
PREDICTIVE POLICING

CAN DATA ANALYSIS HELP THE POLICE TO BE IN THE RIGHT PLACE AT THE RIGHT TIME?

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FOREWORD

Several recent reports have provided us with a thorough and well-documented analysis of the current state of the Norwegian police. A recurrent theme in all these reports is the need to make better use of the potential inherent in information and communication technology. A central message in the report of the 22 July Commission was the acknowledgement that we are in the middle of a technological revolution that has contributed to major changes in society, and that the Norwegian police must keep up with the developments. This leads to expectations that in the future the police will be more ambitious in their use of technology – in operational and preventive work too.

An important objective for the police's operational work is that the patrols are located where they are needed, when they are needed. In recent years the police in several countries have started using new data analysis techniques that predict where and when needs are likely to be greatest. The police and the suppliers of these tools report good experience and claim that these kinds of analyses make it easier to stay ahead of the game and focus more on preemptive policing and prevention.

In this report the Norwegian Board of Technology assesses data-driven analysis tools and predictive policing – and whether they should be adopted by the Norwegian police.

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We would also like to thank the many experts in Norway and abroad who have helped us in the work on this report. The Norwegian Board of Technology's project manager Robindra Prabhu headed the project.

The Norwegian Board of Technology is an independent body that advises the Norwegian Parliament and other authorities on new technology and promotes

an open, public debate. We hope this report will contribute to a nuanced debate about the opportunities and challenges entailed by data-driven policing.

Tore Tennøe
Director, the Norwegian Board of Technology

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SUMMARY AND RECOMMENDATIONS

A proactive police force that prevents crime is better than a reactive police force that responds after the event. The police in several countries have begun to use new technology that is intended to help them to predict where and when new crimes will take place. Should the Norwegian police consider using this kind of technology too?

The Norwegian police are currently undergoing an important and comprehensive reform process. In the wake of the terrorist attacks in 2011, several reports have provided a thorough and well-documented analysis of the current state of the Norwegian police. A recurrent theme has been the need to make better use of the potential inherent in modern information and communication technology (ICT). A central message of the report of the 22 July Commission was the acknowledgement that we are in the middle of a technological revolution that has contributed to major changes in society and that the Norwegian police must keep up with the developments.

The Norwegian police have an interesting time ahead. The conditions necessary for the police to be able to start using modern technology are going to be put in place, so that more tasks can be performed in the field. Through the "Local Police Reform" ("Nærpolitireformen") the police are going to be organ-

ised in such a way that they are more "operational, visible and accessible, with the capacity and competence to prevent crime".¹

An important topic that has been discussed in this context is how the data available to the police ought to be used to enhance police efficacy. Use of technology that analyses the current crime situation and predicts where and when crimes are likely to take place is on the rise. In the USA in particular, the use of these kinds of analyses is becoming more common, but police organisations in European countries such as Great Britain, Germany, Switzerland and the Netherlands have also begun to reap experience from the use of these kinds of tools.

Advocates of this type of predictive policing claim that these kinds of data analyses provide decision support with high operational value, which in turn will lead to more efficient utilisation of the existing police resources and less crime. Critics point out that we still know very little about whether this type of policing actually works, and that the technology in itself raises several methodological and ethical questions with serious implications for the relationship between the police and citizens.

This report assesses both the opportunities and the challenges that predictive analytics will entail for the Norwegian police. The Norwegian Board of Technology wants to pave the way for an open debate on the use of this kind of technology in the police.

NEW TECHNOLOGY AND AN ANALYSIS-DRIVEN POLICE FORCE

The use of data analyses to support the police's strategic and tactical work is not new. In the USA in particular, police organisations have long used GIS-based analysis to chart how different types of crime tend to be concentrated in certain areas and at certain times.

In recent years, this type of analytical work has evolved along with advances in technology and the digital transformation of society. Different police units are adopting so-called predictive analytics to:

¹ Proposition no. 61 to the Storting (bill and draft resolution) (2014–2015), Amendments to the Police Act etc. (The Local Police Reform), p. 5

- predict where and when the risk of certain types of crimes is likely to increase
- predict which people can be linked to an increased risk of committing a crime in the future
- predict which areas, groups or individuals have an increased risk as future targets of crime or that the police for some other reason ought to direct their attention to.

There is broad variation in the methods, complexity and practical application of predictive analytics. At the same time, several aspects of predictive policing are supported by the developments in technology:

- Use of different sources of data. Digitisation of datasets renders them accessible to computer analysis.
- The use of modern ICT to explore patterns and relationships across datasets, as well as to predict how crime is likely to develop in the future.
- Analyses that provide risk predictions within delimited areas and time slots. This lends the analyses a different operational value compared with long-term trend analysis. In addition, using modern communication tools allows insights to be conveyed directly to the patrols, for example, in the form of risk areas marked on a digital map on a tablet.

Predictive policing is based on the assumption that it is not entirely random where and when crimes take place; rather that they are often concentrated in particular places and at particular times. Through better knowledge about when and where crimes occur, the police can analyse what it is about these places that facilitates crime. By changing these factors through, for example visible policing, better street lighting, or other measures, new crimes can be prevented.

PREVALENCE AND EFFECTIVENESS

The USA in particular has seen a surge in the use of predictive analytics in recent years, but European countries too, such as Britain, the Netherlands, Switzerland and Germany are now beginning to test these kinds of tools. Police organisations and suppliers of these kinds of tools generally report positive experiences, in the form of better knowledge and reduced crime. It is

therefore timely to ask whether the Norwegian police ought also to make use of the possibilities this technology affords.

However, critics have queried the neutrality, validity and representativeness of some of these reports. At present there are few systematic, independent evaluations of predictive policing that can confirm or refute whether these kinds of analyses have actually contributed to a statistically significant reduction in crime in the areas where they have been adopted. Lack of transparency about which data sources were used, how the analyses work, how they are used, and how effective they are contribute to the uncertainty concerning predictive policing.

In addition, Norway has population centres of varying sizes, and it is unclear whether these kinds of analyses will have any real utility value in sparsely populated areas with large distances and a relatively small population.

There is a clear need for more knowledge about the efficacy of these systems and their suitability for use in Norway.

Targeted interventions in identified problem areas have been shown to reduce crime in both the intervention area and adjoining areas. This makes predictive policing an interesting working method that the Norwegian police ought to consider.

ETHICAL CONSIDERATIONS

The main motivation behind predictive policing is crime prevention, and the aim is to focus the deployment of police resources to those areas where the needs are greatest or they have the greatest effect. The police have always made these kinds of prioritisations, but predictive policing shifts this focus from larger areas and groups of people to specific places and individuals. This may be useful and necessary, but a number of ethical questions arise when data analysis is used to determine which places and people require more attention from the police.

Predictions involving people can be problematic because they by definition do not treat people as isolated individuals, but rather as members of a larger group that demonstrates certain characteristics that can be associated with statistical probabilities. It can be perceived as fundamentally unfair to be stigmatised simply for belonging to a given group. If the police's response to risk predictions leads to more surveillance, stigmatisation or problems in

everyday life for the "high-risk individuals", this would undermine people's trust in the police and the legitimacy of predictive policing.

Place-based predictions are generally perceived as more neutral, since they do not directly target individuals, but rather geographically defined areas that demonstrate a higher risk of crime. Nevertheless, it is people and not places who commit crimes. Place-based predictions may therefore have consequences for the people in the identified hotspot.

Predictive analytics ought not to contribute to categorical suspicion of individuals in a high-risk area or be used to legitimise a more widespread use of stop and search. Moreover, it is important that predictive analyses are followed up by more than police presence and that the underlying environmental causes of the heightened crime rate are addressed.

Predictive analytics is seldom value-neutral, but is shaped by both the datasets the systems are fed and the assumptions, generalisations and assessments that are built into the algorithms. If the data fed into the system are incorrect, imprecise, incomplete, biased or contain large volumes of dark figures, the predictions will also be wrong. In the worst case, this technology could promote systematisation and legitimisation of bias and discriminatory practices. It is especially important to take steps to ensure that predictive analytics does not mask systematic discrimination of various groups in society.

However, it should be noted that today's policing is not value-neutral. Ethical choices are often not clearly articulated or are hidden away in various qualitative decision-making processes. Proper use of predictive technology can also help clarify these kinds of ethical choices and force a broader discussion on how the police should work. Although this of course presupposes openness about which data predictive analytics uses, how the analyses work and how they are used in practice.

A WORKING MODEL FOR THE NORWEGIAN POLICE

Predictive analytics has the potential to provide the police with new knowledge, important strategic insight and an enhanced basis for decision making in the police's preventive and crime-fighting work. However, it is not the analyses themselves that lead to a reduction in crime. For predictive analytics to be effective, the police must constantly assess which response is best suited to solve a problem and ensure that the necessary measures are carried out and followed up. Analytical work must therefore be closely linked to the

tactical and operational work and be firmly anchored in the police's long-term strategies.

The police can only benefit from predictive policing if the analyses are part of a cyclic working process consisting of at least four elements:

1. **Collection and quality control of data:** It is important that the datasets are complete, that any potential biases² are identified and taken into account, and that the datasets are relevant to the analysis.
2. **Analysis and predictions:** Suitable analytical techniques for the topic under investigation are selected, and it is assessed whether several independent analyses should be run in parallel. Uncertainty and validity restrictions are identified and clarified. It is important to understand the underlying methods and reflect on which factors might contribute to crime in a high-risk area.
3. **Operational response and intervention:** The analyses and predictions are followed up by a professional police assessment of what constitutes an appropriate response. In some cases this may be visible police presence on the scene; in other cases, usually in collaboration with other players, steps may be taken to alter conditions that encourage crime at the particular location. It is important that the people who carry out a specific response are familiar with the analysis, have sufficient information and share a common understanding of the situation and problem.
4. **Evaluation and measurement of effectiveness:** The intervention is followed up by short-term and long-term evaluations of whether the response has had the intended results. It is important that these evaluations are systematic, independent and take uncertainties into account. New data must be generated and analysed, and if necessary the response must be changed and adapted.

This kind of working model assumes that the police's datasets are made available for analysis and that the police establish procedures for data collection and assessment of data quality, build up knowledge and expertise on data analysis, and have the necessary tools for information exchange between analytical and operational units.

² Bias or skew means data that systematically deviates from the true values. Bias may arise as a result of errors, inaccuracies, prejudice or selective use of data.

All predictive policing must of course also respect the legislation, personal privacy, and be able to handle ethical dilemmas. It must be possible for independent parties to inspect the analytical work. Although in some cases it may be tactically necessary to keep information secret, secrecy regarding predictive analysis may also undermine the relationship of trust between the public and the police. A certain degree of openness concerning the results the police achieve using predictive policing ought therefore to be a key element in a Norwegian working model.

RECOMMENDATIONS

Predictive analysis is increasingly being used in police work. Despite the lack of independent and systematic evaluations of these methods, the Norwegian Board of Technology nevertheless believes that the time is ripe to try out these kinds of methods in Norway. Trials will yield empirical data on whether predictive analysis can provide benefits in the form of more efficient resource utilisation and reduced crime.

The Norwegian Board of Technology recommends that the Norwegian police test tools for predictive data analysis in their everyday operational work.

The Norwegian Board of Technology believes that the Norwegian police ought to gain empirical experience with this type of preventive policing under Norwegian conditions. Predictive analytics ought to be tested and evaluated systematically in a number of different police districts in Norway in order to generate knowledge about its effectiveness and suitability for Norwegian conditions. The trials ought to be subject to independent research, evaluation and verification.

The use of predictive analytics ought nevertheless to be restricted:

For the time being, predictive analytics ought only to be used to calculate the risks associated with places, and not individuals

The predictive analysis techniques that make predictions on the individual level are still immature. There are also a number of ethical issues linked to analyses on the individual level. These ought to be debated in the public

sphere, and the long-term consequences need to be considered. The Norwegian Board of Technology therefore recommends that the use of predictive analytics initially be limited to predictions related to places and times.

If the results are positive, more extensive use of predictive analytics can then be assessed. In which case, the Norwegian Board of Technology recommends the following measures:

Use predictive analytics in the management of the patrol fleet

Today's patrol management relies largely on the patrol's experience and the individual police officer's professional judgement and assessments, which can result in considerable variation in the preventive effect. If the findings from the trials with predictive policing are positive, the police ought to consider using data-driven analysis as the starting point for patrol management and open up for dynamic management of the patrol fleet. Although data-driven management of the patrol fleet must necessarily be balanced against the autonomy of the patrol, it is important that the overall resource allocation is rooted in analyses of where and when the need for a police presence will be greatest.

Make the analysis accessible to the police in the field

The main strength of predictive analytics is its ability to make new knowledge and insight available in operational real time. It is therefore important that the police make the necessary arrangements so that the patrols have timely access to this knowledge on mobile devices wherever they are, for example, on a tablet or smartphone. The information must be presented in such a way that it provides real and active decision support in every-day operations.

Collect and make accessible relevant data that can be used for analysis

Predictive analytics requires accurate and up-to-date data of high quality. The Police Analysis ("Politianalysen") identified poor data quality and accessibility as one of the reasons why the Norwegian police have not been able to make full use of the opportunities afforded by data-driven crime analytics. The police's existing data must therefore be digitised and made accessible. Furthermore, the police's ICT systems must be adapted to enable the police to per-

form digital analyses and detect patterns in data for the purpose of crime prevention.

At the same time a unified standard ought to be developed for data collection, including information that is not necessarily relevant in a criminal context, but that might be very useful for analyses for preventive purposes. Examples include weather conditions, evacuation routes and traffic status, and other environmental factors at the location. The technical tools must support increased data collection and the needs that preventive policing has at any given time.

New R&D unit with close ties to the police districts

Predictive policing draws on expertise in mathematics, statistics, computer modelling and informatics, as well as criminology, practical policing and local knowledge.

Although there are commercially available tools that can be used without detailed knowledge of the underlying methods, it is essential that the tools are used correctly, that they are adapted to the local conditions, and that the police are aware of the limitations of the analyses. At the same time, it is also important that the analytical work is not at the expense of the police's other operational tasks.

In several countries around the world, predictive analytics for policing purposes is undertaken in collaboration with different research groups. This kind of collaboration can promote gradual, tailored knowledge transfer and ensure correct use of the tools and correct interpretation of the results. Norway has several research centres that could support a data-driven police force. The Police Boards ("Politirådene") can contribute valuable knowledge about local problems.

The Norwegian Board of Technology therefore recommends establishment of a new interdisciplinary research unit dedicated to data-driven policing; for example, at the Norwegian Police University College. In addition to developing new methods and studying international trends, the unit should also assist the analysis divisions in the police districts in the selection and adaptation of methods and algorithms. The unit should also offer courses, training programmes and instruction in the use of the new methods and analysis tools. This will serve to strengthen the local analytical work in each district, contribute to increased exchange of information and experience across police dis-

tricts, and protect the regional police organisations against powerful commercial interests.

Need for external inspection and supervision of the police's predictive analytics

As automated data analysis becomes a more important decision support element in the justice sector, it will also be important to check and understand how decisions are made. The Ministry of Justice and Public Security ought to ensure that regular supervision inspections are carried out of the algorithms and analyses that the police use in their work. This is important for the ability to check that the police are using the analytical tools correctly, operating within the law, and respecting and safeguarding personal privacy at all levels. Openness of this nature is particularly important in order for the police to maintain the public's trust and confidence. An external, independent and technically competent supervisory body ought to have access to the police computer and data analysis systems in order to assess the extent to which:

- the police are using robust and quality-assured data
- the systems operate within the bounds of the law and applicable guidelines
- the algorithms contain biases, uncertainties, subjective judgements or random choices that might serve to systematise unintended consequences such as discrimination.

