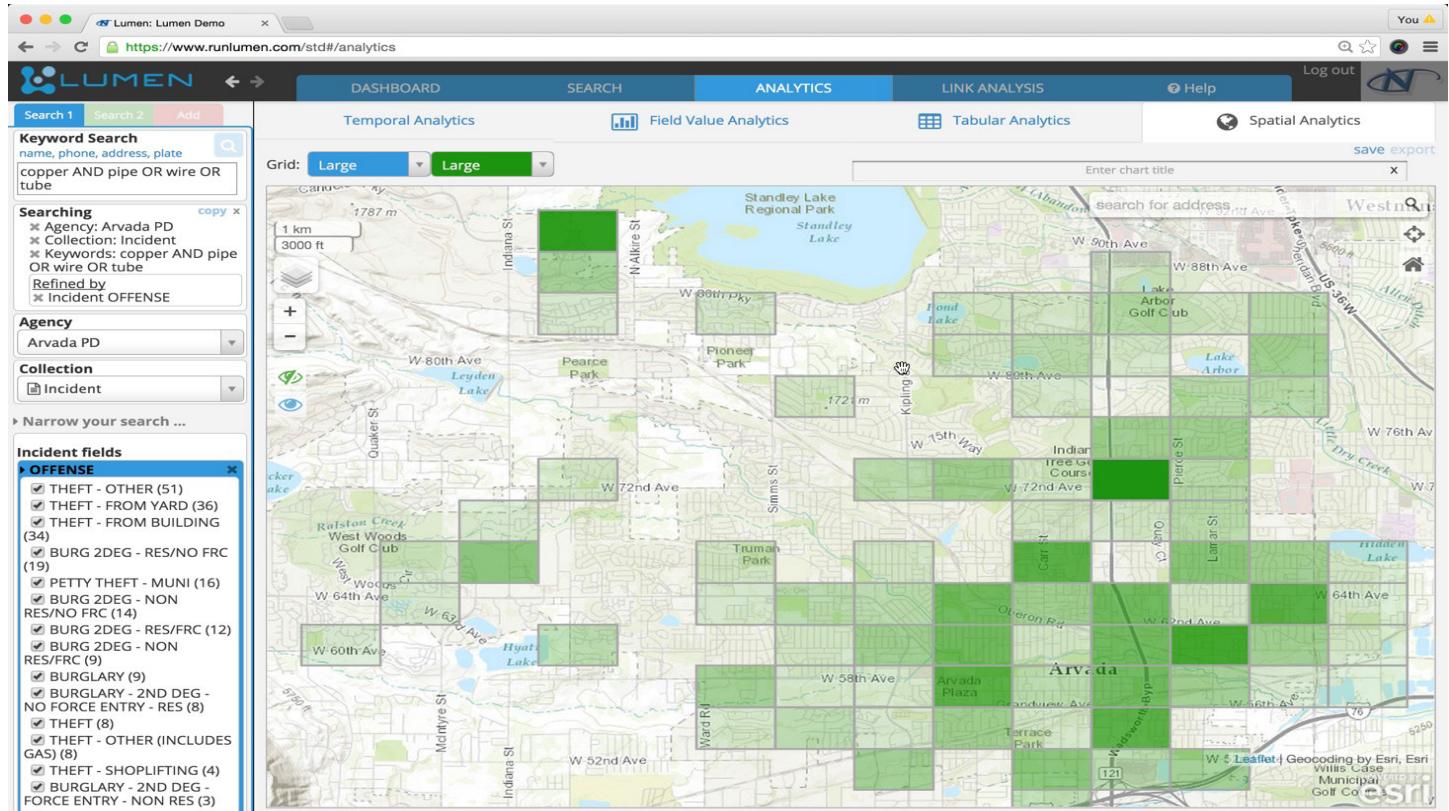


Figure 6. Choropleth map showing backflow device theft locations.

