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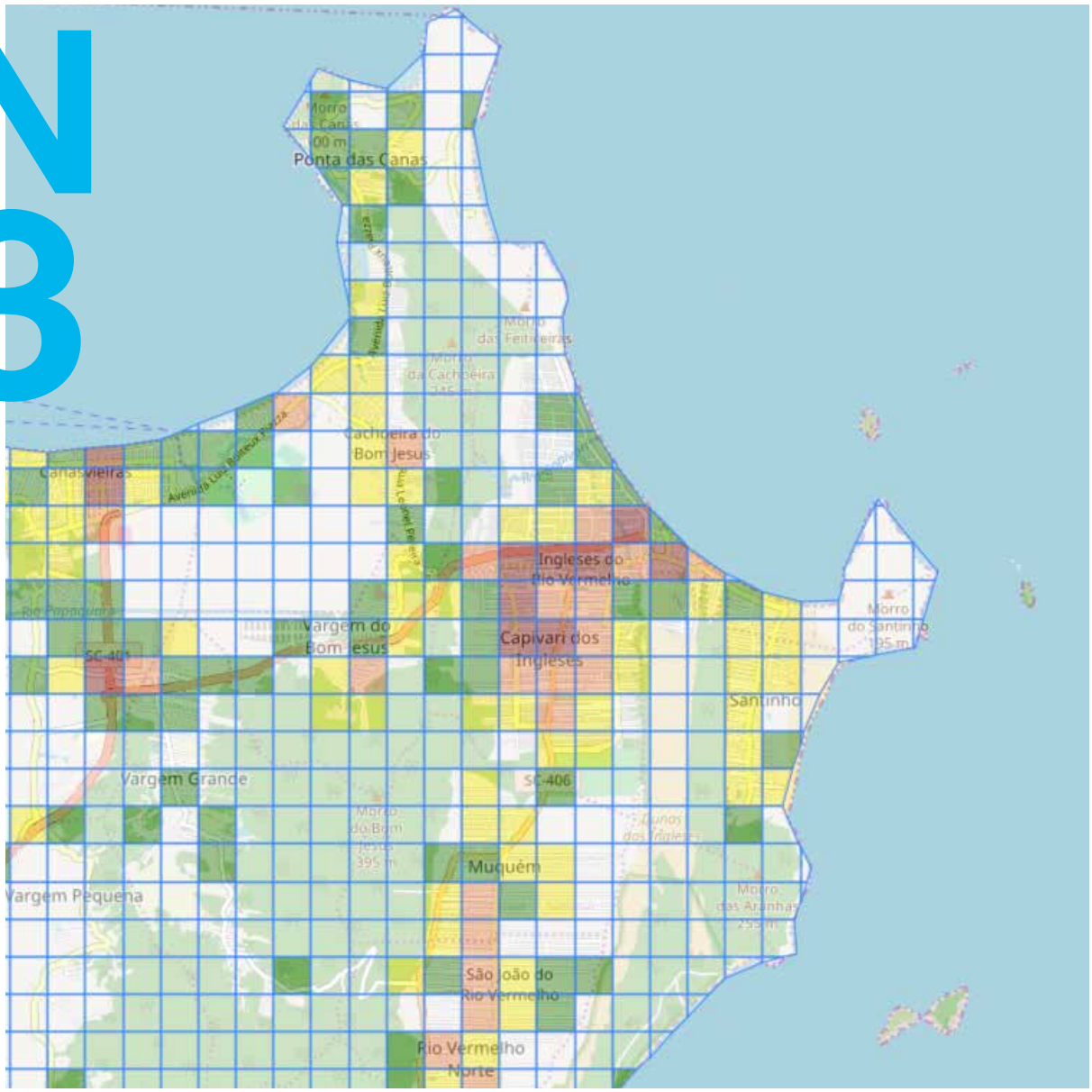

FUTURE CRIME:

Assessing twenty first century crime prediction

Katherine Aguirre, Emile Badran and Robert Muggah

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Introduction

Cities are where the future happens first. They are hubs of innovation, productivity and experimentation. But many cities also are sites of crime and violence. More than ever, municipal authorities, private firms and civic groups are experimenting with new ways to improve real and perceived safety in cities. In some cities, new technologies are improving the situational awareness of public authorities and citizens. In others, all encompassing surveillance and monitoring systems are challenging fundamental norms of privacy.

In most developed cities, high-frequency time series information on insecurity is increasingly available. Literally thousands of gigabytes of raw data are available representing the dynamics and characteristics of crime. New high-power computer analysis is giving rise to a next generation of smart, agile and evidence-informed policing strategies. Predictive platforms in particular can enhance police operations, identifying priority targets for police intervention, and enabling more effective allocation of police resources.

The promise of crime prediction

Predictive analytics are hardly new. Statistical and mathematical models have long been used to predict where crime may occur in the near future.[1] Predictions are in turned based on a series of assumptions. For example, the criminological literature predicts that violent crime and property crime are not only highly concentrated in specific locations, but also tend to occur at predictable intervals.[2]

Predictive policing tools are being rolled out by police departments across North America, Western Europe and parts of Asia. Police departments typically use thermal maps indicating the locations and times where the probability of crime is highest. Senior law enforcement officers can apply this information to plan their routine operations and send officers and patrol cars to the right locations at the right time.

This so-called "hotpots policing strategy" - merging data analytics with targeted policing - has been around for over two decades. Scientific evaluation studies have shown that it is an effective crime prevention strategy.[3] While concentrating resources on crime hot-spots may contribute to a modicum of crime displacement, this is often much less than expected. Indeed, departments must regularly update their data systems and operational strategies as crime itself undergoes structural changes over time.[4]

Predictive policing are also evolving. They are benefiting from advances in machine learning, coupled with more affordable computational power. When compared to traditional hot-spots mapping approaches using retrospective data, predictive analytics can process more granular data at a more rapid pace, generating predictions associated not only to a location, but also to a crime type, and to specific times of the day and days of the week. When applied with fidelity, such tools can help police departments validate their predictions on a daily basis, and adapt responses to transforming crime patterns.

Crime forecasting models are examples of new technologies for agile security: promising data-driven and problem-oriented approaches that can speed up decision-making, and provide smart solutions that help reduce human biases and inefficiencies.[5] In an era marked by a fourth industrial revolution, AI, the Internet of Things and Big Data are available to help law enforcement and criminal justice authorities adopt more effective policing strategies.