The National Police Directorate ought to publish crime statistics and provide more civilian players with access to data about developments in crime and results achieved

Although the police will often have a legitimate need to keep their predictive analyses hidden from the public, it is also important that the police disclose anonymised criminal data indicating where and when crimes occur, type of crime, the current status of the investigation or how police have responded to the incident. The granularity of released time and place data may be adjusted so that publication of the datasets will not cause any tactical harm to the police's ongoing predictive work.

The datasets ought to be published on an official website such as data.norge.no, under a Norwegian licence for public data and be updated fre-

quently. In this way, everyone will have standardised access to anonymous crime data and will be able to use these statistics for various purposes. At the same time, the National Police Directorate ought to develop an online visualisation service that makes it easy for people to find out about the crime trends in their local neighbourhood.

This kind of disclosure and publication of crime data will:

- contribute to transparency in the police's predictive analytical work and pave the way for public debate about police practice and outcomes
- enable involvement and interaction with other civilian players in the local community, such as the municipal authorities, schools and recreational organisations, aid agencies and citizens
- facilitate innovation and development of new tools and analyses

1 THE POLICE REFORM AND THE NEED FOR ANALYSIS

"The primary object of an efficient police is the prevention of crime: the next that of detection and punishment of offenders if crime is committed. To these ends all efforts of police must be directed."

Sir Richard Mayne, "The New Police of the Metropolis" (1829)

The Norwegian police are currently undergoing their most important and comprehensive reform process in recent times. Through a major modernisation and upgrade of their ICT systems and other technology, the police are to "join the information revolution". Technology shall contribute to increased efficiency and improved quality in the performance of tasks.³

However, technology is not only a tool to support the police's work processes; it is also changing the way the police work.

In the last decade we have witnessed how ICT and data analysis have revolutionised work processes in many other information-intensive operations:

³ Official Norwegian Report (NOU) 2013:9, "One police – equipped to meet future challenges", chap. 8.1, p. 43

- **Banking and insurance:** banks use different data analytical processes to determine the risks and creditworthiness of loan applicants
- **The tax authorities:** predictive modelling is used to identify groups of taxpayers with an increased risk of tax evasion⁴
- **The health sector:** various data are analysed to identify patients who might be more likely to have a relapse after surgery⁵

The changes in these sectors have been driven by a combination of advances in technology, including the digitisation of information, and cheaper access to more powerful computing power.

At the same time we are also seeing that sophisticated analysis techniques that were previously reserved for researchers, the financial industry and heavy engineering projects are now becoming more commonplace in other sectors too.

Good police work is often dependent on timely access to and analysis of various data. This data basis will be further strengthened in the coming years, in part because:

- New tools and systems for sharing information will make it easier for the police to use existing datasets⁶ and generate new data in real time.
- Through smartphones and social media the public will be able to assist the police in their work by providing completely new data, as discussed by the Norwegian Board of Technology in a previous report.⁷

Advanced analysis techniques make it possible to glean insight and knowledge from the many different datasets available to the police.⁸ This report focuses on the growing use of so-called "predictive analytics". These kinds of risk assessments are intended to predict where and when certain types of crime are most likely to occur or identify high-risk individuals and groups.

⁴ The Norwegian Tax Administration (2014); the Norwegian Tax Administration (2015)

⁵ Siegel (2013), table 4

⁶ In this context, a dataset means an organised, structured collection of data that can be processed by computers.

⁷ The Norwegian Board of Technology (2014): Online with the public – how smartphones and social media are creating new opportunities for the Norwegian police

⁸ McCue (2003)

The police in a number of countries already use these kinds of techniques. Should the Norwegian police do the same?

1.1 GREATER POLICE EFFICACY USING DATA ANALYTICS?

The police's social mission is to prevent and combat crime, thereby creating security for the population.⁹ It is also an explicit goal that the police shall base its work on knowledge.

Both the 22 July Commission¹⁰ and the Police Analysis¹¹ have called for a more analytical approach to crime prevention. They also highlighted the potential inherent in digital tools as an aid for assigning personnel based on the type of crime and where and when crimes occur.

A knowledge-based police force that works proactively and preventively is better than a reactive police force that responds to incidents after they have occurred. New data-driven analyses can facilitate this kind of proactive work in several ways:

- they can strengthen decision-making processes on the operational, tactical and strategic levels
- they can make crime-fighting and prevention more targeted and effective
- they can ensure improved availability where and when the needs for police services are greatest
- they can ensure a quicker response through better knowledge of the relevant crime situation

⁹ cf. the Police Act, section 1, second paragraph, and section 2, nos. 1 and 2

¹⁰ Official Norwegian Report (NOU) 2012:14, Report of the 22 July Commission, p. 336, *"In this perspective it is therefore important to give priority to systematic data collection and analysis to identify high-risk locations and behaviour patterns in order to prevent crime, facilitate investigations and have sufficient capacity available."*

¹¹ Official Norwegian Report (NOU) 2013:9, One police – equipped to meet future challenges (The Police Analysis), p. 224, *"The analysis should be used to allocate personnel on the basis of the type of crime and where and when crime occurs."*

- they can make it easier to extract new knowledge from the extensive volumes of data that the police possess.

At the same time, these kinds of analyses also raise important questions concerning data quality, the limitations of the analyses, the police's use of the analyses and wrongful suspicion and discrimination. These kinds of considerations must be weighed up against the potential benefits for the police of using digital tools and must be clearly addressed if and when analytical tools are introduced. Here a political boundary must be drawn in the public domain.

1.2 POLITICAL TOPICALITY

The police are currently undergoing a comprehensive reform process. The terrorist attacks on 22 July 2011 served to accelerate this process. Several recent reports have provided us with a thorough and well-documented analysis of the current state of the Norwegian police. A recurrent theme in almost all of these reports is the need to make better use of the potential inherent in information and communication technology.

Several ongoing and upcoming reform processes will stake out the path for the police of the future. It is therefore important that these projects consider the opportunities afforded by new technology and address challenges related to new technologies when necessary.

1.2.1 THE 22 JULY COMMISSION

The report of the 22 July Commission provided a detailed snapshot of the current state of the Norwegian police. An important message of the report was that the potential of modern ICT was not being exploited sufficiently¹² and that we are in the middle of a technological revolution that the Norwegian police must embrace.¹³

Among other things, the Commission called for better management of police resources, pointing out that the police in Norway possess significant amounts of data that can be used to understand and measure activities. For example,

¹² Official Norwegian Report (NOU) 2012:14, Report of the 22 July Commission, p. 16

¹³ Official Norwegian Report (NOU) 2012:14, Report of the 22 July Commission, p. 336

Figure 1 shows a clear disparity between staffing levels and the demand for police services. Police officers have not been at work when the needs were greatest. The Commission ascertained this from data recorded in the police's own information systems.

The Commission also points out that much of the crime in Norway is both place- and time-bound and that "it is therefore important to give priority to systematic data collection and analysis to identify high-risk locations and behaviour patterns in order to be able to prevent crime, facilitate investigations and have sufficient capacity available."¹⁴

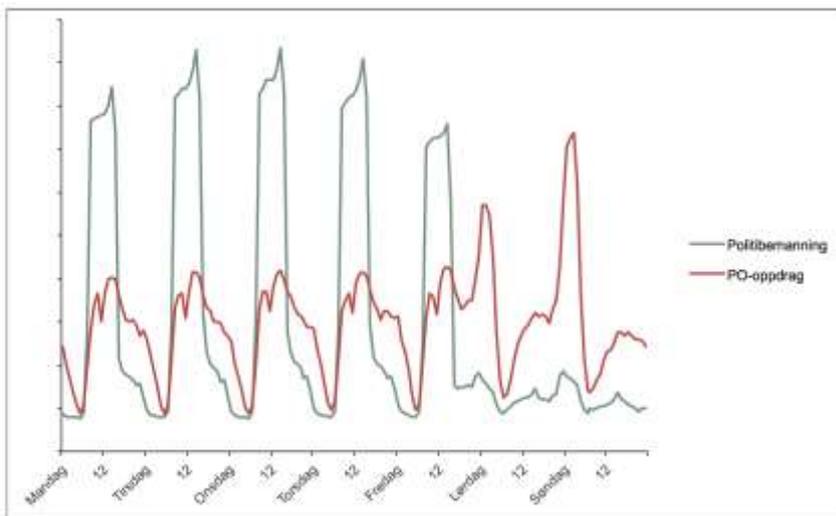


Figure 1 Correlation between police staffing (green) and demand for police services (red) in Norway in 2011. Relative share. Source: Official Norwegian Report (NOU) 2012: 4

1.2.2 THE STOLTENBERG GOVERNMENT'S FOLLOW-UP OF THE 22 JULY COMMISSION'S RECOMMENDATIONS

In the white paper Report no. 21 to the Storting (2012–2013) *Preparedness for terrorism*¹⁵ the Stoltenberg Government provides an account of its follow-up of the 22 July Commission's report. Here statistics and analyses of the volumes, types and location of assignments are emphasised as "necessary

¹⁴ Official Norwegian Report (NOU) 2012:14, Report of the 22 July Commission, p. 336

¹⁵ Report no. 21 to the Storting (2012–2013), Preparedness for terrorism – Follow-up of Official Norwegian Report (NOU) 2012:14 Report of the 22 July Commission

knowledge for the dimensioning of the police's resources" and as a means to make the police "available to the population at the times and in the places they will be important for safety and security (...)". However, the discussion is first and foremost linked to the police's response time. The report discusses how these kinds of analyses can be incorporated into the police's work processes. The white paper does not address how these kinds of analyses can support the police's preventive activities.

1.2.3 RECOMMENDATION FROM THE STANDING COMMITTEE ON JUSTICE CONCERNING THE WHITE PAPER ON TERRORISM PREPAREDNESS

The Storting's Standing Committee on Justice touches upon these shortcomings in Recommendation no. 425 to the Storting of 6 June 2013.¹⁶ A unanimous committee points out that the police possess data that "could draw a detailed picture of the crime landscape and how this evolves over time" and that "the police's operative ICT systems must be such that they enable the police to perform analyses and detect patterns in the crime data, with a view to preventing crime."¹⁷

1.2.4 THE POLICE ANALYSIS

The Police Analysis¹⁸ follows up with a thorough, comprehensive and well-documented analysis of the organisation, management and practices of the police in Norway. Here too, technology and use of technology are placed on the agenda. The Police Analysis discusses important issues relating to the organisation and management of ICT in the police in depth.

According to the Police Analysis, knowledge-driven prevention, timely police presence and rapid response are the keys to effective policing.¹⁹ It makes it clear that a knowledge-based approach to the police's duties ought to be based on data and analyses, "for example, of the crime trends and when and where crimes take place, and on knowledge about best practices and available methods", but that this kind of data-driven management of the resources is cur-

¹⁶ Recommendation no. 425 to the Storting (2012–2013), Recommendation from the Standing Committee on Justice concerning preparedness for terrorism, 6 June 2013

¹⁷ Recommendation no. 425 to the Storting (2012–2013), Recommendation from the Standing Committee on Justice concerning preparedness for terrorism, 6 June 2013, pp. 17–18

¹⁸ Official Norwegian Report (NOU) 2013:9, One police – equipped to meet future challenges

¹⁹ Official Norwegian Report (NOU) 2013:9, One police – equipped to meet future challenges, p. 22

rently very rare.²⁰ Among the reasons, the Police Analysis points to poor availability and quality of data and the lack of analytical tools and expertise.

Although the Police Analysis emphasises knowledge-based work and available police power, these are discussed primarily from an organisational perspective: "The police must be organised so that the patrols can be present where and when crimes happen (...)".²¹

Thus, the Police Analysis does not address the issue of whether the technology can alter the prerequisites for knowledge-based prevention and good resource management. This is a weakness that the current report seeks to remedy.

1.2.5 THE LOCAL POLICE REFORM

In the bill Proposition no. 61 to the Storting (bill and draft resolution) (2014–2015) *The Local Police Reform*, the Solberg Government provides an account of its follow-up of the Police Analysis. The objective of the reform is to provide an operational, visible and accessible police presence, with the capacity and expertise to prevent crime.²² Prevention is thus a priority target in the Local Police Reform.

This bill points out that current preventive activities in the police are prioritised differently in the various police districts²³ and that in the future the police "must meet the expectations that they will prevent crime effectively and be present with the appropriate capacity and expertise where they are needed."²⁴ Systematic prevention, well-organised patrols and good operations control rooms are held up as key factors to establish a "community police service" that is well integrated in the local community.²⁵

One of the bill's central proposals is a reduction in the number of police districts from the current 27 to 12. Merging police districts will promote the development of robust expert teams that will strengthen the police's preventive

²⁰ Official Norwegian Report (NOU) 2013:9, One police – equipped to meet future challenges, p. 46

²¹ Official Norwegian Report (NOU) 2013:9, One police – equipped to meet future challenges, p. 22

²² Proposition no. 61 to the Storting (bill and draft resolution) (2014–2015), Amendments to the Police Act etc. (The Local Police Reform), p. 5

²³ Proposition no. 61 to the Storting (bill and draft resolution) (2014–2015), Amendments to the Police Act etc. (The Local Police Reform), p. 6

²⁴ Proposition no. 61 to the Storting (bill and draft resolution) (2014–2015), Amendments to the Police Act etc. (The Local Police Reform), p. 30

²⁵ Proposition no. 61 to the Storting (bill and draft resolution) (2014–2015), Amendments to the Police Act etc. (The Local Police Reform), p. 69

and crime-fighting activities. Operational resources will be freed up so that they are more visible and accessible in the community. Larger teams will enable continuous patrolling and police presence where needs are greatest.

In addition, the new police districts will all have departments that work on analysis and prevention. These departments will be responsible for conducting all the analyses for the police district, as well as planning and carrying out preventive work across the police district in collaboration with the local service sites.

In this way, the Local Police Reform aims to strengthen the police's preventive work through organisational changes, without discussing in any further detail how technology can support this work. Mobile solutions that will enable more work in the field are primarily related to the criminal justice chain and not to preventive analysis.²⁶ Nor has the need for ICT solutions that connect analytical activities to every-day operations and make them available to patrols in the field been illuminated. And although the bill states that effective prevention requires knowledge about risk factors and "tools to preempt crime"²⁷, it says little about the opportunities and challenges these kinds of tools might bring or lessons that have been learned in other countries.

1.3 OBJECTIVES AND DELIMITATIONS OF THIS REPORT

This report casts light on how new technologies and data analytics can be exploited to strengthen the police's everyday operational and preventive work, especially through analyses designed to predict the likelihood of future crimes. As this technology continues to mature, it might potentially enable the police to work in entirely new ways. At the same time, this report highlights some of the challenges and ethical issues associated with these developments. What constitutes an appropriate, socially beneficial capacity ought to be determined through political decisions. This report wants to contribute to this kind of debate.

²⁶ Proposition no. 61 to the Storting (bill and draft resolution) (2014–2015), Amendments to the Police Act etc. (The Local Police Reform), p. 105

²⁷ Proposition no. 61 to the Storting (bill and draft resolution) (2014–2015), Amendments to the Police Act etc. (The Local Police Reform), p. 34

The Norwegian Board of Technology's conclusions build on experiences from other countries and an assessment of how the main technological developments might affect the police's working methods in the future.

1.3.1 DELIMITATIONS

The Norwegian Police Service is a large agency that performs very many different tasks. Different forms of data analysis can be useful in connection with both specific investigations and the police's general security and intelligence work.²⁸ However, this report is primarily concerned with the police's *preventive* and *operational* activities, with a particular focus on combating "everyday crime", which is often associated with a limited number of places, victims and potential offenders.

This report sets out to describe how technology paves the way for so-called *predictive policing* and considers the opportunities, limitations and challenges inherent in this kind of technology. It also seeks to identify the political and ethical assessments that must be made in order to avoid unintended, unfortunate consequences.