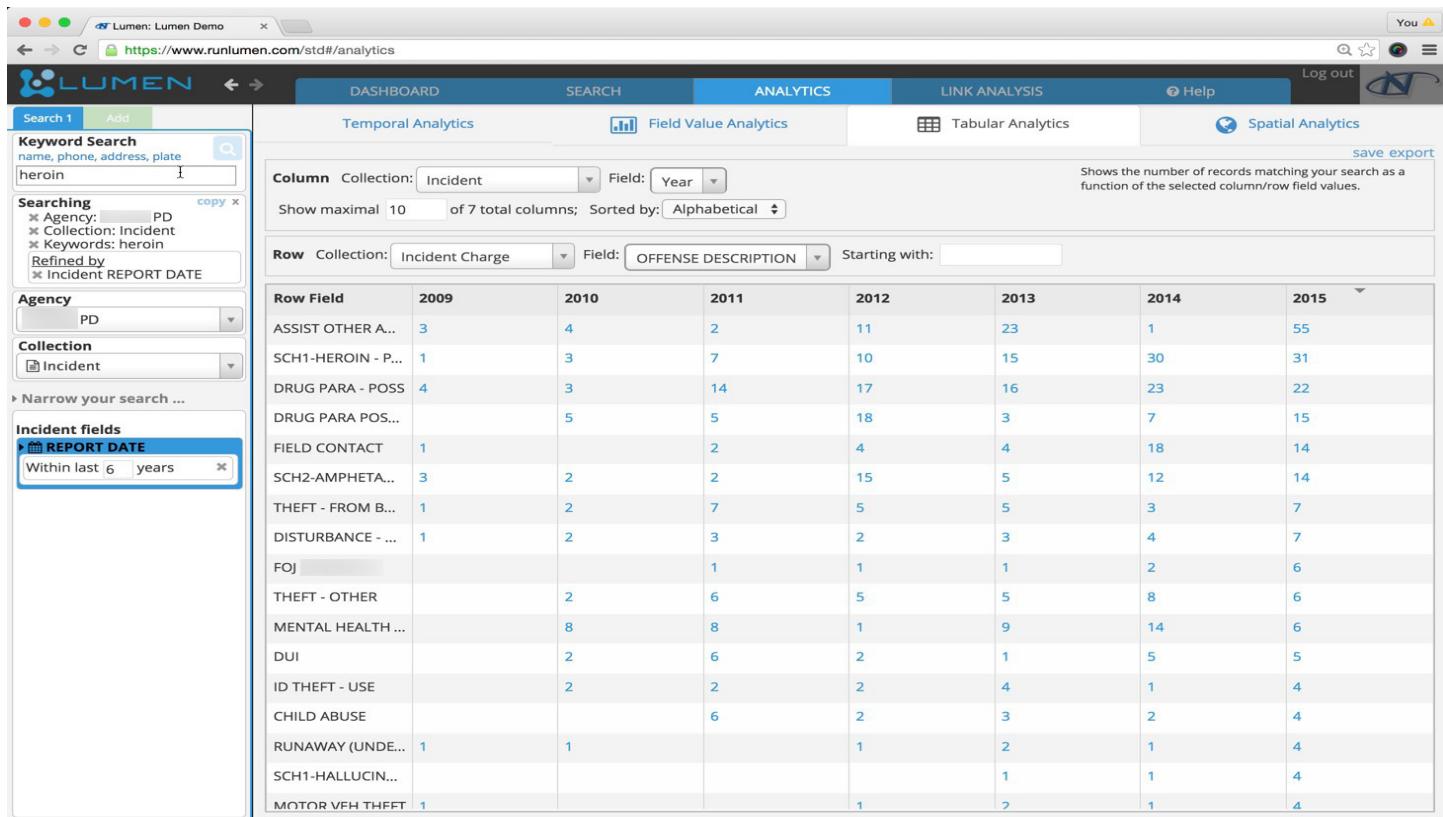


Figure 7. Analysis of incidents involving heroin over time.

involving heroin over the last six years. “Assist other agency” is high on the list because this particular agency has a narcotics dog that is used by other agencies. Many charge types show a significant increase in the number of incidents.

IV. Takeaways

Records management systems in policing house tremendous amounts of data, yet crime mapping and analysis has depended upon traditional data provided in coded data fields in these databases. However, police narratives also contain other rich data about incidents not provided in coded fields. As such, this information has traditionally been an untapped

resource for analyzing crime patterns, etc. Narratives and other unstructured data sources in police reports have significant utility in modern data-driven policing, despite traditionally having little utility due to the sheer volume of textual information and the lack of available tools for examining it. Today, however, through hybrid enterprise search/structured search and analytics tools such as Lumen, analysts can create products that exploit the value of unstructured data in combination with the rich structured data they already used every day. Ultimately, through the use of both data sources and analytic tools, crime analysts will be better equipped to identify critical aspects of incidents and facilitate greater problem solving.



As vice president of the Interactive Intelligence Systems business unit at Numerica Corporation, Nick Coulter oversees the teams creating innovative intelligence solutions for customers in law enforcement, defense, and private industry. Nick previously served as a program director for integrated air and missile defense at Numerica. Prior to joining the company in 2008, Nick spent ten years working with leading mathematicians, scientists, and engineers on innovative, unique solutions and products for problems in seismic exploration, space physics, data compression, and image processing. He has led the development and launch of five separate product offerings and is the author or co-author of eight published papers and one patent. Education: M.B.A. – Massachusetts Institute of Technology; Ph.D. – Applied Mathematics, University of Colorado at Boulder; M.S. – Applied Mathematics, University of Colorado at Boulder; B.A. – Mathematics, Carleton College

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20th Anniversary SCIP (Strategic and Competitive Professionals) European Summit
3-5 November, 2015 Madrid, Spain

<https://www.scip.org/infoConference.php?ConferenceID=526>

Maryland Criminal Justice Association
4-6 November, 2015 Ocean City, Maryland
<http://mdcja.com/events/fall-2015-conference/>

The 7th Annual Search and Rescue GIS Workshop and Meeting
12-15 November, 2015 Sonora, California
<http://events.r20.constantcontact.com/register/event?oeidk=a07ebj3nub834a6869b&llr=nplxpb-dab>

American Society of Criminology Annual Meeting
18-21 November, 2015 Washington, DC
<https://www.asc41.com/annualmeeting.htm>

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