1 Mohler, Short, Brantingham, Schoenberg, Tita, 2012.

2 Cohen & Felson, 1979.

3 Braga, Papachristos, Hureau, 2012.

4 Johnson, Guerette, Bowers, 2014.

5 Muggah, 2018.

Limitations of crime prediction

For all their promise, predictive crime analytics are not a panacea. For one, certain types of crime - including domestic and interpersonal violence - is not easily amenable to predictive models since they are seldom concentrated in specific locations, and cannot be readily attributed to specific profiles of victims. While predictive algorithms may reduce certain forms of human bias by reducing subjectivities, they ultimately rely on often flawed crime data with systematic reporting biases.

What is more, predictive policing experiences, when subjected to closer scrutiny, have registered a host of challenges.[6] They are often costly owing to data storage, lack transparency in relation to the underlying algorithm, and have on occasion led to the violation of basic rights and civil liberties.[7] Without high quality data and due care in the way they are built, predictive algorithms can unintentionally reproduce and exacerbate societal prejudices.[8] Identifying biases in data sets is complex, requiring deep knowledge in statistics, mathematics, and programming.

As with most policing technologies, successful application requires adopting a comprehensive approach. It depends not just on institutional leadership and the technical capacity of law enforcement agencies to incorporate predictive tools into routine operations, but also the development of minimum standards for responsible development, auditing and evaluation.

Designing and deploying predictive tools

Crime forecasting is by definition a mixed method, involving a host of integrated tasks. These include time-series modeling, intensive data mining, hot-spots analysis, and socio-temporal assessment applied to historical crime data. It is important to stress that predictive policing goes beyond basic online mapping tools that track crime.

Statistical methodologies include the *near-repeat theory* and *crime hot-spot analysis*. These approaches assume that once a particular violent or property crime occurs in a particular location, it is likely to occur again in that same area. Meanwhile, the *risk terrain model* is more focused on geographical analysis, seeking to identify risk factors and features of crime-affected locations, such as insufficient public lighting and potential escape routes.

Predictive policing is grounded on several established theories of crime behavior and crime opportunity explaining crime concentration and repetition, and why crime occurs in some places and not in others.

These include:

Routine Activity Theory that states that crime depends on multiple factors including the motivation of offenders, suitable targets and an absence of capable guardians;[9]

6 Knight, 2017.

7 Lum, Isaac, 2016.

8 Oram, 2016.

9 Cohen & Felson, 1979.

Rational Choice Theory underlines that criminals make rational decisions based on opportunity and estimated costs such as the possibility of being imprisoned and punished;[10] and

Crime Pattern Theory that explains why, when and where crime happens, focusing on the intersections and commonalities between victims and perpetrators.[11]

By applying different combinations of these methods and theories, a growing number of universities and commercial vendors have developed predictive policing software, serving to some of the world's largest police departments. Existing commercial solutions can be broadly categorized into two categories: (i) methods that predict the location of crime; and (ii) methods that predict likely crime offenders and victims.

The first method involves processing historical police reports, emergency hotline calls, weather forecasts and even the locations and dates of large public events to calculate the probability of crime happening in space and time. The second - and perhaps more controversial - method often processes arrest data[12] including criminal records and social media profiles as well as location, race, age, gender, and ethnic data. The method generates a shortlist of high risk individuals who are determined to be potentially involved in future crime.

There are a host of commercial vendors aggressively marketing predictive crime tools. The most well known is **PredPol** - a location-based crime forecasting platform applying near-repeat theory and processing historical crime event data.[13] The software is used in, among other areas, Los Angeles, Atlanta and Kent (UK). Another well-known vendor is **HunchLab**[14] which is deployed in Chicago, Miami, New York and Philadelphia. The tool processes crime data and city feature variables and is based on the risk terrain model.

Other vendors include **Palantir**, a widely known and controversial[15] company. The firm initially developed diagnostic tools for the US military during operations in Afghanistan. The Palantir solution applies pattern recognition combining crime data, arrest data, and social network analysis. Meanwhile, one of the first crime prediction tools developed in Latin America was created in Chile by the Center of Analysis and Modeling in Security of the University of Chile.[16] Today, crime prediction is common across Denmark, Italy, Japan with new projects underway in Argentina,[17] Brazil, Colombia,[18] and Uruguay.[19] A new project involving the National University and Quantil, a private company, involves setting-up a crime prediction platform in Bogotá that purposefully avoids reproducing biases and profiling.[20]

Meanwhile, one of the first crime prediction tools developed Latin America was created in Chile by the Center of Analysis and Modeling in Security of the University of Chile.[21] Today crime prediction is common across Denmark, Italy, Japan with new projects underway in Argentina,[22] Brazil, Colombia,[23] and Uruguay.[24]