A comment from the member of the expert group Håkon Wium Lie:

"Håkon Wium Lie finds that the report ought to have focused more on the problems associated with the political aspects of algorithms. It is conceivable that pressure from different players will be able to influence the algorithms without this being subject to any kind of professional or political assessment. For example, in a society where gender equality is an overarching goal, there may be a wish to adjust the algorithms to ensure that an equal number of women and men are convicted. These kinds of political considerations could undermine the police's efficacy and make it easier for certain social groups (in this example, men) to break the law."

1.3.2 THE STRUCTURE OF THIS REPORT

This report consists of four parts:

²⁸ The National Police Directorate (2015); See, for example, the discussion on the use of statistics, analytical methods and analysis capacity in chap. 7

Chapter 2 presents predictive policing and describes how and why predictive algorithms are used for preventive purposes. This chapter also provides various examples of predictive policing from a number of countries and discusses some myths and limitations associated with these kinds of analyses.

Chapter 3 discusses ethical issues and the implications for data privacy and the interests of openness and transparency.

Chapter 4 discusses the various preconditions that must be in place for the Norwegian police to be able to benefit from predictive policing and how these kinds of analyses ought to be anchored in a robust working model that strengthens the knowledge base, addresses ethical issues, and allows for measurement of efficacy and transparency.

2 PREDICTIVE POLICING

When Hurricane Katrina struck the southern United States in 2005, the supermarket chain Walmart made sure its warehouses in the affected areas were well stocked with bottled water, duct tape and strawberry-flavoured Pop-Tarts. By systematically analysing their customers' buying patterns, the latter item had been found to be a regular, albeit somewhat surprising purchase ahead of previous extreme weather events. While their competitors sent a standard range of items to the affected areas, Walmart could concentrate on filling its warehouses with precisely those goods the company had predicted the customers would be especially interested in hoarding ahead of the hurricane. Thanks to their analytics, Walmart was able to identify useful correlations between products that do not have any obvious links in terms of use, such as duct tape and Pop-Tarts.

It is increasingly common for companies in a range of different sectors to use data and analytical models to describe and predict their customers' behaviour. In the USA and elsewhere, police organisations have been inspired by the use of these kinds of predictive tools.

2.1 IS IT POSSIBLE TO PREDICT CRIME?

It is not possible to predict exactly where and when a crime will be committed, exactly who will commit it or who will end up as a victim of a criminal act.

Nevertheless, studies show that crime is rarely evenly spread in towns and cities; rather certain types of crime tend to occur more frequently in certain places and at certain times.²⁹ In Oslo, a high percentage of the registered crimes are linked to drinking establishments within a geographically delimited area in the city centre and the associated access routes.³⁰ In 2013 the national daily paper *Aftenposten* reported that there are as many armed robberies in a few square kilometres either side of the Akerselva river in Oslo as in the rest of Norway combined.³¹

2.1.1 REPEAT OFFENCES

According to the National Police Directorate, 13 crime hotspots throughout the whole of Norway are responsible for between 20 and 42% of location-identified pickpocketing thefts, while 70 delimited areas can be linked to 27% of all location-identified incidents of violence.³² Other studies too show that a large proportion of crimes committed in urban areas tend to be related to a small number of addresses or locations.^{33 34}

A significant proportion of the police's resources are used responding to repeat offences that happen at given places and within specific time slots. By analysing repeat offences and focusing attention and resources on these areas, the police can strengthen their work on local prevention and preemption of crime.³⁵ Predictive policing seeks to do this by using new data-driven tools that calculate the risk of certain types of crime taking place at specific locations at various times.

²⁹ Burke (2014), p. 283

³⁰ Oslo Police District (2013), p. 5

³¹ Article in *Aftenposten* (2013), "Kriminalitet i hovedstaden: Ni kriminelle handlinger i timen" [Crime in the capital: Nine criminal acts per hour]

³² National Police Directorate (2014), p. 15 and p. 21

³³ Brå (2011)

³⁴ National Institute of Justice (2009)

³⁵ National Police Directorate (2014), p. 15

REPEAT OFFENCES

Repeat offences do not have to be linked to a specific geographical location; they can also be associated with specific individuals, groups of people, certain types of property or specific items.³⁶ Repeat offences will vary in complexity, and not all correlations are equally obvious or straightforward. Some repeat offences such as breaches of the peace as a result of trouble outside a nightclub, domestic disturbances, arguments between neighbours and gang fights, tend to involve parties who know each other and who have a distinct relationship. Experienced police officers are usually well aware of these kinds of incidents.

Other repeat offences may involve parties who do not necessarily know each other and who over weeks or months develop patterns that exhibit less obvious links between the victim, offender, place and type of property. Analytical tools are especially interesting when it comes to detecting these kinds of complex correlations.

2.1.2 A CRIMINOLOGICAL EXPLANATION?

Thus, for certain types of crime it is not entirely random where and when offences take place – meaning in some cases it ought therefore also to be possible to make predictions based on risk analyses.

These kinds of predictions build on criminological theory, which attempts to explain why crime is distributed as unevenly as it is and why certain types of offences (e.g. burglary, robbery and theft) occur more frequently in some places than others, and often also at specific times.

Unlike theories that attempt to describe how social, economic and psychological conditions can act as drivers for criminal behaviour, this group of theories focuses primarily on criminal *acts* and attempts to describe the situations that enable these acts and the environmental conditions that must exist for them to take place.³⁷

³⁶ Boba and Santos (2011), p. 20

³⁷ Wortley and Mazerolle (2008), "Situating the theory, analytic approach and application"

WHERE AND WHEN DOES CRIME OCCUR?

Criminologists have proposed various theories to explain why crimes are committed in some places and not in others³⁸:

- **Event-based** theories state that criminal acts take place at the cross-section of motivated offenders, suitable targets and the lack of a capable guardian.
- **Place-based** theories attempt to describe crime on the basis of local place-specific shortcomings, such as lack of security, poor lighting, good escape routes and vulnerable targets.
- **Opportunity-based** theories state that criminal acts primarily occur when there are easy, attractive targets that will yield high rewards with relatively low risk.
- **Contextual** theories regard crime as a complex convergence of several different factors. These kinds of theories assume that the perpetrator and victim, in their interaction with the social surroundings, often share the same pattern of movement and that criminal acts take place where these patterns overlap with each other in time and space.

Whichever model or hybrid is chosen, this type of theory stipulates a correlation between certain identifiable environmental conditions and the observed crimes. If the factors that facilitate crime can be identified, it is not only possible to predict where future offences are likely to take place; tailored countermeasures can be implemented to prevent the crime.³⁹

Criminologists and analysts have identified various environmental factors that appear to be important facilitators of certain types of crime. The layout of the street network and access to escape routes⁴⁰, correlations in the movement patterns of the perpetrator and the victim⁴¹, weather conditions⁴², lighting⁴³, payday⁴⁴ and time of day⁴⁵ are all factors that can affect how and when certain types of criminal acts are committed.

According to these kinds of theories, criminals consciously or subconsciously assess the risks by weighing up these kinds of factors prior to committing a

³⁸ See, for example, Ferguson (2012), pp. 274–284

³⁹ AIC (2011), p. 13

⁴⁰ Hagan (2012), p. 167

⁴¹ Wortley and Mazerolle (2011), p. 86

⁴² Cohn (1990)

⁴³ Weisburd et al. (2013), pp. 114–117

⁴⁴ Hollywood et al. (2012)

⁴⁵ Wortley and Mazerolle (2011), p. 87

crime.⁴⁶ They also tend to choose the same type of place, time or victim group as in previous successful crimes.⁴⁷

There are several different theories, some of which are briefly described in the Appendix to this report.

A common denominator for all these theories is that they describe criminal acts as a dynamic interaction between the perpetrator, the victim (or target) and concurrent situation-specific and environmental conditions at specific places at specific times.⁴⁸ Criminals have habits in terms of the type of crime they commit, where they commit them, whom they collaborate with, and which risk assessments they make – consciously or subconsciously – before committing a crime. These assessments are in turn influenced by local environmental conditions and the opportunities for committing a crime.⁴⁹

Crime patterns are interpreted and explained on the basis of local situation-specific and environmental conditions and are used to derive predictions about growing, new or future problems. This insight can be used as decision support in preventive and crime-fighting work.^{50 51}

However, although these kinds of theories have proven to be able to provide plausible descriptions of crimes of gain, such as robbery, theft and burglary, they are by no means universal or capable of describing all forms of crime. Crimes involving people who know each other and crimes not motivated by gain, such as domestic violence, hate crimes and rape, are steered by a different dynamic and are not as easily described by these kinds of theories.⁵² The same applies to crimes that do not exhibit distinct patterns in time and space, such as rare terrorist attacks. Even when theories are able to provide plausible descriptions, it is not given that the description can be used to develop models that can generate accurate predictions.

⁴⁶ Perry et al. (2013), p. 3

⁴⁷ AIC (2008), p. 14

⁴⁸ Wortley and Mazerolle (2011), "Environmental criminology and crime analysis: situating the theory, analytic approach and application"

⁴⁹ Perry et al. (2013), pp. 2–3

⁵⁰ Wortley and Mazerolle (2011), "Environmental criminology and crime analysis: situating the theory, analytic approach and application"

⁵² Perry et al. (2013), p. 3; Rosenbaum (2006), p. 247

These kinds of limitations may also affect the validity of the analyses used in predictive policing and the definition of the areas in which these kinds of analyses can be used by the Norwegian police.

2.2 WHAT IS PREDICTIVE POLICING

Predictive policing uses data analysis to predict how the crime situation is likely to develop in the future and then uses this insight as tactical decision support in preventive policing and crime-fighting efforts.⁵³ Among other things, these kinds of analyses can:

- predict where and when the risk of certain types of crimes is likely to increase
- predict which people can be linked to a heightened risk of committing future offences
- predict which areas, groups or individuals have a heightened risk as future targets of crime or that the police for some other reason ought to direct their attention to.⁵⁴

In its simplest form, a predictive analysis will analyse how, say, historical burglary data are distributed in time and space, try to identify statistical patterns and accumulations, and then use this insight to predict where and when future burglaries are likely to occur.⁵⁵ As will be discussed below, these kinds of studies are motivated by criminological theories and empirical evidence that suggest that not all forms of crime occur randomly in time and space; rather that they are closely related to circumstances at the site.

⁵³ Perry et al. (2013), pp. 1–2; Ferguson (2012), p. 265

⁵⁴ Perry et al. (2013), p. 8

⁵⁵ Ferguson (2012), p. 266



Figure 2 The police can have risk areas marked on digital maps – both in operations control rooms and on mobile devices. Illustration: Birgitte Blandhoei

Using data analysis to inform strategic and tactical work is by no means new in the policing context.⁵⁶ Police organisations in the USA in particular have long used GIS-based analysis to chart how different types of crime tend to be concentrated in certain areas and at certain times.⁵⁷

In recent years, this type of analytical work has evolved along with advances in technology and the digital transformation of society.⁵⁸ Although today there is wide variation in the complexity, methods and use of the analyses in every-day police work, some common features can be identified:

- **Richer data basis:** The analyses use large⁵⁹ datasets and often combine data from different sources.⁶⁰ Historical crime statistics can be supple-

⁵⁶ Perry et al. (2013), p. 2

⁵⁷ As the examples below show, these kinds of analyses have also been used by the Norwegian police. See "Oslo: Map-based analytics to prevent pickpocketing"

⁵⁸ Perry et al. (2013), pp. 1–5; Beck (2009)

⁵⁹ "Large datasets" is necessarily a relative term, but in this context means datasets that include so much data that a single analyst would find it difficult to draw any conclusions without the use of software.

⁶⁰ Perry et al. (2013), p. 2

mented with information on arrests, calls received and patrol reports.⁶¹ The analyses may also draw on other sources such as weather data, socio-demographic data, information about local businesses, local infrastructure, and other environmental factors such as lighting and traffic conditions.⁶²

- **Use of ICT tools:** Data analytics uses modern ICT equipment to process and analyse the data sources. The analyses use various mathematical and statistical techniques to explore patterns and relationships in the datasets, as well as to predict how crime is likely to develop in the future.⁶³
- **Place and time dependent:** Unlike analyses that explore general trends over time and within large areas, predictive analyses aim to determine the risk of certain types of crime taking place within delimited areas and time slots.⁶⁴ The predictions have a limited lifespan, and the analyses are updated as new data becomes available. In some cases, this process is partially automated.⁶⁵
- **Criminological support:** The analyses often rely on criminological theory, which stipulates a link between criminal behaviour and local situation-specific and environmental conditions that facilitate criminal acts.⁶⁶
- **Operational anchoring:** The analyses provide a basis for the tactical work and affect the management of operational resources. For example, risk areas can be marked on a map that can be shared with the patrol units via mobile devices.⁶⁷ Because the risk assessments are both location-specific and time-limited, they have a different operational value to longer-term trend analyses.

This report will primarily discuss whether predictive analytics can help the police predict *where* and *when* the risk of certain types of crime is greatest, and how this kind of information can support the police's preventive and operational activities. This delimitation was chosen because analyses that make place-based predictions seem to be both more widespread and more methodi-

⁶¹ Ferguson (2012), p. 266

⁶² Perry et al. (2013), pp. 44–45

⁶³ See, for example, Perry et al. (2013), chap. 2

⁶⁴ Vlahos (2012), p. 62 and p. 66; see the examples from California and Germany / Switzerland.

⁶⁵ See the example from Memphis.

⁶⁶ See the previous discussion under "A criminological explanation?"

⁶⁷ See the example from California.

cally mature than analyses that make predictions involving people.⁶⁸ Nevertheless the report does include some examples of analyses that calculate the risk linked to people and discusses recent ethical problems related to both placed-based predictions and predictions involving people.

PREDICTIVE ANALYTICS – FORECASTING CRIME

Predictive policing is based on predictive analyses, which provide a basis for making decisions, similar to traditional weather forecasting. Weather forecasts indicate the likelihood of a certain type of weather in the near future on the basis of both recent historical and current data, using an underlying meteorological model that describes the physical dynamics of weather systems mathematically. In most cases, the forecasts are only accurate for a short period ahead.

Similarly, predictive analytics indicates the likelihood of a certain type of crime being committed in the near future on the basis of historical crime data, the current conditions in the local area, criminological theory and an underlying mathematical model.

And like the assessments that are included in a weather forecast, these kinds of analyses are based on more than just historical data: five successive days of sun does not mean it will not rain on the sixth day.

Nevertheless, the weather forecast is no crystal ball. And similarly, errors can also occur in predictive analytics. But the more precisely it is possible to know where and when the rain is likely to fall, the more useful the weather forecast is as decision support.

2.3 EXAMPLES FROM AROUND THE WORLD

The use of predictive analytics is particularly prevalent in the United States, but recently police organisations in other countries have also started experimenting with predictive analytics in their daily work.

Predictive analytics is used as a tool to uncover new correlations, links, trends or factors that may contribute to new insight and better prerequisites for performing the many tasks ascribed to the police.

Below is a review of some practical examples and self-reported experiences with predictive policing from a number of different places. The examples have been chosen to illustrate the breadth in the design of the technology, policing

⁶⁸ Perry et al. (2013), p. 81

practices and possible areas of application. There are very many different practices, and the examples below are not intended to represent best practice. As is discussed below, nor have the reported results necessarily been subjected to independent evaluations.

2.3.1 CALIFORNIA: DECISION SUPPORT FOR PATROLS

PredPol is an analytical program that on the basis of type of crime, place and time performs a risk assessment to predict where and when a similar incident could take place in the immediate future. The program does not use arrest data or information that can be linked to individuals.⁶⁹ The software is built on a mathematical model inspired by the techniques for modelling seismic aftershocks: in the same way as aftershocks often follow in the wake of an earthquake, certain criminal acts also tend to be followed by new acts in the same area.⁷⁰ Updated maps show the identified risk areas as small red boxes. The maps can be shared with police patrols in real time via mobile devices. This allows the patrols to concentrate on the main risk areas and take appropriate steps where they are needed.