10 Cornish & Clarke, 1987.

11 Cullen & Wilcox, (n.d.).

12 Lum & Isaac, 2016.

13 Predpol, (n.d.).

14 Hunchlab, (n.d.).

15 Peretti, 2017.

16 CEAMOS, 2018.

17 Gobierno Argentina, 2017.

18 Alvarado, 2017.

19 Ministerio del Interior, (n.d.).

20 Semana, 2019.

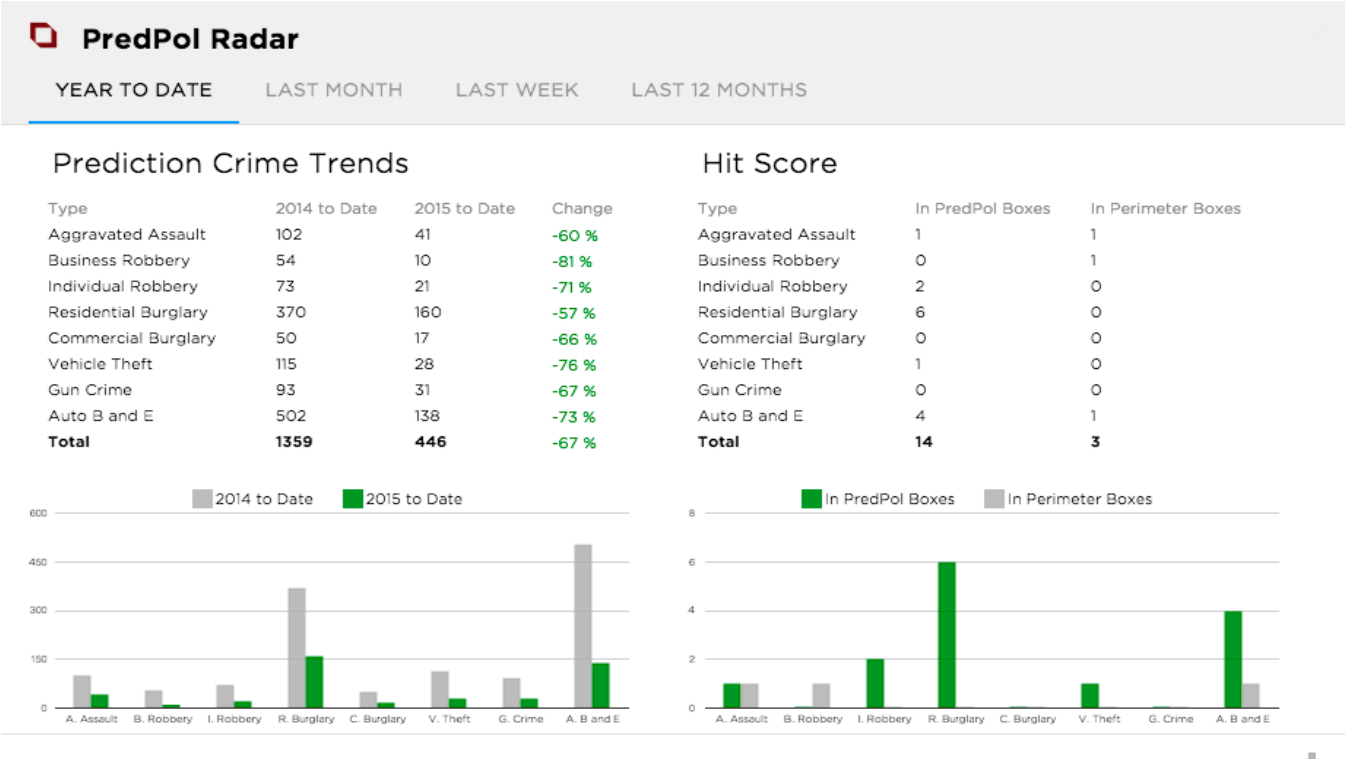
21 CEAMOS, 2018.

22 Gobierno Argentina, 2017.

23 Alvarado, 2017.

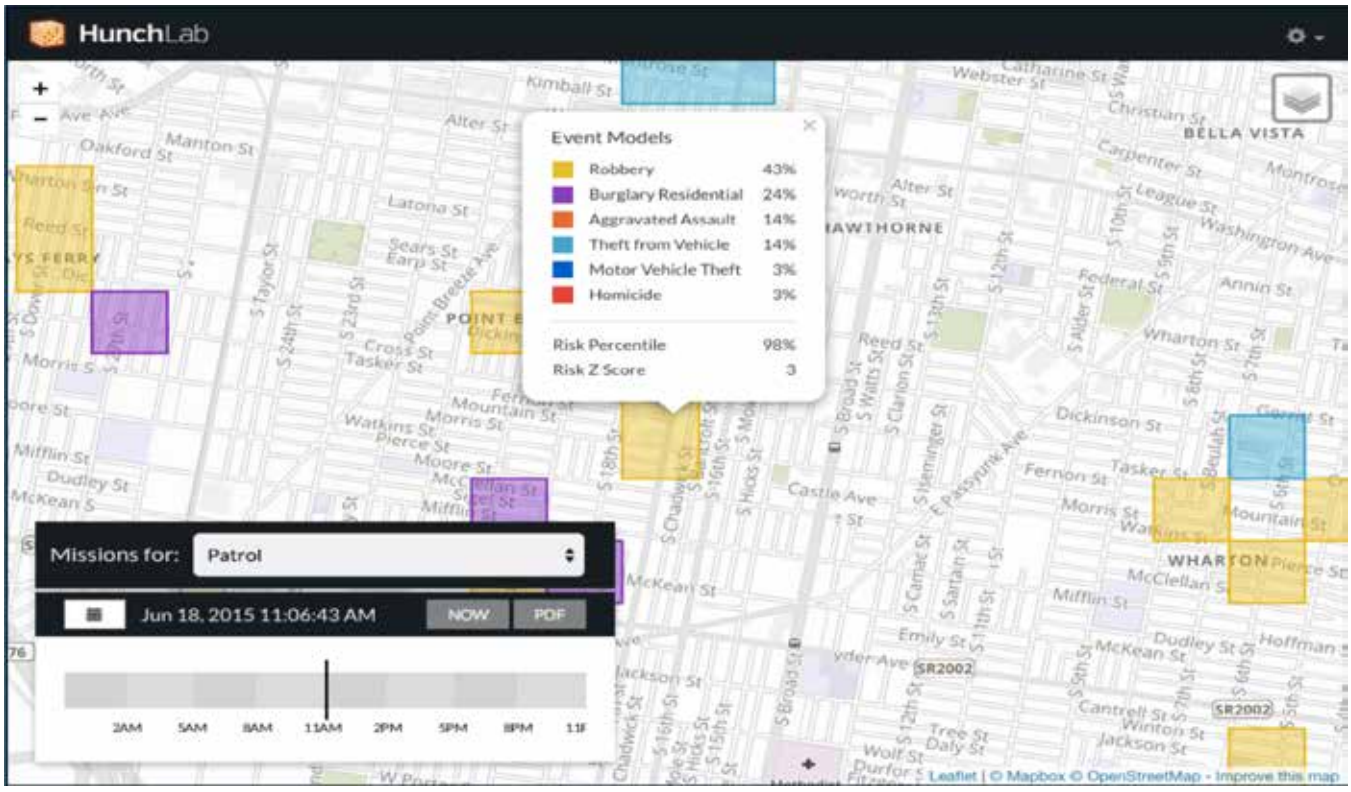
24 Ministerio del Interior, (n.d.).

Figure 1. PredPol Radar



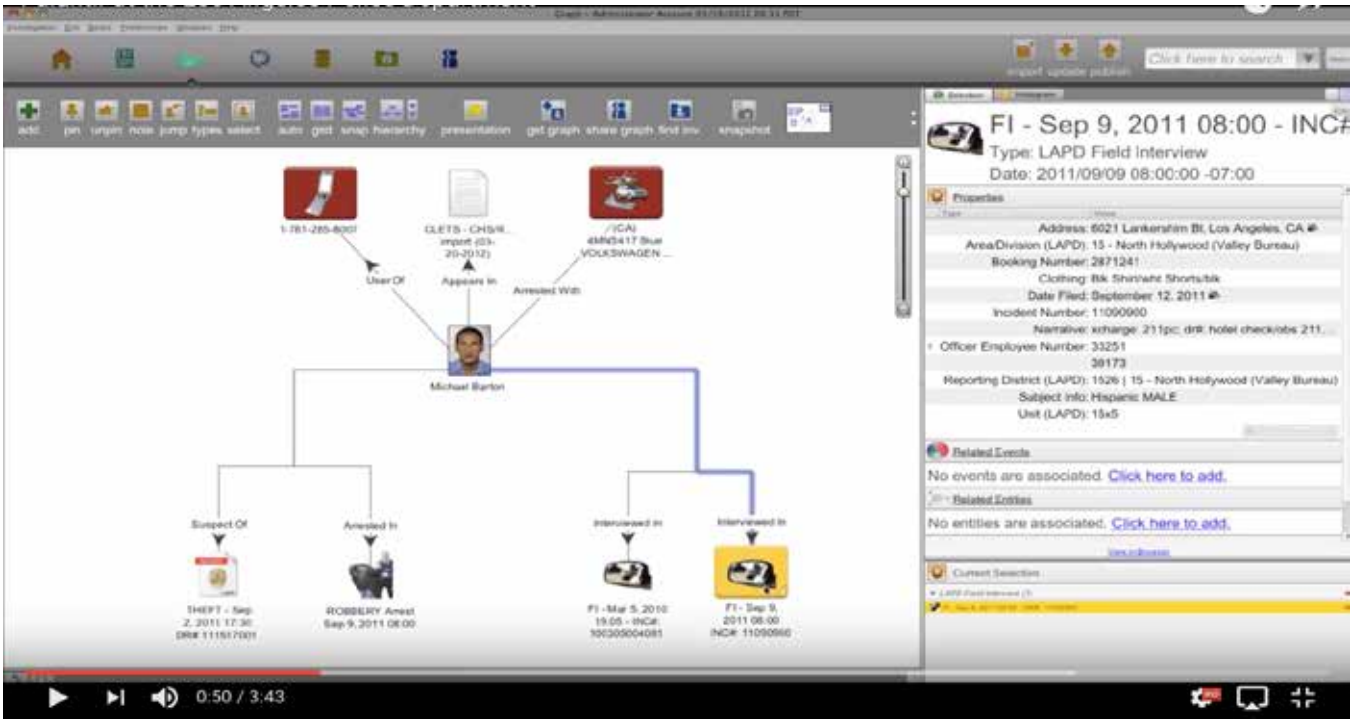
PredPol Crimes Audit Report.

Figure 2. HunchLab



Hunchlab Predictive Missions interface.

Figure 3. Los Angeles Police Department



YouTube video screenshot - Palantir at the Los Angeles Police Department.

The impacts of crime prediction analytics

Digital crime mapping and management tools first burst on the policing scene in the 1990s. One of the most well known was CompStat[25] developed by the New York Police Department. The first documented use of predictive policing models date back to 2008 when the Los Angeles Police Department deployed Predpol and estimated that it doubled the probability of accurately predicting crime occurrence. The platform gained attention from the National Institute of Justice of the United States (NIJ)[26] which actively promoted the tool across the US.[27]

Meanwhile, a review of Predpol in Kent (UK) found that it modestly improved crime prediction. Specifically, 8.5% of crime occurred in the predicted boxes, in comparison of 5% of police analyst predictions.[28] What is more, a study by McKinsey[29] determined that predictive policing could decrease fatalities from 2.9% to 5% and crime incidents from 9.7% to 11.1%, depending of the context of the city in relation with the level of criminality, concentration of crime and efficiency of emergency response.

25 Harvard Kennedy School, (n.d.).

26 Office of Justice Programs, 2014.

27 At the same time, predictive tools have also been used to promote road safety and even predict the placement of improvised explosive devices. For the most part, these platforms are non-transparent.

28 The Economist, 2013.

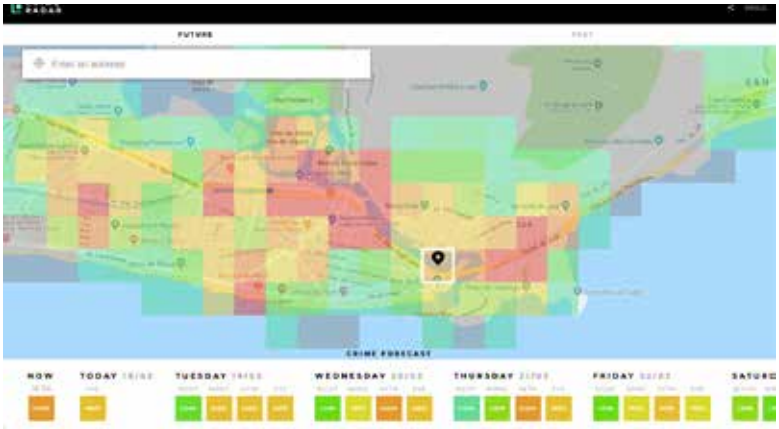
29 Woetzel, et al., 2018.

Notwithstanding these findings, there is still comparatively mixed evidence of the accuracy of crime prediction, its impact on clearance rates, whether it improves response times or even leads to significant reductions in crime.

The only way to really gauge the impacts of crime forecasting is to conduct statistical evaluations that isolate the effects of the measure, including randomized control trials (RCTs). The annex provides a summary of the findings from a number of the most well-known instances of crime prediction implementations.