⁶⁹ According PredPol's own website: <https://www.predpol.com>

⁷⁰ Mohler et al. (2011) and conversations with Prof. George Mohler, Santa Clara University.



Figure 3 Deputy Chief of Police Steven Clark at Santa Cruz Police Department in California explaining how PredPol indicates the risk of new offences (November 2013).

Police resources can be allocated more precisely because the predictions are limited to small and manageable areas of approximately 150 x 150 m. In addition, the risk maps can be updated before each new patrol shift.⁷¹

PredPol does not tell the patrols what to do, but ensures that all police officers have access to the same knowledge. A study carried out at Santa Cruz Police Department showed that experienced officers could guess approximately half of the areas identified by the algorithm. However, less experienced officers were able to predict only a few risk areas.⁷²

Intuition and experience will always be important elements in the police's operational work, but predictive analytics can ensure better spread of knowledge, that new patterns are identified promptly and addressed at an early stage, and that the information the police have access to in the field is always up-to-date.

⁷¹ "How PredPol Works", <http://www.predpol.com/how-predpol-works/>

⁷² Friend (2013)

According to PredPol and the police organisations that have used the system, this tool has led to a decrease in crime in the areas where it has been used.⁷³ PredPol reports that in Los Angeles the burglary rate in the test area where PredPol was used decreased by 13%, compared with an overall increase of 0.4% elsewhere in the city. Santa Cruz Police Department claims that the tool has contributed to a 27% decrease in the number of burglaries, although this figure is uncertain as no controlled tests have been performed here.⁷⁴ At the same time, PredPol has been criticised for its lack of transparency and for involving police organisations in an aggressive marketing campaign for the product without the results having been verified independently.⁷⁵

2.3.2 MEMPHIS: CLOSE CONTACT WITH THE OPERATIONS CONTROL ROOM

The city of Memphis has been plagued by serious crime for some time.⁷⁶ Between 2006 and 2012, however, the city saw a 30% decrease in serious crime.⁷⁷

Memphis Police Department and local authorities attribute some of this decline to the analytics program "Blue CRUSH" (short for Crime Reduction Using Statistical History), developed in a collaboration between Memphis Police Department, the University of Memphis and the ICT company IBM.^{78 79} However, there are no independent studies proving that the decline is actually due to Blue CRUSH.⁸⁰ The program was first tried out in 2005, and in 2007 its use was expanded to include the entire city.⁸¹

Blue CRUSH produces crime forecasts within a limited geographical area and time frame by compiling and analysing historical crime data from police records with real-time data from the police patrols. The forecast draws on various

⁷³ Policy Exchange (2012)

⁷⁴ According to in-house figures from the company Predictive Policing (<http://www.predpol.com/results/>) and talks with Deputy Chief of Police Steven Clark, Santa Cruz Police Department

⁷⁵ SFWeekly (2013), "All Tomorrow's Crimes: The Future of Policing Looks a Lot Like Good Branding"; TechDirt (2013), " 'Predictive Policing' Company Uses Bad Stats, Contractually-Obligated Skills To Tout Unproven 'Successes' "

⁷⁶ Perry et al. (2013), p. 67

⁷⁷ The Atlantic Citylab (2012), "How To Catch a Criminal With Data"

⁷⁸ Memphis PD Initiatives, Blue CRUSH: <http://www.memphispolice.org/Initiatives.asp>

⁷⁹ Perry et al. (2013), p. 67

⁸⁰ Mayer-Schönberger and Cukier (2013), p. 158

⁸¹ Perry et al. (2013), pp. 67–68

information such as place, type of crime, day of the week, time of day, various traits of the victim, etc. ⁸²

The information is plotted on digital maps and shared with the patrols in the field via mobile devices. When the patrols register a new incident, the relevant data linked to the incident is immediately registered by Blue CRUSH and statistically linked to historical incidents. In this way the patrols at all times have up-to-date situational awareness of the crime status in the city. ⁸³

The program has also been integrated into the city's operations control room – Memphis Police Department Real Time Crime Center. This makes it easier for the operations control room to coordinate the patrols that are out in the field, to answer calls and to allocate resources in an appropriate and timely manner. It also makes it possible to evaluate which interventions have been most effective from week to week. ⁸⁴

2.3.3 BAVARIA AND ZURICH: COMBATING BURGLARIES WITH ALGORITHMS

Although future burglaries are difficult to predict, it has long been known that new burglaries often occur in the wake of a successful burglary, usually shortly afterwards and in the same area.

The police patrols in Bavaria and Zurich exploit this knowledge using the analytics software Precobs (Pre Crime Observation System)⁸⁵, which predicts when and where the next burglary is most likely to take place. After a successful burglary, the program calculates the risk of a new burglary taking place within a radius of 500 m, over the next seven days.⁸⁶ On a digital map the patrols see 250 x 250 m squares coloured red, yellow, green or blue. A red square indicates the areas with a very high risk.

The program builds on historical, anonymised burglary data and automatically searches for various statistical correlations between different elements in the data: time and place, whether it is a flat, detached house or terraced house, whether the burglars entered through a back door or through a window, etc.

⁸² Perry et al. (2013), p. 68

⁸³ Perry et al. (2013)

⁸⁴ IBM (2010); IBM (2011)

⁸⁵ Institut für musterbasierte Prognosetechnik (Institute for pattern-based Prediction Technique): <http://www.ifmpt.de>

⁸⁶ Spiegel (2014), " ' Precob': Polizei will Einbrüche per Software vorhersagen"

In this way the program can review large volumes of burglary statistics and quickly look for correlations: if C follows from A and B often enough in the historical data, then the system will issue an alert the next time A and B occur together in the fresh data.⁸⁷

After a trial period of one year, Zurich City Police reported that the burglary rate has fallen by 30% in the areas where the program has been used.⁸⁸ The police in Bavaria recently conducted a pilot project in Munich using the same software and report that during the trial period the number of residential burglaries fell by 42% in the areas police had visited as a result of the program's risk assessments.⁸⁹

2.3.4 OSLO: MAP-BASED ANALYTICS TO PREVENT PICKPOCKETING

Expensive and sophisticated computer models are not necessary to be able to prevent crime. Relatively simple analyses can also yield benefits by detecting patterns and trends that were not previously known.

Back in 2004–2005, Central Oslo Police Station had good success using geographic information systems (GIS) in their efforts to combat pickpocketing in central Oslo.⁹⁰ By plotting historical crime data aggregated over several years on maps, the police station was able to achieve a clearer overview of *where* and *when* pickpocketing thefts take place and who the victims are. This helped them identify causal relationships that had not previously been recognised. For example, the analysis revealed that a large proportion of the victims were women aged 20–34 years. The analysis also showed how the various pickpocketing hotspots moved within the city from early afternoon and on through the evening.

On the basis of this new knowledge, Central Oslo Police Station was able to develop concrete hypotheses related to specific places and times about why pickpocketing thefts take place. In collaboration with the public and other problem owners, they could then implement targeted measures to modify the environmental factors that made it possible for pickpockets to operate at the particular site. For example, the police station suggested that a bar in one of the high-risk areas mount hooks on the underside of its tables where guests

⁸⁷ Süddeutsche (2014), "Gesucht: Einbrecher der Zukunft"

⁸⁸ SRF (2014), "Der Wetterbericht für Einbrüche"

⁸⁹ The Bavarian Ministry of the Interior (2015)

⁹⁰ "Kunnskapsbasert politiarbeid" [Knowledge-based policing], presentation by Philip Tolloczko, the Norwegian Board of Technology, 17 December 2012

could hang their bags and jackets, as opposed to hanging them over the back of the chairs where they were more vulnerable to pickpocketing thefts.

THE SARA MODEL FOR PREVENTIVE POLICING

The pickpocketing case from Central Oslo Police Station is an example of preventive work based on the so-called SARA model, which is a popular method within problem-oriented policing. The SARA model seeks first to identify the underlying causes of specific crimes, in order then to introduce measures to modify the factors that facilitate the crime. The method consists of four distinct phases:⁹¹

Scanning – First the problem is described in detail and mapped.

Analysis – The second step is to find relevant data that clarify the problem elements. These data are examined and analysed in an attempt to understand the factors that contribute to the problem. Are there trends and patterns in the data pertaining to specific places, people, events or times? Whom should the problem be addressed to and who should be involved in the solution process?

Response – Once the problem has been analysed, measures must be found and implemented with clear lines of responsibility that amend the environmental factors that facilitate the problem.

Assessment – Once the measures have been in place for a while, it is evaluated whether and to what extent they have been effective, for example through a detailed comparison of data from before and after implementation of the measures.

The SARA model has proven to be a very effective problem resolution tool for the police. Data analyses support the decision-making basis throughout the entire process, and predictive analytics could successfully be incorporated into this working method.

With a few simple measures, Central Oslo Police Station was able to intervene in crime patterns by changing the environmental conditions on site. One year after the measures were implemented, the police station evaluated the efficacy of the measures and where the problem had displaced to, by visualising the change in the crime statistics on a map showing the specific intervention areas. In this way, the method also functioned as a tool for evaluating and monitoring the measures they had implemented.

2.3.5 LONDON: SMARTPHONES IDENTIFYING THE NEXT HOTSPOT

Predictive policing can also make use of demographic data in its predictive analyses. This is because many criminological theories stipulate a correlation

⁹¹ Center for Problem-Oriented Policing: <http://www.popcenter.org/about/?p=sara>

between criminality and demographic variables such as level of education, income bracket, unemployment and cultural background.

Demographic datasets are often resource-intensive to build up, and in many cases several years can pass between updates. Moreover these kinds of datasets describe relatively large geographical areas, often an entire town or borough. It can therefore be difficult to make precise predictions regarding times and places using these kinds of data.

Nevertheless, the proliferation of smartphones makes it possible, in theory, to track the movements of the population within shorter time intervals and with more precise location information. By linking this kind of data regarding people's movements to demographic variables such as age, gender, income bracket, place of residence, etc., it is – in principle – possible to measure changes in demographic composition at a given place at a given time and then use this knowledge in models to predict crime.

Researchers at the University of Trento in Italy have collaborated with MIT Media Lab in the USA and the telephone company Telefonica on a study using aggregated, anonymised traffic data from mobile users in London:⁹²

- The traffic data provided the researchers with figures on how many women and how many men within a certain age segment were in a given area of the city at a given time of day. They also indicated whether these people most probably lived in the area, worked in the area or were passing through.
- This information was collated with public historical crime data regarding, among other things, what types of crimes had been committed in the area, in what month and in what year.
- The researchers also used public demographic information about different parts of the city, such as income levels, unemployment, cultural composition, property prices, number of parks, traffic density, the number of families with small children, local businesses, etc.

This information mix enabled the researchers to develop a prediction model that could predict future crime hotspots with an accuracy of nearly 70%.⁹³

⁹² Bogomolov et al. (2014)

⁹³ Bogomolov et al. (2014), p. 8

The model was developed as an academic feasibility study and has not yet been adopted by the police in London or elsewhere. Nevertheless, it shows how new and unfamiliar data sources, which have no obvious link to crime can in principle be used in predictive models for the police. Similarly, feasibility studies have also been conducted that attempt to exploit social media for the same purpose (see the box "Can social media be used to predict crime?").

Although these kinds of methods are not yet in use, they highlight the need for a delimitation of which data sources the police shall be allowed to use for predictive work.

2.3.6 CHICAGO: FROM "HOTSPOT" TO "HOT PERSON"

Predictive analytics can also be used to identify individuals who have a heightened risk of committing a crime in the future or who risk ending up as a victim of a crime.

Chicago is a city that has long been plagued by gang-related violence.⁹⁴ Decades of conflicts have given rise to complex and violent relations between different gangs.⁹⁵ Although analyses have provided the police with good knowledge about where in the city the gangs operate and which areas are associated with a particularly high risk of gang-related violence, they have traditionally provided few indicators of who has a particularly high risk of committing a criminal act in the near future or who is likely to be the next victim.

In collaboration with sociologists and technologists, the police in Chicago have now begun to adopt new predictive methods based on mathematical analyses of relational networks among people who in different ways have had registered contact with the police.

It is a well-known fact among criminologists and the police alike that association with criminal environments increases the risk of future involvement in a criminal act. Using recent network theory and criminology based on models for the spread of disease, it is claimed that the police can now quantify the risk associated with individuals in these kinds of networks more precisely than before. This kind of network study from a high-crime part of Chicago showed, among other things, that people who either know a murder victim or who

⁹⁴ New York Times (2014), "Gang-Related Shootings Decline in Chicago"

⁹⁵ Chicago Magazine (2013), "The Small Social Networks at the Heart of Chicago Violence"

know someone who knows a murder victim, have a risk of being involved in a future act of violence that is 900% higher than the average for the area.⁹⁶

The police in Chicago now supplement predictive hotspot analyses with network analyses, resulting in a much more detailed understanding of how risk is distributed in the area linked to specific individuals. The network analyses are limited to people who have had contact with the police and draw on factors such as criminal records, parole status, the status of arrest warrants, arrests for weapons or drugs offences, the person's broader circle of acquaintances and their criminal history, and whether any of these acquaintances have been involved in a shooting incident.⁹⁷ In this way the police want to:

- establish systematic "risk networks" in order to be able to quantify and visualise various forms of risk associated with people in the network
- highlight commonalities and differences between different gangs in different parts of the city or different cities
- focus resources and interventions on individuals who have been assigned a very high risk

Using these kinds of analyses, the police in Chicago have compiled a list of some 400 people who have a high probability of being involved in serious gang-related crime in the near future.

The police use this list to make targeted visits to high-risk individuals and their close acquaintances such as friends and partners, to explain the risks they face and the possible consequences. The goal is to motivate these high-risk individuals to change their behaviour before they are involved in a serious criminal act.⁹⁸

The Chicago police have been criticised for the way in which they have conducted home visits, the lack of openness and transparency regarding the risk list, and the assessments on which it is based.⁹⁹

⁹⁶ Papachristos and Wildeman (2014)

⁹⁷ Chicago Tribune (2013), "Chicago police use 'heat list' as strategy to prevent violence"

⁹⁸ The Verge (2014), "The minority report: Chicago's new police computer predicts crimes, but is it racist?"

⁹⁹ The Verge (2014), "The minority report: Chicago's new police computer predicts crimes, but is it racist?"; Upturn (2014), pp. 18–19

Nevertheless, this example demonstrates that the police have not only refined their hotspot methodology, but have also taken the step from purely place-based predictions to predictions involving individuals. As will be discussed later in this report, this transition raises a number of ethical questions.

PREDICTIONS INVOLVING PEOPLE IN THE US JUSTICE SECTOR

The Pennsylvania Board of Probation and Parole is responsible for supervision of prisoners on parole. In collaboration with the University of Pennsylvania, the Board has implemented a model that statistically assesses the risk of a prisoner being considered for parole returning to their former ways and committing a serious crime such as murder or whether they are particularly at risk of being a victim of violence or murder.¹⁰⁰

The model is based on historical crime data from several tens of thousands of past cases and uses several dozen different variables including age, sex, place of residence and criminal history to predict the risk of recidivism.

The Probation and Parole Board uses this risk calculation to assess whether it is appropriate to release the prisoner in question on parole and if so, whether the released prisoner will need any extra supervision.

The findings of the analyses were surprising because they suggested that it was not the type of crime that the prisoner had been convicted of that determined whether a prisoner on parole would commit a serious criminal offence, but rather the length of time between the past offences and when the first and last crimes were committed.¹⁰¹

2.4 WHAT IS IT NOT?

Predictive analytics can be very useful in the police's preventive and crime-fighting work. It is nevertheless important to be aware of the limitations of these kinds of analyses.