In 2016, the Igarapé Institute partnered with Via Science - a data analytics firm - to develop the CrimeRadar app, a public-facing crime forecasting platform that evaluated relative crime frequencies in different locations and times of metropolitan Rio de Janeiro. The underlying crime data was retrieved from the state Institute for Public Safety and included official crime records produced by the state civil police. The platform was launched during the Rio Olympics, in August of that year.[30] At the time, residents and tourists could access the website to view the predictions displayed on an intuitive mobile heatmap.

Figure 4 and 5. CrimeRadar



The public-facing CrimeRadar app developed by the Igarapé Institute and launched during the 2016 Rio Olympics.

A prototype of the police-facing CrimeRadar tool that is currently being developed by the Igarapé Institute.

30 The Institute provided expert knowledge about the region and worked with various data providers to gather and verify accurate historical data. Via Science helped to create and test the formula behind the app using their proprietary machine learning software architecture. Finally, Mosaico, a local software firm, helped design the mobile app interface. Although the website remains online, the algorithm and data are currently not being updated, and visitors to the website receive a notice informing that the data and predictions are outdated.

Starting in 2018, the Institute partnered with the State Military Police of Santa Catarina to develop and pilot a police-facing version of CrimeRadar. In 2020, the initiative will be evaluated using a randomized controlled trial (RCT) to assess the effectiveness of predictive policing on the planning of police patrol itineraries and scheduled operations. The goals are to assess changes in crime levels and crime displacement as well as average police response times and public trust in the police.

Importantly, the entire development process and resulting crime forecasting algorithm is being documented in a "social impact statement". The intention is to describe the challenges associated with (and steps taken to ensure) the responsible monitoring and analysis of crime data. The Igarapé Institute is committed to designing and implementing crime forecasting algorithms in a publicly accountable manner.

To start, the software license will require that all police departments deploying the predictive tool comply with a minimum set of transparency and reporting standards. A list of five minimum requirements are set out below and were prepared by the FAT/ML[31] work group, a community of researchers and practitioners concerned with fairness, accountability, and transparency in machine learning:

*"**Responsibility and Recourse** - Make available externally visible avenues of redress for adverse individual or societal effects of an algorithmic prediction system, and designate an internal role for the person who is responsible for the timely remedy of such issues;*

***Explainability** - Ensure that algorithmic predictions as well as any data driving those predictions can be explained to end-users and other stakeholders in non-technical terms;*

***Accuracy** - Identify, log, and articulate sources of error and uncertainty throughout the data sources so that expected and worst case implications can be understood and inform mitigation procedures;*

***Fairness** - Ensure that algorithmic predictions do not create discriminatory or unjust impacts when comparing across different demographics;*

***Auditability** - Enable interested third parties to probe, understand, and review the behavior of the algorithm through disclosure of information that enables monitoring, checking, or criticism, including through provision of detailed documentation, technically suitable APIs, and permissive terms of use."*

Controversies associated with crime prediction

As noted above, there are widespread concerns that predictive policing tools could unintentionally exacerbate over-policing of marginal areas and undermine privacy. It is widely known that algorithms can reproduce existing patterns of discrimination, reinforcing previous errors and biases of programmers and embedded in databases. There are very real ethical questions about the extent to which such tools can influence police to disproportionately surveil marginalized neighborhoods and communities. Related, there are fears that such tools may augment race and age profiling and undermine privacy rights and civil liberties.

Recent studies funded by the US National Science Foundation demonstrate how predictive policing models are susceptible to 'runaway

31 FAT/ML, (n.d.).

feedback loops'.[32] In these cases, police are repeatedly sent to the same identified hot spots, irrespective of the true crime rates. The researchers demonstrated how historical crime incidents that have been "discovered" by on-duty officers can aggravate the degree of runaway feedback, while in turn, historical incidents that were "reported" by citizens can attenuate, but cannot entirely remove such feedback.

There are likewise worries about the ways predictive tools can unfairly target crime offenders and crime victims. For example, the Correctional Offender Management Profiling for Alternative Sanctions (COMPAS) framework which is used by U.S. courts to determine the likelihood that convicted criminals will commit future crime was found to be biased against minorities.[33] Likewise, the Chicago Police Department was subject to intense scrutiny in 2016 when a study conducted by the Rand Corporation[34] found that individuals estimated to be at highest risk of gun violence were neither *"more or less likely to become a victim of a homicide or shooting."* The researchers noted that "*one potential reason why being placed on the list resulted in an increased chance of being arrested for a shooting is that some officers may have used the list as leads to closing shooting cases."*

Meanwhile, the Chinese Government is piloting facial recognition[35] coupled with artificial intelligence to analyze video footage from surveillance cameras installed in public areas in the city of Chongqing, southwestern China. The images are said to be used to track suspects and predict crime. A director of a Chinese tech company developing video surveillance software summarizes the approach as "tracking routine movement" of people to identify suspicious behavior.

In a country with 172 million state-controlled surveillance cameras, the nation-wide expansion of the initiative can further damage the already battered civil liberties of the Chinese people. The system is said to be imperfect, yielding a large number of false positives (when the facial recognition algorithm wrongly identifies a suspect). Experts in law and technology question whether there are due process systems in place to protect citizens from false accusations, and if the false positives are disproportionately skewed toward political dissidents or minority groups.

Nevertheless, the Chinese are eager to disseminate their facial recognition surveillance solutions to foreign governments. Recently, members of the newly-elected Brazilian government have visited China to learn about the technology, and are studying the possibility of using Chinese facial biometrics systems in Brazilian CCTV network, raising similar concerns.[36]

The accelerated pace and spread of crime and violence prediction tools means that these concerns will only grow in the coming years. Indeed, new platforms are already being tested that aim to automatically classify gang-related crime,[37] combine social media with criminal history to predict crime,[38] and use artificial intelligence to identify individuals[39] with higher risk profiles of committing terrorist acts. The rapid roll-out of these tools invariably raise complex ethical questions in relation to police action and civil rights.

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32 Ensign, Friedler, Neville, Scheidegger, Venkatasubramanian, 2017.