2.4.1 NO CRYSTAL BALL FOR THE POLICE

Predictive analytics may give the impression that the police know the future, that it is possible to predict exactly when and where criminals will strike against their targets, and that analytics programs virtually tell the police where to go to pick up criminals. Parallels have been drawn to science-fiction

¹⁰⁰ Ritter (2013)

¹⁰¹ Wired (2013), "U.S. Cities Relying on Precog Software to Predict Murder"

films like *Minority Report*, where the police in an imaginary future world have access to "foreknowledge", which provides them with the knowledge and authority to arrest people before they commit a crime.¹⁰²

However, predictive analytics is merely an analytical tool that attempts to calculate risk based on a variety of factors. Alerts are issued on the basis of statistical operations performed on historical data and therefore necessarily only represent probabilities, not that something will definitely happen.

Predictive analytics can never *know* exactly where and when the next crime will take place or who will commit it. Instead, these kinds of analyses seek to quantify the risk of certain types of crime being committed in certain places and how this risk is likely to change in the immediate future.

2.4.2 MACHINES CANNOT REPLACE PEOPLE

Predictive analytics may give the impression that advanced mathematical methods and powerful computers are a necessary and sufficient precondition for the police to be able to work on prevention and fight crime. This is not true. People are still the most important resource in good predictive policing. It is people who obtain relevant data, prepare the data for analysis, identify errors and deficiencies, interpret the results of the analysis, and implement an appropriate response.

In other words, analysis-driven preventive policing does not entail a break with existing and well-established practices. Intuition and experience will still be important elements in operational and tactical police work. A fundamental view is that the earlier correlations between incidents are detected and dealt with, the easier it will be in many cases to take appropriate action. This can prevent the matter from developing into a long-term problem that will require further police resources in the future.

¹⁰² See, for example, The Week (2013), "Is predictive policing making *Minority Report* a reality?"

Predictive analytics can make valuable contributions to preventive policing by:

- providing an independent confirmation (or refutation) of intuition-driven hypotheses and ensure knowledge is shared evenly among experienced and less experienced police officers
- uncovering previously unknown correlations that provide new insight or improve understanding of the problem
- providing an analytical framework for the allocation of resources in line with the police's focus areas.

2.4.3 COMPUTERS AS NECESSARY AIDS

Although computers cannot replace humans, computer analytics does offer several advantages and will in some cases be an essential part of the police's information work.

With time the police's own datasets – and any external datasets that the police have lawful access to use – will become so large and complex that they can no longer be processed manually. It is nigh impossible to undertake comparisons among different datasets and uncover correlations between many different variables without the use of computers.

Automated analyses can, for example, detect whether a current emergency call is related to earlier emergency calls, or interpret the message in the light of a broader analysis of areas where experience shows that there is a heightened need for police services or where risks are expected to increase in the future. Information that puts an isolated incident into a wider context can also be of great benefit to the police in the field.

Nevertheless, computer analyses can also have their drawbacks. When decisions are made by machines, not people, it can be more difficult to both trace and understand the motivation behind these decisions. Which data have the computers used and which interpretations have they made to arrive at these decisions? Lack of access and transparency can weaken the understanding of the analysis and the conclusions drawn on the basis thereof. This is discussed in more detail in the final chapter.

In the worst case, the use of technology may even undermine the police's relationship with the public and give a false impression that it is machines, not people, who are running operations. If too many resources are redirected to

analytical work, or if it seems as if the police patrols in a focus area are always sitting glued to a tablet instead of entering into dialogue with citizens, the police's visibility may diminish, and in the worst case, the distance between the police and the public may widen.

2.5 DO WE KNOW WHETHER PREDICTIVE POLICING WORKS?

In 2011 the analytical tool PredPol was named one of the year's 50 best "inventions" by TIME Magazine.¹⁰³ There has been considerable enthusiasm surrounding predictive analytics in recent years, and it is easy to get the impression that the introduction of these kinds of tools guarantees a clear and measurable reduction in crime.

2.5.1 CAN IT GUARANTEE REDUCED CRIME?

Although several police organisations claim to have had good experiences with predictive analytics, critics say that these studies are often done in closed collaboration with commercial suppliers with strong vested interests.¹⁰⁴ There are therefore grounds to query the neutrality, validity and representativeness of these studies.¹⁰⁵ Most studies also lack a systematic comparison of the reported data with data from control groups and publication of results in line with scientific criteria and that allows independent verification and assessment.¹⁰⁶ As will be discussed in the next chapter, critics also point out that predictive analytics can be used to underpin discriminatory police practices and that this kind of policing does not necessarily address the underlying causes of crime.¹⁰⁷

Despite the growing interest in predictive policing, there are currently few independent scientific studies that confirm or disprove whether predictive

¹⁰³ Time (2011), "The 50 Best Inventions"

¹⁰⁴ SFWeekly (2013), "All Tomorrow's Crimes: The Future of Policing Looks a Lot Like Good Branding"

¹⁰⁵ Statewatch (2014b)

¹⁰⁶ Next City (2014), "The Problem With Some of the Most Powerful Numbers in Modern Policing"; Gluba (2014), pp. 9–10 and p. 12

¹⁰⁷ openDemocracy (2014), "Predictive policing: mapping the future of policing"

analytics actually contributes to measurable crime reduction.¹⁰⁸ At the time of writing, however, the RAND Corp. was conducting an independent evaluation of the use of predictive analytics, funded by the US National Institute of Justice, in the cities of Shreveport, Louisiana and Chicago in the USA. An interim report on Shreveport concludes that the program cannot demonstrate a statistically significant reduction in crimes against property. It is therefore possible that predictive analytics did not work as intended in Shreveport. At the same time, the study points out that divergent intervention practices and the weak statistical basis of the study might explain why no effect was observed. On the plus side, the report emphasised that the program strengthened the police's relationship with the local community and that it did not contribute to any noticeable increase in costs.¹⁰⁹

So-called hotspot analyses do not make dynamic predictions; rather they are based on longer-term trends. However, the use of hotspot analysis does share several tactical similarities with predictive analytics, namely resource allocation to areas with the highest probable risk. These kinds of analyses have been in use for some time now and are therefore somewhat better documented.¹¹⁰ In an independent literature study from 2012, the Campbell Collaboration concluded that 20 of the 25 reviewed test cases of hotspot analysis demonstrated statistically significant crime reduction.¹¹¹

Nevertheless, more studies are needed to chart whether new predictive methods can help reduce crime, and the Norwegian police ought to be involved in the work on strengthening this knowledge base. Regardless of the analytical tools that are used, it is primarily the police's response and intervention that serve to reduce crime. In a field study, criminologist P. K. Manning examines three different cities in the USA that use analysis-based crime fighting inspired by Compstat¹¹² and concludes that in two of the three cities the systems were underused and that few officers outside the management showed sufficient willingness to use information from the system in a systematic way.¹¹³ In the third town Manning found that the system was successful, and concluded that this was because the management made sure there was support for use of

¹⁰⁸ Communication (1 June 2015) with Prof. Shane Johnson, UCL Dept. of Security and Crime Science; Zeit (2015), "Noch hat niemand bewiesen, dass Data Mining der Polizei hilft"

¹⁰⁹ Hunt et al. (2014)

¹¹⁰ Communication (2 June 2015) with Prof. Shane Johnson, UCL Dept. of Security and Crime Science

¹¹¹ Braga et al. (2012)

¹¹² Abbreviation for COMPuTer STATistics, a management and responsibility process developed by the New York police in the 1990s. See the Appendix.

¹¹³ Manning (2011), p. 162

the system at all levels of the organisation by holding regular meetings twice a month. Here personnel from across the various departments were gathered together and used the system as decision support and as a basis for discussing possible solutions.¹¹⁴

As discussed in the chapter "A Norwegian model", it is therefore important that the police's analytical work is firmly rooted at all levels of the organisation and that it is constantly subject to systematic, independent and scientifically robust evaluation.

2.5.2 WILL PREDICTIVE POLICING WORK IN NORWAY?

Predictive analytics requires good crime data. It might therefore seem logical to assume that the methods will only work in large towns and cities with high crime rates, and that small places will benefit less from adopting these kinds of methods. We know too little about this at present, and in this regard several factors might come into play:

An important prerequisite for predictive analytics is that crime patterns exhibit a degree of regularity that makes it possible to predict where and when the next incident is likely to take place. This regularity may vary from one place to another, and it is conceivable that these kinds of patterns will be less obvious in sparsely populated areas. However, there are no studies that either confirm or disprove this.

Then, even if the crime patterns are predictable, sparsely populated areas may present practical problems. When the patrols have to cover large distances, it may be difficult for them to be on site at the correct time. In sparsely populated areas, it is therefore quite possible that predictive analytics with dynamic patrol management will be less effective. In these kinds of places, statistical analysis of longer-term trends may therefore be more appropriate.

Roughly 80% of the population of Norway lives in urban settlements. However, urban settlements in Norway vary greatly in size and population. Approximately one third of the country's population lives in one of the five largest urban settlements, all of which have more than 100,000 inhabitants. Approx-

¹¹⁴ Manning (2011), p. 180

imately 1 in 5 Norwegians live in an urban settlement with a population of between 10,000 and 60,000 inhabitants.¹¹⁵

Another potential problem is that crime is not distributed evenly across the country. Oslo, for instance, has the most cases of reported crimes of gain and theft from public places, while drug crime is greatest in the Agder counties in relative terms. Adjusted for population size, Finnmark reports as much violent crime as Oslo. The crime rate thus does not necessarily increase with the population.¹¹⁶

Although it might seem reasonable to assume that predictive analytics will have the greatest utility value in the largest population centres in Norway, these kinds of analyses ought to be tested in different police districts in Norway and subjected to systematic and thorough evaluation to provide more knowledge about efficacy and suitability for Norwegian conditions.

2.5.3 WON'T CRIME JUST MOVE ELSEWHERE?

As discussed above, at present there is little documentary evidence of the effectiveness of predictive policing.

Critics have also focused on the so-called "*displacement effect*", i.e. that crime simply moves to other areas once the police have implemented preventive measures in one crime hotspot.^{117 118}

These kinds of displacement effects do not just involve movement in space, but may also mean that the crimes take place at other times, have different victims, involve different methods or that the criminal activity assumes a completely different form. Removing the conditions that facilitate crime only results in a displacement of the criminal activity, because the underlying causes of crime have not been treated and the offender is free to seek out new opportunities.

Another possibility is that concentrated efforts in one high-crime area, will also provide crime reduction in adjacent areas that do not get the same attention from the police. This kind of *diffusion of benefit* may be because the crim-

¹¹⁵ Statistics Norway (2014a), "Population and land area in urban settlements, 1. January 2014"

¹¹⁶ Statistics Norway (2014b), "Offences reported to the police, 2014"

¹¹⁷ Guerette (2009)

¹¹⁸ Barr and Pease (1990)

inals are unsure of the risks associated with the crime or believe that the risk now outweighs the gain.

There are few studies that systematically evaluate whether concentrated measures in geographically delimited areas lead to displacement effects or diffusion of benefit. However, a recent attempt to evaluate the documentation from a number of different measures implemented in identified crime hotspots in different countries concluded that on average this kind of policing¹¹⁹:

- leads to a significant decline in the types of crime that were addressed
- results in a trend in favour of diffusion of benefit to nearby areas
- has outcomes that vary depending on which preventive model underlies the measures, where problem-oriented policing provides greater diffusion of benefit than models that only intensify the police presence.

The working methods of problem-oriented policing¹²⁰ are based on the SARA model (see the box: The SARA model for preventive policing) and often involve the local community in the solution process. The final chapter discusses how the SARA model can underpin predictive policing.

¹¹⁹ Bowers et al. (2011)

¹²⁰ See the Appendix "Models for preventive policing".

3 ETHICAL CONSIDERATIONS

Although all places and people are entitled to equal treatment by the police, this does not mean that the police should prioritise all cases equally. Predictive policing is all about focusing the police's resources on the areas where the needs are greatest.

The police have always had a special focus on the areas with the highest needs – a selective focus on places or communities that are linked to priority problems in various ways. However, predictive policing shifts this focus from larger areas and groups of people to specific places and individuals. A selective focus can be both useful and necessary, but a number of ethical considerations arise when working out which places and people require more attention.

In the discussion below, the word "discrimination" is used to refer to unjustified differential treatment of different groups of individuals. The word "bias" is used to describe a systematic predisposition, preference or imbalance in data acquisition and algorithmic systems. Unjustified discrimination may be the result of human judgements, misuse of technology, or properties of the technological tools used. Measures must be taken to avoid both discrimination and bias – in advance and retroactively.

Even if the analytical work is perceived as acceptable, it may have unintended consequences that can be perceived as very unfortunate. Weighing up the benefits against potential downsides is a key challenge of predictive analytics, especially in connection with policing.

At the same time, the analyses can help make the priorities and choices that the police make on a daily basis clearer to society. When and why does one area or one person deserve to be flagged as presenting a high risk by the police? Where do we draw the line?

All kinds of questions arise that are important for policy design and practice. In this chapter we will discuss some of these issues in the light of both predictions involving people and place-based predictions in predictive policing.

3.1 PREDICTIONS INVOLVING PEOPLE

The examples in this report have shown that predictive analytics can be used to identify the risk linked to both places and people. Predicting who is at risk of being involved in crime is not necessarily an expression of unfair discrimination. But is an ethical boundary crossed when we move from making predictions regarding places to predictions regarding people?

3.1.1 FRAMING: *DO YOU HAVE A PROBLEM, OR ARE YOU A PROBLEM?*

Analyses that attempt to predict human behaviour can be experienced as both very helpful and highly problematic. It is often the context in which the analysis is being performed that is decisive for whether it is perceived as useful or problematic.¹²¹ The following hypothetical examples help illustrate this:

- Genetic information is used to determine the risk of a baby developing a serious chronic disease. Early identification makes it possible to take preventive countermeasures to reduce this risk.
- Genetic information is used to determine the risk of a baby developing a criminal career. Early identification makes it possible to take preventive countermeasures to reduce this risk.

Numerous concerns are instantly raised related to the police's risk scoring of people, but risk calculations on the individual level are neither a new phenomenon nor a completely alien practice in Norway. These kinds of methods are already in use in various sectors: the insurance industry uses risk analysis to

¹²¹ Data and Society (2014)

determine insurance premiums; the Norwegian Tax Administration compiles risk profiles that divide taxpayers into categories according to their risk of making mistakes¹²²; the health system uses risk profiles to evaluate people's susceptibility to various diseases.

In what contexts are these kinds of risk calculations justified, and when ought they not to be used?

In many cases the answer will depend on how the predictive tools are used by the exercisers of authority: are they used to characterise and define individuals as a problem for the rest of society, or are they used to identify individuals who run a risk that might have negative consequences for their own lives?

In many cases, both approaches are valid, but some institutions may nevertheless choose to consider the problem from one side only: for an insurance company, a high-risk person is primarily a person that the company may lose money on.

In the justice sector, this kind of one-sided approach is more complex and problematic. At the same time, the police's choice of measures for intervention against high-risk individuals could easily be swayed by whether these people are seen as problems in society or as individuals who run a risk in relation to their own lives and prospects.

When predictive analytics is applied to individuals, it must be done in such a way that the people identified as having a heightened risk are given more support, new opportunities and the chance to avoid crime. If it instead leads to more surveillance, stigmatisation and a more difficult life for the individuals on the at-risk list, this will undermine not only the relationship of trust between the police and the public, but also the legitimacy of predictive policing. Moreover, the political priority ascribed to preventive measures builds on a cost–benefit assessment to a certain degree: reactive measures are both more costly and less beneficial to society than helping high-risk individuals and giving them new opportunities.