33 Angwin, Larson, Mattu, Kirchner, 2016.

34 Saunders, Hunt, Hollywood, 2016.

35 Denyer, 2018.

36 Burt, 2019.

37 Winston & Burrington, 2018.

38 Winston, 2018.

39 Mortimer, 2017.

Establishing standards and regulations

Based on this cursory review, there are several considerations that law enforcement agencies would do well to consider before implementing predictive policing systems. First and foremost, departments must evaluate the quality of their crime data and the capabilities of officers and officials to perform such an evaluation. Specifically, it is imperative that crime underreporting and blind spots are dealt with, and that departments can ensure that citizens from all neighborhoods and social groups have confidence - and make use of - the police emergency hotline to report crime when in need. Likewise, police reports must indicate precise addresses including their geographic coordinates. Also, to help mitigate the risk of runaway feedback loops, incidents must be labeled to indicate if they were reported by citizens, or if they were initiated by an on-duty officer while on routine patrol.

Capital and operational expenditures associated with crime prediction tools must also be carefully assessed. The most sophisticated forecasting packages are expensive and may not be suitable for all police departments, especially smaller and mid-sized units in low- and medium-income settings. Instead of purchasing expensive software, some police departments may benefit more from hiring and training analysts[40] to use standard (and often open source) software to plot crime events on a map and run simple, yet useful, time series analysis.

Policing innovations for agile security also should make use of the interconnection of urban infrastructure[41] including sensors and unstructured data. Even so, privacy concerns should be paramount in the decision to process such information. Where possible, predictive tools should allow citizens to understand what is inside the "black box". While private vendors understandably seek to protect their source code, this lack of transparency (coupled with their underlying mathematical complexity) makes it difficult for law enforcement agencies and civil society to understand how the predictions are generated. This can undermine confidence in the tool.

Complicating matters, the secrecy associated with predictive tools may subject departments to increasing legal liabilities as cybersecurity and privacy regulations continue to evolve. For example, Article 11 of the European Union's General Data Protection Regulation (GDPR)[42] Directive 2016/680 prohibits the making of *"a decision based solely on automated processing, including profiling, which produces an adverse legal effect concerning the data subject or significantly affects him or her"*, unless appropriate safeguards are in place, including *"at least the right to obtain human intervention"* (see Annex 2).[43]

In North America, civil society organizations are also mobilizing to make police departments accountable when using predictive policing methods. For example, the American Civil Liberties Association (ACLU)[44] together with 17 organizations recently issued a statement

40 Olligschlaeger, (n.d.).

41 Muggah, 2018.

42 European Union, 2016.

43 Fortunately, the same directive lays out a set of principles that competent authorities should follow when processing personal data for the purpose of law enforcement. These principles can impact how crime data is collected and processed, and how predictive algorithms are developed, tested, documented, and deployed.

44 ACLU, 2016.

outlining concerns regarding racial biases and lack of transparency in predictive policing. Likewise, the Brennan Center for Justice[45] has challenged the NYPD on court for their refusal to disclose information on their predictive policing systems. These types of legal requests are likely to grow more, not less, frequent.

To ensure that such tools are developed and used in a responsible manner, engineers and law enforcement agencies can make use of guidelines and principles when developing, deploying, and disclosing information about predictive policing tools. Positive examples include the "Digital Decisions Tool" of the Center of Democracy and Technology[46] and the International Conference of Data Protection and Privacy Commissioners' Declaration on Ethics and Protection in Artificial Intelligence.[47]

At a minimum, law enforcement agencies around the world need to be informed on the challenges and caveats when applying these types of agile and smart policing strategies. While some governments may be less concerned with the ethics of undertaking intrusive monitoring of would be suspects, many democratic states will need to ensure that privacy and transparency are principles that are kept up front and center.

Above all, people must remain the most important element in the crime forecasting process, even when the most advanced software packages are used. Predictive tools need not replace the intuition and experience of law enforcement officers, but rather complement them in a transparent and auditable manner. When responsibly implemented, predictive policing tools can improve law enforcement's capabilities to solve problems, make decisions, and more effectively plan their operations.

45 Levinson-Waldman & Posey, 2017.

46 CDT, (n.d.).

47 ICDPCC, 2018.

Annex 1. Selected applications of predictive policing and evaluation results

City, date of the evaluation, software name	Finding
Shreveport, Louisiana (US), 2012, Predictive Intelligence Led Operational Targeting (PILOT).[48]	Formal evaluation (blocked randomized controlled field experiment). No statistical evidence that crime was reduced more in the experimental districts than in the control districts.
Los Angeles (US), 2013, PredPol.[49]	Formal evaluation (randomized control trial). Average 7.4% reduction in crime volume as a function of patrol time. Reduction of property crimes by 12% compared with the previous year in treated area (Foothill); in neighboring districts, property crime rose 0.5%. Note: non-independent evaluation, done by founders of PredPol.
Chicago (US), 2013, Strategic Subjects Litc - SSL.[50]	Quasi experimental evaluation. No impact on the list of people most likely to be involved in a shooting.
Greater London Area (UK), 2013, Metropolitan Police Service MBR Algorithm.[51]	Evaluation of crime forecasting accuracy. Burglary – 'very low' to 'low' predictive accuracy (hit rates of 0 – 5%). Motor vehicle theft – 'low' predictive accuracy (hit rates of 1-10%). Robbery – 'low' to 'medium' predictive accuracy (hit rates of 0-20%). Theft – 'medium' to 'good' predictive accuracy (hit rates of 13- 54%).
Kent (UK), 2014, PredPol.[52]	Operational review. PredPol is 10 times more likely to predict the location of crime than random patrolling and more than twice as likely to predict crime as boxes produced using intelligence led techniques. During the North Kent pilot, 25% of boxes were visited on average and a 4% reduction in crime was observed.

48 Saunders, Hunt, Hollywood, 2016.

49 Mohler et. al, 2012.

50 Saunders, Hunt, Hollywood, 2016.

51 Bryant, Azhar, Blackburn, Falade, 2015.

52 Kent Police, (n.d.).

City, date of the evaluation, software name	Finding
Milan (IT), 2008-17, KeyCrime.[53]	Quasi-random evaluation. Increase in clearance rates. Reduction of robberies in 18%. Saving in prevention of violence of up to USD$2.5 million.
Santa Cruz, California (US), 2011, PredPol.[54]	Report of results (no evaluation). An initial 11% reduction in burglaries and a 4% decrease in motor vehicle thefts. As time progresses, the reductions increase. Over a 6-month period, burglaries declined 19%.
Richmond, Virginia (US), 2006-17, WebFOCUS -IBM SPSS's Clementine and Predictive Enterprise Services.[55]	Report of results (no evaluation). Since implementation, reduction of incident rates of murder (32%), rape (20%), robbery (3%), aggravated assault (18%), burglary (18%) and auto theft (13%).
Santiago de Chile (CL), 2015, CEAMOS.[56]	Report of results (no evaluation). Tests carried out by the police have reported an effectiveness of 89%.
La Plata (AR), 2018.[57]	Report of results (no evaluation). Reduction of crime in 40% in identified hot spots.
Durham (UK), 2013, Harm Assessment Risk Tool (HART).[58]	Royal United Services Institute study. HART was found to predict low-risk individuals with 98 per cent accuracy and high-risk with 88 per cent accuracy.
The Netherlands, 2017, Crime Anticipation System (CAS).[59]	Trial pilot. Over 30% of thefts were committed in the zones predicted by the algorithm.
Baden-Württemberg (GE), 2016, PRECOBS.[60]	Max Planck Institute evaluation. Moderate effects in the reduction of burglary.

53 Mastrobuoni, 2017.
54 Friend, 2013.
55 Harris, 2008.
56 CEAMOS, 2018.
57 El Dia, 2018.
58 Babuta, 2017.
59 Harinarayan, 2017.
60 Straub, 2018.

Annex 2. GDPR Directive 2016/680, Article 4 - Principles relating to processing of personal data

Member States shall provide for personal data to be:

(a) processed lawfully and fairly;

(b) collected for specified, explicit and legitimate purposes and not processed in a manner that is incompatible with those purposes;

(c) adequate, relevant and not excessive in relation to the purposes for which they are processed;

(d) accurate and, where necessary, kept up to date; every reasonable step must be taken to ensure that personal data that are inaccurate, having regard to the purposes for which they are processed, are erased or rectified without delay;

(e) kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which they are processed;

(f) processed in a manner that ensures appropriate security of the personal data, including protection against unauthorised or unlawful processing and against accidental loss, destruction or damage, using appropriate technical or organisational measures.

References

ACLU (2016). *Statement of Concern About Predictive Policing by ACLU and 16 Civil Rights Privacy, Racial Justice, and Technology Organizations.* Retrieved from https://www.aclu.org/other/statement-concern-about-predictive-policing-aclu-and-16-civil-rights-privacy-racial-justice.

Alvarado, N. (2017). *¿Cómo Sirve Big Data para Prevenir el Crimen? Esperamos Averiguarlo en 6 ciudades en Colombia.* Retrieved from https://blogs.iadb.org/seguridad-ciudadana/es/sirve-big-data-prevenir-crimen-esperamos-averiguarlo-6-ciudades-colombia/.

Angwin, J., Larson, J., Mattu, S., Kirchner, L. (2016). *Machine Bias.* Retrieved from https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing.

Babuta, A. (2017). *Big Data and Policing.* Retrieved from https://rusi.org/sites/default/files/rusi-bigdata-press-2017.pdf.

Braga, A., Papachristos, A., Hureau, D. (2012). *Hot Spots Policing Effects on Crime.* Retrieved from http://www.campbellcollaboration.org/media/k2/attachments/Braga_Hot_Spots_Policing_Review.pdf.

Brantingham, P. L. & Brantingham, P. J. (1991). *Environmental Criminology.* DOI: 10.4135/9781412959193.n32.

Bryant, R., Azhar, H., Blackburn, B., Falade, M. (2015). *Evaluation of the MPS Predictive Policing Trial* (June 2015). Retrieved from http://create.canterbury.ac.uk/15974/1/15974.pdf.

Burt, C. (2019). *Possibility of Chinese Facial Biometrics Systems in Brazilian CCTV Network Raises Concerns.* Retrieved from https://www.biometricupdate.com/201901/possibility-of-chinese-facial-biometrics-systems-in-brazilian-cctv-network-raises-concerns.

CDT (n.d). *Digital Decisions.* Retrieved February 07, 2019, from https://cdt.org/issue/privacy-data/digital-decisions/.

CEAMOS (2018). *The Rise of Predictive Policing: The Experience of Baltimore, Chicago and Chile.* Retrieved from http://ceamos.cl/wp/?p=1344.

Cohen, L. & Felson, M. (1979). Social Change and Crime Rate Trends: a Routine Activitiy Approach. *American Sociological Review,* 44, 588 - 608. DOI: 10.2307/2094589.

Cornish, D.B. & Clarke, R.V. (1987). Understanding Crime Displacement: An Application Of Rational Choice Theory. *Criminology*, 25 (4), 783 - 990. DOI: 10.1111/j.1745-9125.1987.tb00826.x.

Denyer, S. (2018). *Beijing Bets on Facial Recognition in a big Drive for Total Surveillance.* Retrieved from https://www.washingtonpost.com/.

El Dia (2018). A un año de su Aplicación, Destacan los Resultados del “Policiamiento”. Retrieved from https://www.eldia.com/nota/2018-10-10-1-43-41-a-un-ano-de-su-aplicacion-destacan-los-resultados-del-policiamiento--policiales.

Ensign, D., Friedler, S., Neville, S., Scheidegger, C., Venkatasubramanian, S. (2017). *Runaway Feedback Loops in Predictive Policing.* Retrieved from https://arxiv.org/abs/1706.09847.

European Union (2016). Directives. *Official Journal of the European Union,* 119 (89). Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L0680&from=EN.

FAT/ML (n.d.). *Fairness, Accountability, and Transparency in Machine Learning.* Retrieved February 07, 2019, from http://www.fatml.org/resources/principles-for-accountable-algorithms.

Friend, Z (2013). *Predictive Policing: Using Technology to Reduce Crime.* Retrieved from https://leb.fbi.gov/articles/featured-articles/predictive-policing-using-technology-to-reduce-crime.

Gobierno Argentina (2017). *Programa para Reducir Delitos Callejeros.* Retrieved from https://www.argentina.gob.ar/noticias/programa-para-reducir-delitos-callejeros.

Harvard Kennedy School (n.d.). Compstat: A Crime Reduction Management Tool. *Government Innovators Network.* Retrieved February 7, 2019, from https://www.innovations.harvard.edu/compstat-crime-reduction-management-tool.