¹²² The Norwegian Tax Administration (2015), p. 9

3.1.2 ARE YOU "STATISTICALLY GUILTY"?

The risk analyses carried out by the police in Chicago (see 2.3.6) provide the police with access to a ranked list of 400 persons whom the analyses ascribe an especially high probability of involvement in future violent crimes – either as a victim or as a perpetrator. According to Chicago Police Department, the probability of involvement in crime is significantly higher for the people on the list than the average for the city.¹²³ A police officer in Chicago has been quoted as saying: "If you end up on that list, there's a reason you're there".¹²⁴

However, even if the police's calculations are correct and robust, and the people on the list have a demonstrable statistically higher risk of involvement in crime as a result of various factors and the people they know, it is important to remember that none of them have actually carried out the acts for which they have been flagged as at risk of committing. This naturally limits the police's possibilities for intervention.

¹²³ Chicago Tribune (2013), "Chicago police use 'heat list' as strategy to prevent violence"

¹²⁴ The Verge (2014), "The minority report: Chicago's new police computer predicts crimes, but is it racist?"

"SHOW ME WHERE YOU SHOP AND I'LL TELL YOU WHO YOU ARE"

When American Kevin Johnson came home from his honeymoon, he was surprised to receive a letter from the credit card company American Express. Johnson, whose finances were orderly and who had a high credit rating was suddenly told that the credit limit on his card had been lowered by almost 65%.¹²⁵

The reason for his new reduced credit limit was not any default on payment by Johnson; rather other customers who had shopped in the same shops as Johnson had bought from had a poor repayment history with American Express. In other words Johnson had been flagged as a high-risk customer because he had a shopping pattern that the credit card company thought resembled the pattern of customers who had trouble paying their debts. The fact that Johnson's personal credit history was impeccable – that he had never had a late repayment or exceeded his credit limit – was not included in the risk assessment.

Johnson was a victim of so-called "behavioural profiling" – a data-driven method where similarities between an individual's behaviour and the behaviour of a larger group is used to guide decisions. But is it fair that Johnson was flagged as a high-risk customer simply because he belongs to a statistical group with certain behavioural characteristics?

Can decisions in the justice sector be based on statistical "truths", or should they be based solely on the individual's own behaviour and not what other people in a similar situation have done?

For even when predictive analytics provides a risk score for individuals, these kinds of analyses necessarily never treat people as isolated individuals, but rather as members of a larger group that share certain probable characteristics. The people on the list are ascribed a higher risk because they share certain statistical, relational and social similarities with other people who have previously been involved in serious crime. This also applies in cases where the analyses draw on the individual's criminal history.

When predictive analytics leads the police to intervene at the individual level, for example, to make a preemptive home visit to issue a warning, these interventions can easily be perceived as unfair differential treatment based on the "socio-statistical group" the individual belongs to or what other people in similar situations have done in the past.

¹²⁵ ABC News (2009), "GMA' Gets Answers: Some Credit Card Companies Financially Profiling Customers"

It can be difficult to find an appropriate police response. The police must exercise great caution when responding on the basis of predictive analytics, and especially predictions involving people.

3.1.3 SURGICAL RESOURCE MANAGEMENT OR MASS SURVEILLANCE?

It may also be timely to ask why the Chicago police's high-risk list consists of some 400 names and not 10 or 10,000? An alternative system could be that everyone living in the city was given a risk score, regardless of their background, and that the police, in the light of their available resources, give first priority to measures targeting the people at the top of the list at any given time.¹²⁶ However, this kind of system would have clear parallels to mass surveillance.

The threshold for delimitation and flagging of high-risk people and areas is motivated by statistical and strategic considerations, but also represents value choices because they are involved in determining who the police will be keeping a closer eye on. An important question in this context is how we define problems and how we decide which areas or which groups of people should be allowed to be risk-assessed using predictive analytics.

3.2 PLACE-BASED PREDICTIONS

Unlike predictions involving people, place-based predictions tend to be perceived as more neutral. After all, these kinds of analyses do not target individuals directly, but rather seek to identify geographically delimited areas that for some reason appear to be more susceptible to crime.

Yet it is ultimately people who commit crimes, not places. When the police know where and when the risk of crime is greatest, this will often have consequences for people who find themselves at these places. However, predictive analytics does not tell the police which response is best suited to resolve a local problem.

¹²⁶ ACLU (2014), "Chicago Police 'Heat List' Renews Old Fears About Government Flagging and Tagging"

Below we discuss how unfortunate use of place-based risk analysis can be perceived as an instrument for wrongful suspicion, discrimination and stigmatisation.

3.2.1 CATEGORICAL SUSPICION

Although environmental factors may pave the way for criminal acts in some places, it is ultimately the acts that are criminal, not the mere existence of a hotspot.

Nevertheless, predictive analytics can lead to categorical suspicion of everyone who happens to be in a crime hotspot. This can in turn be used to justify more extensive use of "stop and search" and interrogation than is currently common practice.¹²⁷

For people who simply happen to find themselves in the place identified as a hotspot, this kind of contact with the police can be perceived as very unpleasant. Citizens may experience the police's need for preventive intervention as illegitimate and arbitrary, or in the worst case, as wrongful stigmatisation. This kind of development may in turn undermine the trust between the police and the public.

It is therefore imperative that the police consider their methods of intervention very carefully and communicate clearly to the public which interventions may be used against individuals who are on a high-risk list or in a crime hotspot. Methods that limit people's freedom in public spaces ought to be limited in favour of methods that seek to change the conditions that facilitate crime.

¹²⁷ Rosenbaum (2006), p. 254

DOES PREDICTIVE ANALYTICS PROVIDE REASONABLE GROUNDS FOR SUSPICION?

A hypothetical example:

The city of Drammen has experienced a series of car break-ins at various locations in the city over a period of time. On Tuesday morning, predictive analyses at Drammen Police Station indicate that the risk of another break-in is particularly high around Havnegata and a patrol car is therefore directed there. On arrival, the patrol observes a person carrying a large sports bag over his shoulder. The man with the bag is in the middle of the indicated risk area, and the police are suspicious. Does the man have sports clothes in the bag or a crowbar that can be used to break into one of the cars parked in the area?

Carrying a sports bag is not sufficient grounds to stop someone. Nor is the risk analysis that the police have received. But since the prediction and profile coincide in the same place, the police decide to stop the person and check the contents of the bag. They find only old exercise clothes and let the man go. The man is disconcerted. He does not understand the police's intervention and expresses strong dissatisfaction at having been stopped in this way.¹²⁸

3.2.2 REASONABLE GROUNDS FOR SUSPICION?

In the USA, the authorities are discussing whether and to what extent predictive analytics ought to be allowed to give the police reasonable grounds for suspicion.¹²⁹ If the analysis is robust and part of a wider preventive strategy, it might also be normal to expect that the police will have greater opportunity to intervene to prevent an unfortunate or criminal situation unfolding.

In the USA, the threshold for reasonable grounds to suspect a person is already slightly lower in areas with high crime rates.¹³⁰ However, there is no exact definition of what constitutes a high-crime area. Here predictive analyses of relatively small, delimited risk areas and time slots might serve to focus the police's attention and strengthen the civil liberties of citizens who happen to be in a more widely defined crime hotspot.¹³¹

The example above shows that it is not always entirely straightforward to determine how an intervention should take place and what powers the police should have. This applies in particular to interventions targeting individuals who are in a high-risk area. In New York, the police have received much

¹²⁸ Ferguson (2012), pp. 308–310

¹²⁹ Ferguson (2012)

¹³⁰ Perry et al. (2013), p. 24

¹³¹ Ferguson (2012), pp. 310–312

criticism for their "stop-and-frisk" programme in areas with allegedly high crime rates, where the majority of the people who have been stopped are of African–American or Latino background.¹³²

Individuals who not have criminal intentions will often experience intervention by the police as restricting their civil liberties and as an expression of wrongful criminalisation simply because they were "at the wrong place at the wrong time". If this kind of intervention takes place in a public space with other citizens looking on, it can also be perceived as embarrassing or stigmatising. This impression is further reinforced if it is unlikely that the person would have been stopped if the police had not had the insight generated by the predictive analysis.

3.2.3 A SELF-FULFILLING PROPHECY?

Predictive models generally use historical crime data to calculate where and when – or for whom – the future risk of a similar crime is greatest. Although this historical data is fed into complex models, the "form" of the data will often be decisive for where or to whom the police direct their attention.

Critics of predictive methods point out that the very fact that these kinds of methods send the police to the places where needs are greatest naturally results in the police identifying more crimes and making more arrests in these areas. When new data from old hotspots are then fed into the predictive analytics systems, this could further reinforce old hotspots as future hotspots too. In this way, predictive analytics can actually serve to "trap" the police in a vicious circle.

As is discussed below, it is therefore important that problems are not addressed with increased police presence alone, but that the police also follow up any increased presence with a long-term strategy to change the conditions that facilitate the problem.

3.2.4 ONCE A HOTSPOT, ALWAYS A HOTSPOT?

Although historical data can be used to calculate the risk of a future burglary in a given area at a given time, the number of previous burglaries cannot ex-

¹³² New York Civil Liberties Union: <http://www.nyclu.org/issues/racial-justice/stop-and-frisk-practices>; Salon (2015), "America's over-policing bombshell: How new data proves "stop & frisk" critics were right all along"; see also ECHR Gillian and Quentin V UK, judgment 12, Oct 2010, application no. 4158/05, paragraphs 84–85.

plain why a future burglary takes place. The reason for this must be attributed to environmental factors in the area that facilitate this type of crime. If these factors are not identified and addressed, the area continues to be a hotspot for burglaries.

The fact that an area is identified as a high-risk area by predictive analyses means that there are environmental shortcomings there (such as poor lighting, good escape routes, hiding places, etc.) that have not been addressed and which pave the way for a given type of crime. By being on site in advance, the police might be able to avert a future crime, but as long as the environmental factors at the site remain unchanged in all other respects, it may flare up again as a hotspot as soon as the police leave.

Furthermore, it can be perceived as an infringement of civil liberties when people passing through defined hotspot areas are subject to suspicion if the police does not communicate clearly why the area is regarded as a high-risk area that requires attention and what steps they have taken to try to resolve the issue. It is also important that the police act on the basis of relevant and up-to-date analyses: Environmental changes in an area would also change the basis for the analyses and possibly render them invalid.

3.2.5 STIGMATISATION

The public may come to have negative perceptions of areas that are labelled as "hotspots" – they are unsafe and dangerous for normal use and transit. In some cases, this kind of stigmatisation may even exacerbate a negative spiral that actually enhances the local conditions for criminal acts. This applies in particular to areas that border a hotspot or that have had a moderate criminal activity profile.

It may also manifest itself in the form of a decline in property values or problems for local businesses. These kinds of consequences are especially unfortunate if the hotspot "label" is incorrect as a result of poor data or errors in the analysis. The police can choose not to go public with its hotspot identification, but this makes it difficult to involve the local community and other stakeholders in the solution process.¹³³ It also challenges the legitimate need for transparency and disclosure in these kinds of analyses.

¹³³ Rosenbaum (2006), pp. 254–255

3.3 DISCRIMINATION – ARE ALGORITHMS EVER NEUTRAL?

Predictive analyses can never be better than the data they are fed. Systematic errors in the underlying data will result in erroneous predictions. If the data that are fed into the system are incorrect, imprecise, incomplete, biased or contain large volumes of dark figures, the technology can actually reinforce and legitimise bias and discriminatory practices.

3.3.1 UNDERREPORTING AND BIASED DATASETS

While burglaries are often reported, many other types of crime are frequently underreported; for example, rape. If predictive analyses do not take underreporting into account, they may draw an incorrect picture of the crime landscape and result in unfortunate consequences in connection with the allocation of resources.

Underreporting and incomplete datasets may not only have negative consequences for resource management, but may also contribute to serious systematic discrimination against individuals.

For example studies from the USA show that some ethnic minorities are arrested more frequently for marijuana possession than is the case for the ethnic majority, despite the fact that the use of marijuana is approximately equal across ethnic groups.¹³⁴ If the police treat different groups in society differently, the police's datasets will quickly draw a distorted picture of reality. If these kinds of biased datasets are fed into predictive models, the predictions could easily serve to perpetuate and reinforce prejudices and errors.

The risk calculations will therefore not be "neutral". If biased datasets are used to manage the police's resources, groups that experience biased treatment might experience predictive policing as a legitimisation and systematisation of discriminatory and wrongful police practices.

The impression that predictive analytics are scientific and neutral may lead to blind and uncritical faith in them. In the worst case, this can be misused to mask discriminatory practices. This might lead to the discrimination spreading further through the system: If a previous arrest for marijuana possession is

¹³⁴ Levine et al. (2010)

included as a variable in the algorithm to predict whether prisoners should be released on parole, and this algorithm does not correct for bias in the arrest statistics, ethnic minorities risk being systematically dealt worse cards than the ethnic majority throughout the entire judicial system.

Use of these kinds of analyses will then serve to further reinforce the vicious circle that gave rise to the biased data in the first place. Dwork and Mulligan point out that this kind of practice will be very difficult to stop, partly because considerations of data privacy often prevent the openness and transparency that is needed to detect and eradicate the biases that are inherent in the existing datasets.¹³⁵

According to Harcourt, it is conceivable that in this way predictive analytics can be so stigmatising that groups that did not originally wish to pursue a life of crime become ostracised from society by bad software and bad data, and thus have no other choice than to try to make a living through crime.¹³⁶

3.3.2 DRIVEN BY DATA, BUT WHICH DATA?

Predictive policing is governed by data-driven analysis. Not only are there many different analysis techniques; there is also a growing number of different data sources that the police can use in these kinds of analyses. While crime data is often obtained from the police's own systems, the police must obtain other information, such as, for example, weather data or socio-demographic data, from external data sources. Although these kinds of datasets may be publicly available, they do raise some ethical issues that require reflection.

Demographics and proxy variables

There are several laws prohibiting discrimination on the basis of gender¹³⁷, ethnicity or religion¹³⁸, etc. At the same time, the insurance industry is allowed to charge women higher insurance premiums than men, because women tend to live longer than men. Similarly, they are allowed to demand higher car insurance premiums from young men, because this group is attributed a higher risk in the insurance model. Differential treatment, which in the labour

¹³⁵ Dwork and Mulligan (2013)

¹³⁶ Harcourt (2007)

¹³⁷ Act relating to gender equality (Gender Equality Act),

<https://lovdata.no/dokument/NL/lov/2013-06-21-59>

¹³⁸ Act relating to a prohibition against discrimination on the basis of ethnicity, religion and belief (Ethnicity Anti-Discrimination Act), <https://lovdata.no/dokument/NL/lov/2013-06-21-60>

market is regarded as unfair discrimination, is considered legitimate risk differentiation in the context of insurance.

The police's risk models will also treat different people differently. But is it right that these models are fed with variables describing *who we are* and *where we come from*, as opposed to *what we have done*?

And even if personal traits such as ethnicity and religion are not used, it is still important to be aware that it is all too easy to create "proxy variables" through elements such as address or income. These kinds of variables are often linked to specific social groups and can easily disguise a risk differentiation based on ethnicity and social stratum.

It is therefore important to have clear guidelines defining which variables the police shall be allowed to use in their predictive policing and to clarify who should prepare them.

New data sources and social media

In recent years we have seen an explosion in new sources of data. Weather data, traffic data and payroll data have all become digitised and can be easily shared with, for example, the police. In particular, the sudden and widespread prevalence of smartphones has given rise to entirely new and very interesting data sources.

As discussed in section 2.3.5, anonymised traffic data from smartphones could be used to improve predictive models: if traffic data are linked to demographic data, the models can carry out a risk assessment based on the likelihood of the number of women and men within a given age segment being in the area at a given time and whether they live there, work there or are simply passing through.