Harinarayan, S. (2017). *Predicting Crime Using Big Data.* Retrieved from https://www.hollandtimes.nl.

Harris, C. (2008). *Richmond, Virginia, Police Department Helps Lower Crime Rates with Crime Prediction Software.* Retrieved from http://www.govtech.com/public-safety/Richmond-Virginia-Police-Department-Helps-Lower.html.

Hunchlab (n.d.). *Resources.* Retrieved February 7, 2019, from https://www.hunchlab.com/resources/.

ICDPPC (2018). *Declaration on Ethics and Data Protection in Artificial Intelligence.* Retrieved from https://icdppc.org/wp-content/uploads/2018/10/20180922_ICDPPC-40th_AI-Declaration_ADOPTED.pdf.

Johnson, S., Guerette, R., Bowers, K. (2014). Crime Displacement: What we Know, What we Don’t Know, and What it Means for Crime Reduction. *Journal of Experimental Criminology,* 10 (4), 549 - 571. DOI: 10.1007/s11292-014-9209-4.

Levinson-Waldman, R., Posey, E. (2017). *Predictive Policing Goes to Court.* Retrieved from https://www.brennancenter.org/blog/predictive-policing-goes-court.

Lum, K., Isaac, W. (2016). To Predict and Serve? *Significance*, 13 (5), 14 - 19. DOI: 10.1111/j.1740-9713.2016.00960.x.

Mastrobuoni, G. (2017). *Crime is Terribly Revealing: Information Technology and Police Productivity.* Retrieved from https://www.dropbox.com/s/nxwabyzqvklombk/Keycrime_evaluation_new4.pdf?dl=0.

Ministerio del Interior (n.d.). *Visita a Departamentos de Policía de Estados Unidos.* Retrieved February 7, 2019, from https://www.minterior.gub.uy/index.php/component/content/article/78-noticias/ultimas-noticias/1717-visita-a-departamentos-de-policia-de-estados-unidos.

Mohler, G., Short, M., Brantingham, P., Schoenberg, F., Tita, G. (2012). Self-Exciting Point Process Modeling of Crime. *Journal of the American Statistical Association*, 106 (493), 100 - 108. DOI: 10.1198/jasa.2011.ap09546.

Mortimer, C. (2017). *China's Security Boss Planning to use AI to Stop Crime Before it Even Happens.* Retrieved from https://www.independent.co.uk/.

Muggah, R. (2018). *How Smart Tech Helps Cities Fight Terrorism and Crime.* Retrieved from https://www.weforum.org.

Office of Justice Programs (2014). Predictive Policing. *National Institute of Justice.* Retrieved from https://www.nij.gov/topics/law-enforcement/strategies/predictive-policing/Pages/welcome.aspx.

Olligschlaeger, A. (2015).*Crime Forecasting on a Shoestring Budget. Crime Mapping & Analysis News, 2.* Retrieved from https://crimemapping.info/article/crime-forecasting-shoestring-budget/.

Peretti, J. (2017). Palantir: *The 'Special ops' Tech Giant That Wields as Much Real-World Power as Google.* Retrieved from https://www.theguardian.com.

Predpol (n.d.). *The Three Pillars of Predictive Policing.* Retrieved February 7, 2019, from https://www.predpol.com/law-enforcement/.

Kent Police (n.d.). *Pred Pol operational review.* Retrieved February 7, 2019, from http://www.statewatch.org/docbin/uk-2014-kent-police-predpol-op-review.pdf.

Knight, W. (2017). *The Dark Secret at the Heart of AI.* Retrieved from https://www.technologyreview.com.

Oram, A. (2016). *If Prejudice Lurks Among us, can our Analytics do Any Better?* Retrieved from https://www.oreilly.com/ideas/if-prejudice-lurks-among-us-can-our-analytics-do-any-better?imm_mid=0ebaf1&cmp=em-data-na-na-newsltr_20161228.

Saunders, J., Hunt, P., Hollywood, J. (2016). Predictions Put Into Practice: a Quasi-Experimental Evaluation of Chicago's Predictive Policing Pilot. *Journal of Experimental Criminology,* 12 (3), 347 - 371. DOI: 10.1007/s11292-016-9272-0.

Semana (2019). *La Universidad Nacional ayudará a predecir crímenes en Bogotá.* Retrieved from https://www.semana.com/educacion/articulo/la-universidad-nacional-y-la-alcaldia-de-bogota-trabajan-en-un-sistema-de-prediccion-de-crimenes/609920.

The Economist (2013). *Don't Even Think About it.* Retrieved from https://www.economist.com.

Winston, A. (2018). *New Orleans Ends its Palantir Predictive Policing Program.* Retrieved from https://www.theverge.com.

Winston, A. & Burrington, I. (2018). *A Pioneer in Predictive Policing is Starting a Troubling New Project.* Retrieved from https://www.theverge.com.

Woetzel, J., Remes, J., Boland, B., Lv, K., Sinha, S., Strube, G., Means, J., Law, J., Cadena, A., Tann, V. (2018). *Smart Cities: Digital Solutions for a More Livable Future. McKinsey & Company.* https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/smart-cities-digital-solutions-for-a-more-livable-future.

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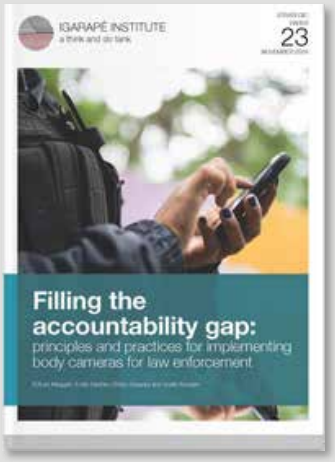

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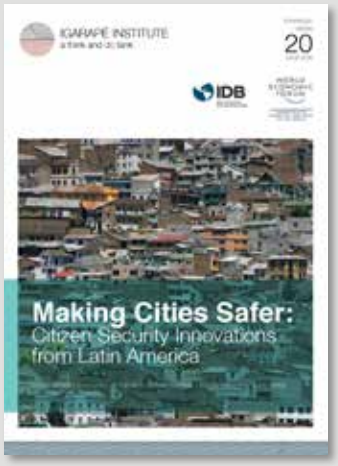

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