But ought the police to be granted access to anonymised traffic data from telecommunications operators to support their predictive analytics? These kinds of data paint a detailed picture of our daily movement patterns, and studies have shown that they are also relatively easy to de-anonymise.¹³⁹ Is this surgical policing, or does this border on mass surveillance? Ought mobile

¹³⁹ de Montjoye et al. (2013)

phone users themselves to be given the opportunity to choose whether they want to share their traffic data with the police or not?

CAN SOCIAL MEDIA BE USED TO PREDICT CRIME?

Although criminals rarely reveal their plans or deeds on social media, citizens often announce their every-day activities on these kinds of platforms. A study from the University of Virginia's Predictive Technology Lab shows that the details we routinely share on social media correlate strongly with certain types of crime.

The study included a computer analysis of the content of 1.5 million tweets from various areas of Chicago and compared these to the police's crime data from the same place and time. For example, if an area had had many burglaries in a given month, the study tried to find out what people in the area had tweeted that month. If an area had experienced an unusual amount of vandalism, etc., the study tried to identify what activity on Twitter from the area coincided with the vandalism. This information was then used to predict the crime rates for the following month.

The study concluded that this kind of use of public data from Twitter can strengthen the police's predictions in 19 out of a total of 25 different types of crime.¹⁴⁰

Smartphones have also become a useful and popular platform to access the internet and social media. As described in a previous report from the Norwegian Board of Technology, social media have rapidly become a very important communication platform for many people and a place where people share different experiences and thoughts.¹⁴¹ The above example (see the box: "Can social media be used to predict crime?") illustrates how predictive analytics could also make use of this kind of information.

But if the police use information we share on social media in this way, will we then censor ourselves or in some other way moderate and limit our use of these media? How would this use of social media be experienced in areas where the relationship between the police and the local community is already strained? Even when information posted on social media is openly available on the internet, this degree of openness is not always intentional or even known. The fact that the boundaries between what is "public" and what is

¹⁴⁰ Gerber (2014); Clemmons (2014)

¹⁴¹ The Norwegian Board of Technology (2014): Online with the public: – How smartphones and social media are creating new opportunities for the Norwegian police

"private" on the internet are fuzzy may pose a challenge to the police's use of this kind of information in predictive analyses.¹⁴²

For this reason clear definitions are needed in relation to which data sources the police shall be allowed to use in their predictive work, as well as guidelines on how they should be handled.

3.3.3 ARE ALGORITHMS NEUTRAL?

Algorithms and data-driven analyses are often presented as scientific, neutral, unprejudiced and procedural. These are also the qualities that are used to justify the introduction of these kinds of tools.

However, algorithmic systems are rarely completely value-neutral. This also applies to the police's predictive analyses. The models that the analyses are based on include embedded assumptions, simplifications, idealised descriptions and evaluations in terms of which factors are given weight. Moreover, both conscious and subconscious choices made in connection with data collection and processing can affect the outcome of the analysis.¹⁴³ Also the way in which the police choose to use and evaluate the methods includes value choices.

Determining which areas or people the police are going to focus their attention on will always involve value choices. This is not something new that the technology entails, but when these kinds of value choices are hidden away in technical analyses, they can be harder to spot. If we do not understand how a predictive model works, what trade-offs and choices have been made, and how a given prediction is reached, the system can quickly become a "black box" that masks important assumptions, value choices and uncertainties.

These kinds of considerations motivate the need for transparency and possibly supervision of the police's analytical work. Openness concerning which datasets are being used, which variables the analyses use, how these are weighted and how the algorithm works is essential to build confidence in the analytical work, to ensure legitimate use and ensure that bias and discrimination are not normalised.

¹⁴² The Norwegian Board of Technology (2014), chap. 4.4.4

¹⁴³ If, for example, the models are primarily fed with data from a given minority in society, the analyses could be trained to systematically associate a higher risk to individuals from this group.

Openness and transparency are undoubtedly important, but it is also challenging to indicate how to ensure the access and supervision that are necessary to practise openness. For example, how can robust control methods be developed that enable detection of biased or discriminatory practices, biased datasets, or unbalanced algorithms?

It is important that a future pilot project to test predictive analytics in the Norwegian police ensures that the research project includes participants with criminological and legal-sociological backgrounds who have experience in working with these kinds of issues.

3.3.4 DO IMPORTANT VALUE CHOICES BECOME MORE OR LESS VISIBLE?

Many value choices in the justice sector are not necessarily clearly articulated and can often be concealed in various qualitative decision-making processes. When these kinds of choices are made by people, it is at least possible to ask them and challenge them on the choices they have made.

But what happens when these kinds of value choices are embedded deep in algorithms?

Some people might argue that algorithmic systems can cast new light on this issue and force a discussion of these kinds of value choices. For example, the program that is used to risk-assess prisoners being considered for parole in Philadelphia (see the box "Predictions involving people in the US justice sector" in Chapter 2.3.6) requires that the judicial authorities decide in advance whether they want the threshold to be high or low. A high threshold will entail that the authorities might overreact and are unnecessarily strict towards low-risk prisoners, while a lower threshold entails that the authorities risk underestimating some high-risk prisoners. Precisely where to draw the line is a value choice that the authorities are forced to consider, after which the program is adapted accordingly. It is claimed that this ensures that algorithmic systems contribute to visibility and awareness of the value choices made in the justice sector.¹⁴⁴

However, it remains unknown whether such systems actually contribute to a more informed and relevant public debate about how the police and judicial

¹⁴⁴ The Economist (2013)

authorities ought to prioritise their resources, what values shall govern decisions, and what society is willing to accept or what it is not.

When important value choices made by the software are hidden behind complicated technical machinery, it is also quite possible that the system becomes a black box that makes these choices less visible. And if commissions composed of articulate people are replaced by computer programs, there is no longer anyone to ask about the value choices that algorithm makes on its way to a decision. At worst, the only value choice that the authorities and the public can be involved in is whether to select a "high" or "low" setting on a kind of measuring scale.

Many conscious or unconscious choices may lurk in the analysis in the form of assumptions, simplifications, biased training data, etc. These kinds of choices have always been made, but it is important that the technology does not mask them further.

4 A NORWEGIAN MODEL

Strengthening preventive measures has been an explicit goal of the Norwegian authorities and the Norwegian police for some time now. Both the 22 July Commission¹⁴⁵ and the Police Analysis¹⁴⁶ have called for a more analytical approach to preventive policing.

At the same time, new technologies are maturing that can enable the police to predict where and when the risk of future crime is likely to be greatest, and to improve the basis for deciding how resources should be deployed and which measures ought to be taken. The use of predictive analytics is becoming more widespread and being adopted by more and more police organisations in North America and Europe.

Many of them have police cultures that differ from the Norwegian to varying degrees.¹⁴⁷ However, a common denominator is that they all use data analysis as a tool to ensure their work is knowledge-based and focused on prevention. The Norwegian police ought to do the same.

¹⁴⁵ Official Norwegian Report (NOU) 2012:14, Report of the 22 July Commission, p. 336, *"In this perspective it is therefore important to give priority to systematic data collection and analysis to identify high-risk locations and behaviour patterns in order to prevent crime, facilitate investigations and have sufficient capacity available."*

¹⁴⁶ Official Norwegian Report (NOU) 2013:9, One police – equipped to meet future challenges (the Police Analysis), p. 224, *"The analysis should be used to allocate personnel on the basis of the type of crime and where and when crime occurs."*

¹⁴⁷ See, for example, Johannessen (2013) and Barland's criticism in the book review published in the Nordic Journal of Studies in Policing (*Nordisk politiforskning*) 2(1), 2015, pp. 112–115.

In the following we discuss the prerequisites for effective use of data-driven analytics and how these kinds of analyses ought to be integrated into the every-day work of the Norwegian police.

For the police to be able to reap strategic, tactical and operational gains from predictive analytics, they must have the necessary tools and skills to be able to collect relevant data, systematise and analyse them, and use them in the operational police work. At the same time, there must be openness and transparency regarding data collection, clear criteria and guidelines for use, and new mechanisms for management (in advance and retrospectively) and supervision.

4.1 A WORKING MODEL FOR PREDICTIVE POLICING

Predictive analytics has the potential to provide the police with new knowledge, important strategic insights and improved decision support; but analytics alone will never lead to a reduction in crime. For predictive analytics to have the intended effects, insight must be translated into action. The analytical work must therefore be linked closely to the police's tactical work, operational work and preventive activities.

Some commercial products are specially designed for field work, for example by plotting risk areas on digital maps on a tablet. These kinds of tools can make it easier for the police to be in the right place at the right time, and their mere presence can have a significant preventive effect in the short term. To deal with the specific problems in the longer term, however, the underlying issues must be understood and addressed.

The police have many ways of working preventively and over the years have developed a number of different working methods that focus on preventive measures. Problem-oriented policing¹⁴⁸ has been a particularly important methodological approach to prevention¹⁴⁹, often based on the SARA model¹⁵⁰.

¹⁴⁸ See the Appendix.

¹⁴⁹ National Police Directorate (2002)

¹⁵⁰ See the box "The SARA model for preventive policing" in section 2.3.4

This model was used in Central Oslo Police Station's efforts to combat pick-pocketing thefts in Oslo.¹⁵¹

RAND describes how predictive analytics can be integrated into the SARA model for preventive policing.¹⁵² The process is outlined in Figure 4 and is described as a cycle consisting of four phases:

I. Data collection and data access

Predictive analytics is data-driven. It is therefore dependent on access to relevant data. Historical datasets must be digitised and made machine readable. As described below, it is important that the data are subject to quality control, that they describe the relevant circumstances in the best possible way, and that they are constantly updated to ensure changes are taken into account. Poor-quality, incomplete or biased data lead to erroneous predictions.

It may also be pertinent to supplement the police's data with datasets from other sources, such as, for example, data on infrastructure, weather conditions, salary payments or demographics. It is therefore important to facilitate cross-linking of the various sources of information. However, this kind of cross-linking must be weighed up against the consideration of data privacy and could be monitored by independent supervision mechanisms.

II. Analysis

There are many different techniques and tools for analysis. Choice of method depends on various factors, and methods must be selected and adapted with care.¹⁵³ In many cases it may therefore be useful to run several parallel analyses.¹⁵⁴

Predictive analyses necessarily build on a simplified description of reality and do not describe all forms of crime equally well. It is therefore important to nurture awareness about the theoretical and statistical limitations of these kinds of analyses.

¹⁵¹ See the example "Oslo: Map-based analytics to prevent pickpocketing".

¹⁵² Perry et al. (2013)

¹⁵³ See, for example, Chainey et al. (2008)

¹⁵⁴ Caplan et al. (2011), p. 4

III. Operational action

For the analyses to serve any real purpose, the police must be able to intervene in the flagged problem area or against the flagged problem group. The intervention method will vary from problem to problem. In some cases, preventive intervention will mean collaboration with local institutions such as schools, youth clubs and local authorities. In other cases, it may mean a visible presence or installation of a police camera. Regardless of the response the police choose, all the parties will need sufficient, adapted information to be able to choose the most appropriate measures. It is also important that short-term prevention is always followed up with measures aimed at resolving the underlying issues at the site.

IV. Reaction

Many different factors can contribute to an increase or decrease in local crime. To investigate whether the implemented measures have had the desired effect, it is therefore important to use robust evaluation methods under the most controlled conditions.

If the police's response to a flagged risk was successful, the conditions for crime at the hotspot will have changed. The crime may be displaced to other locations or may manifest itself in new ways. Changes in the conditions at the site mean that the old data are no longer valid and that new data must be collected and analysed. And so the process must be repeated.

The four points 'Data collection', 'Analysis', 'Operational action' and 'Reaction' describe four elements that ought to be central to all police work that aims to predict problems.

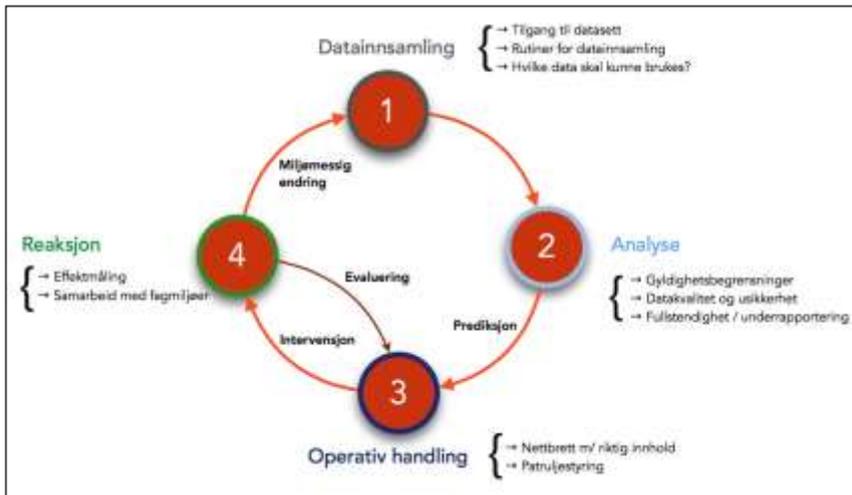


Figure 4 A cyclic working model with four elements that ought to be central to all predictive policing.

4.2 DATA COLLECTION AND ACCESS

4.2.1 SECURE ACCESS TO OWN DATASETS

Predictive analytics is data-driven and necessarily requires access to relevant, digitised data.

The 22 July Commission points out that the police in Norway possess significant amounts of data that can be used to understand and measure activities. However, much of this data has not been made readily available and adapted for analysis at the police stations around the country. The Police Analysis highlights, among others, lack of availability and poor data quality as two reasons why data analytics has not previously taken root in the Norwegian police.

In connection with the imminent major and necessary modernisation and upgrade of the police's ICT systems, it is essential that datasets that can support these kinds of analyses are made available to the police's analysis teams in the various districts. At the same time, the systems must ensure that the police can easily merge their own datasets with data from other players, such as weather data and traffic data, for example.

4.2.2 ESTABLISH ROUTINES FOR DATA COLLECTION

A data-driven police cannot live on historical datasets alone, rather these datasets must be constantly updated and maintained. It is therefore important that the police collect information in such a way that it will support both ongoing and future analytical work. A uniform standard for information collection and quality control of data that is used throughout the entire police force will be very useful to ensure that the data are as complete as possible.

As part of this work, it should also be considered whether the current system for gathering information in the field has sufficient breadth; with a view to supporting predictive analyses it may be necessary to register information that does not necessarily have any obvious, immediate utility value for ongoing investigations or criminal proceedings, such as, for example, the weather conditions and geographical and environmental features at the scene of an incident.

4.2.3 DELIMITATION AGAINST EXTERNAL DATA SOURCES

While the police can hardly be prohibited from using their own datasets for preventive analysis, it does not therefore follow that they ought also to be granted permission to supplement their analyses with external datasets – even if this would provide the analyses with significant added predictive value.

While weather data may seem innocent enough, many people would perceive data about their mobile phone usage from telecom operators as an unnecessary intrusion into their private life. If the police's preventive activities are perceived as surveillance, this could undermine the relationship of trust between the police and the public.

Other datasets, such as information posted on social media, might be openly available to other actors in society, but the police's use of such information may nevertheless lead to an unwanted chilling effect.

In the future, an increasing number of datasets will be made available for use in predictive analytics, and this creates a need for a political demarcation to clarify which purposes and what analytical capacity are considered legitimate and necessary for the Norwegian police.

4.3 FROM DATA TO ANALYSIS

Not even the best predictive algorithms are "crystal balls" that can magically foresee the future; they are simply mathematical models that express the probability of a future event taking place. Like all other mathematical models, these kinds of tools will also have weaknesses that the Norwegian police need to be consciously aware of. Blind or incorrect use of these kinds of analyses might have unfortunate consequences that will undermine the public's trust in the police.

4.3.1 VALIDITY RESTRICTIONS

Predictive analyses rely on a number of different criminological theories that often relate to a particular type of crime. The predictions will therefore only be valid for the corresponding types of crime and will not necessarily apply to other forms of crime. Crimes of gain often tend to correlate with environmental factors such as concealment, lighting, escape possibilities, etc., while different factors will tend to affect violent crimes, such as revenge and gang territory.

Predictive models that work well for burglary will not necessarily work for other types of crime governed by entirely different factors. For this reason it is important to understand both the differences between the various models and their different areas of validity.

It is also important to know the period of validity of a prediction. In some cases, the warnings will only be valid for a very short period of time. This applies especially to so-called "near-repeat" models, where the risk of a second burglary at a neighbour's house is high shortly after a property has been burgled. However, this risk falls rapidly, and it may therefore be important to act on the prediction during the course of the following day.¹⁵⁵ At the same time it is also important that new crimes are dealt with promptly and that the analytical tool is updated with the new data.

The results of the analysis must also be communicated to the patrols in a suitable manner, so that they have the opportunity to act on the information while the prediction is still valid. In some cases this will require real-time reporting,

¹⁵⁵ Chainey (2012)

data processing and communication between analysts and patrols, as is discussed in section 4.4.1.

4.3.2 DEALING WITH UNCERTAINTY

Before decisions are made that have consequences for the operational activities, it is important to take into account the uncertainties in the individual models and in the data included in the analysis. Acting on the basis of a predictive statement without knowledge and understanding of how the model generates these predictions entails a risk of developing a blind dependency on the technology, which – as previously explained – can have a range of negative consequences.

4.3.3 DATA QUALITY

Predictive analyses are often based on historical data. It is therefore important that the data that are used in these kinds of analyses are as complete, correct and robust as possible. Inadequate or incomplete data may result in uncertain predictions, which ought to be reflected in the conclusions.

4.3.4 COMPLETENESS AND UNDERREPORTING

It is important to be aware of how complete the *datasets* are. While burglaries and break-ins are often reported, many other types of crime are frequently underreported; for example, rape. If predictive analyses do not take underreporting into account, they may draw an incorrect picture of the crime landscape. As experience is acquired, police officers will develop an intuitive feeling for the extent of the dark figures for different types of crime and in some cases even within certain geographical areas or communities. It is therefore important that predictive analyses do not steer all the resources away from crimes where the data are sparse, but that the police also maintain a focus on crimes that are underreported. Predictive policing must also make use of and support empirical police experience.

Underreporting and incomplete datasets may not only have negative consequences for resource management, but may also contribute to serious systematic discrimination against individuals.

4.4 FROM ANALYSIS TO ACTION

4.4.1 TABLETS – A TOOL FOR INFORMATION EXCHANGE

Now that they have been equipped with tablets, the police patrols in Norway have mobile access to several of the police's ICT systems. This means the patrols can access various police registers and the police's operations log when they are away from the office. Although mobile access to office systems is important, as it enables the police to spend more time outside in the field and means that they can perform tasks in the field efficiently, this access to information needs to be expanded and improved in order to reap benefits from predictive analytics.

Many predictive analyses produce forecasts that are only valid for a limited period of time. In some cases, the period of validity will be a couple of days or less. It is therefore important that the police react to alerts from the system promptly. This requires that the results of the analyses are shared with the patrol at the right time and in a precise manner. In addition, the information must be presented in such a way that the patrols do not have to hunt through the system for it, but automatically receive real, active decision support in their every-day operations. In this way, data analyses can become an integral part of the police's planned execution of their tasks.



Figure 5 Patrols can have risk areas and related instructions for the patrol shift marked on a map that they can access using a mobile device. Illustration: Birgitte Blandhoej

Automated, continuous exchange of information with the patrols in the form of precise instructions for specific areas is possible and can provide significant gains. It is therefore important that new operational tools, such as mobile tablets, not only serve as a portal to the police's computer systems, but are also adapted to the needs of preventive policing.

This could mean that the results of the analytical work and the ensuing strategies are communicated to the patrols in real time in the form of either precise instructions or guidelines for their patrol: "Patrol this area after 22:30" or "High probability of shoplifting, keep a watchful eye". These kinds of instructions can be communicated efficiently through digital maps on mobile devices that dynamically indicate and update, for example¹⁵⁶:

- different geographical focus areas, sorted by type of crime
- simplified historical data and other relevant information related to these areas, such as tips from the public, working hypotheses, etc.
- which areas are considered high-risk areas for new incidents within the time frame of the current shift

¹⁵⁶ See Taylor et al. (2011), p. 23

- what actions ought to be implemented in these areas

This kind of information platform will democratise access to information, meaning it is no longer a matter of experience and intuition.

4.4.2 PATROL MANAGEMENT

Today's patrol management in the police in Norway relies largely on the experience of the patrol and gives the individual police officer a high degree of freedom and autonomy.¹⁵⁷ The patrol fleets are rarely steered by an overall, coordinated strategy for prevention. In addition, in the largest cities such as Oslo, a lot of the shifts are marked by incident-driven policing, where the patrols have to act as incidents occur.¹⁵⁸

Predictive analytics will make patrolling in Norway less reactive and incident-driven. The fact that the patrol is one step ahead will also reduce the response time to incident-driven calls. Although experienced officers tend to know where the needs are greatest, experience from other countries indicates that predictive analyses result in more precise risk assessments.

These kinds of analyses can be used to manage police patrols in at least two different ways:

- highly detailed management, with precise instructions that define the sphere of activity for every patrol, or
- giving the patrols a certain degree of autonomy and the opportunity to choose their own priorities.

Strictly controlled management of patrol provides better opportunities to coordinate the patrol fleet and ensure that the overall patrolling supports the police's long-term priorities and goals. At the same time, such rigid management can make it difficult for the patrols to implement self-initiated actions in connection with incidents that arise while they are on their patrol shift and that are not covered by preventive activities. The most appropriate solution will be a hybrid style of management.

¹⁵⁷ Finstad (2013), p. 71

¹⁵⁸ NRK Ytring (2013), "Fremtidens politi bør være fortuseende" [The police of the future should be able to predict]

In areas with relatively little criminal activity, it may be sufficient that the patrol gives priority to hotspots between incident-driven policing assignments. In larger cities, where the crime rates are higher, it may be necessary to divide the patrol fleet into two parts, where some dedicated patrols are exempt from responding to incident-driven assignments and can concentrate on patrolling the relevant high-risk areas for preventive purposes.

Regardless of how the patrol is managed, analytical tools pave the way for coordinated and targeted management of the entire patrol fleet.¹⁵⁹ These kinds of methods might be useful if police districts are merged, resulting in larger patrolling areas for each police station than is currently the case, as the government has proposed.¹⁶⁰

4.4.3 FROM WHERE TO WHY

In the long term, it does not help to direct police resources to high-risk areas if it is not understood why these areas facilitate crime and action is not taken to change them.¹⁶¹ It is therefore important that the analytical work not only identifies where and when the crime takes place, but also asks *why* an area has a heightened risk. Long-term prevention requires that these issues be addressed, and resources for immediate interventions must therefore be balanced against resources allocated to long-term strategies.

The police have a number of different strategies to counteract repeat offences and combat recurring crime. Some involve physical presence in the form of a patrol on the scene; in other cases preventive activities may involve collaboration with different stakeholders in the local community, such as the municipal authorities, schools or after-school programme providers. It may therefore be natural to link the analytical work to the Police Boards.

Regardless of which preventive intervention methods the police adopt as the basis for their work, it is necessary to know where and when crimes take place in order to be able to choose effective countermeasures.

¹⁵⁹ See, for example, McCue (2007), chap. 13

¹⁶⁰ Proposition no. 61 to the Storting (bill and draft resolution) (2014–2015), Amendments to the Police Act etc. (The Local Police Reform)

¹⁶¹ Rosenbaum (2006), p. 251

Tore Bjørgo (of the Norwegian Police University College) has developed a comprehensive and generally applicable model for crime prevention that builds on nine mechanisms.¹⁶² The ability to detect and stop crimes before they happen is one of them. Here predictive analytics can help.

¹⁶² Bjørgo (2015)

4.5 IMPACT ASSESSMENT, INNOVATION AND DEVELOPMENT

HOW TO MEASURE THE IMPACT OF PREDICTIVE POLICING?

In the UK, several police districts have started using predictive analytics. For example, the police in Kent have started using a customised version of PredPol.¹⁶³ The Trafford borough of Manchester, where the police have started using predictive analytics to combat burglaries, has reported a 26% decrease, compared with a decrease of 9% for the city as a whole.^{164 165166}

With support from the Home Office, West Midlands Police have teamed up with researchers to develop the largest predictive policing project in the UK. **Operation Swordfish** is a project that aims to strike an ideal balance between traditional, reactive policing with a focus on short response times and a more proactive position, where resource allocation is adapted to the geographical needs.

Nearly 30% of the burglaries in Birmingham in 2011 were repeat offences, where either the same property was burgled again or a neighbouring property was burgled.¹⁶⁷ The project aims to study and document whether predictive analytics can help reduce the burglary rate and at the same time measure the success rate of these kinds of analyses against that of more traditional methods. To this end, West Midlands Police have divided Birmingham into different zones: in half of the zones the police will use analytical tools in their work, while in the other half they will continue to work using more traditional policing methods. The zones were selected randomly and are randomly distributed throughout the city. There are neutral "buffer" zones between all the active zones, to reduce bias in the evaluation data caused by burglars being displaced from one area to another.

In partnership with the **Jill Dando Institute of Crime Science** at University College London, the police will now test predictive analytics in half of the zones. The Jill Dando Institute is providing the analytical tools and assisting the police in the work on collating descriptive data about burglaries, such as typical features of the area, type of property, access to the property, etc., with existing crime data.¹⁶⁸ In this way the police will be able to generate a map indicating where and when it is most likely that the next burglaries will take place. In the other zones, the police will use traditional methods for dealing with burglaries.¹⁶⁹

¹⁶³ The Guardian (2014), "Predicting crime, LAPD-style"

¹⁶⁴ Chainey (2012)

¹⁶⁵ Jones and Fielding (2011)

¹⁶⁶ Channel4 (2012), "Predictive policing: tackling crime in advance"

¹⁶⁷ BBC (2012), "Could 'predictive policing' help prevent burglary?"

¹⁶⁸ DecisionMarketing (2012), "Police trial pre-crime data unit" and talks with Prof. Shane Johnson, UCL Dept. of Security and Crime Science

¹⁶⁹ Between two zones, the project has introduced neutral "buffer zones" to minimise any bias in the evaluation data caused by burglars being displaced from one area to another.

4.5.1 MEASURING EFFICACY AND INTRODUCING NEW ROUTINES

It is difficult to measure the efficacy of predictive policing, and it is important to establish sound routines from an early stage to gauge what works and what does not.

An interesting example of this kind of method comes from the city of Birmingham in the United Kingdom. Here, in collaboration with University College London, the police are conducting a project that sets out to systematically measure displacement effects and diffusion of benefit (see the box: "How to measure the impact of predictive policing?"). This kind of strategy is very useful in the start-up phase and is important to ensure robust evaluation of predictive policing.

4.5.2 COLLABORATION WITH EXPERTS

The examples discussed in this report show that predictive policing is often undertaken in collaboration with actors outside the justice sector. One such example is Operation Swordfish, where the police are working closely with an academic institution that provides technical and analytical expertise. Another example is PredPol in the United States, where the analysis tool has been spun off from an interdisciplinary university team, which now assists police organisations by customising the tool to local needs and purposes.¹⁷⁰

Although analytical tools can be purchased commercially, close collaboration with relevant experts can be beneficial for several reasons:

- Advanced statistical data processing, mathematical modelling and numerical analysis require expertise that is not necessarily included in traditional police training. In many cases this kind of expertise may be necessary to ensure correct application of the methods and correct interpretation of the results. Partnering up with relevant experts will also free up police resources to concentrate on police work in the field, while providing a gradual development of new skills.
- It is important, but often extremely difficult, to measure the efficacy of preventive analyses. Here external experts can both be helpful, and at the same time also act as an independent control body.

¹⁷⁰ PERF (2014), pp. 3–4

- Relevant research institutes, with no vested financial interests, could evaluate various tools before a purchasing decision is made and thus shield the police from powerful commercial interests.

Norway has several institutes that could help make the police more data-driven. The Norwegian Police University College ought therefore to establish a network for development of expertise and data analysis consisting of a mix of academic and private operators who can provide the police with valuable skills support when analytical work is being introduced and strengthened in the various districts, and at the same time protect the police against powerful commercial interests.

4.6 SUPERVISION, INSPECTION AND TRANSPARENCY

4.6.1 SUPERVISING THE ALGORITHMS

The police will often have a legitimate need for a certain degree of secrecy in relation to the details of analyses to support their tactical operational work. If criminals have access to the police's predictive analyses, the predictive value of the analyses will diminish rapidly.

At the same time, the public ought to have insight into the underlying assumptions and assessments on which the analyses are based, which data are used, how they have been collected and how complete, correct and relevant they are. If the public is not given the opportunity to understand how the probability calculations that govern the police's resources are made, the police's intervention in an area may be perceived as alienating, stigmatising and an infringement of civil liberties.

DO WE UNDERSTAND WHAT PREDICTIVE ALGORITHMS DO?

Predictive algorithms are being used more and more in a wide range of different business sectors, and companies like Amazon and Telenor have become an unconscious part of every day life for many people. At the same time, very few people know how Amazon's algorithms work and which judgements underlie the recommendations that the online service gives to its customers.

Amazon and other private players can – and do – justify their lack of transparency with the need for secrecy in order to ensure a competitive advantage. But is secrecy acceptable when predictive algorithms are being used by the police?

The police will have to strike a balance between the need for tactical secrecy and a degree of openness that enables external and independent oversight of the analytical work. It must be possible for external parties to check the algorithms, so that the public can make sure that they do not contain inherent biases or weaknesses that stigmatise or discriminate against certain groups.¹⁷¹ It must be possible to document the analyses and reproduce the results so they can be verified and tested by independent external parties.

In his book *"To Save Everything, Click Here"* Evgeny Morozov calls for regular and independent audits of both the algorithms the police use and the systems on which these are based, inspired by similar inspection routines for algorithmic trading in the financial industry.¹⁷²

4.6.2 TRANSPARENCY, DISCLOSURE AND PUBLIC INVOLVEMENT

Preventive policing will often be more effective if it is pursued in a collaboration between the police, local authorities and relevant players in the local community.

If crime data and predictive analytics are not communicated and shared with the local community, the public is denied important opportunities to take part in decision-making processes that affect their own lives. At the same time, the police would be denying themselves opportunities to get useful interpretations, input and ideas from members of the local community who know the area well and could contribute to more effective preventive strategies.

¹⁷¹ Koss (2015), pp. 329–331

¹⁷² Morozov (2013)

In cases where it is deemed natural and appropriate, the police ought therefore to involve other civilian players like local authorities, schools, local businesses, associations and NGOs, as well as the citizens, in their work on interpreting the analyses and choosing an appropriate response. Making these kinds of datasets public would also give other players the opportunity to use the police's data in new and innovative ways.

There is growing recognition that open data adapted for further use¹⁷³ can be of great value to the public sector and private players.¹⁷⁴ Not least, it can help provide citizens with insight into the basis on which decisions are made and the priorities in the public sector. Norway's official website for public data, data.norge.no has already made several public datasets openly available for further use.

While datasets about developments in crime rates and the police's response have been released for public access and further use in several places around the world, no such datasets currently exist in data.norge.no's archives.

¹⁷³ This necessarily implies that the datasets do not contain sensitive personal information, confidential information, etc.

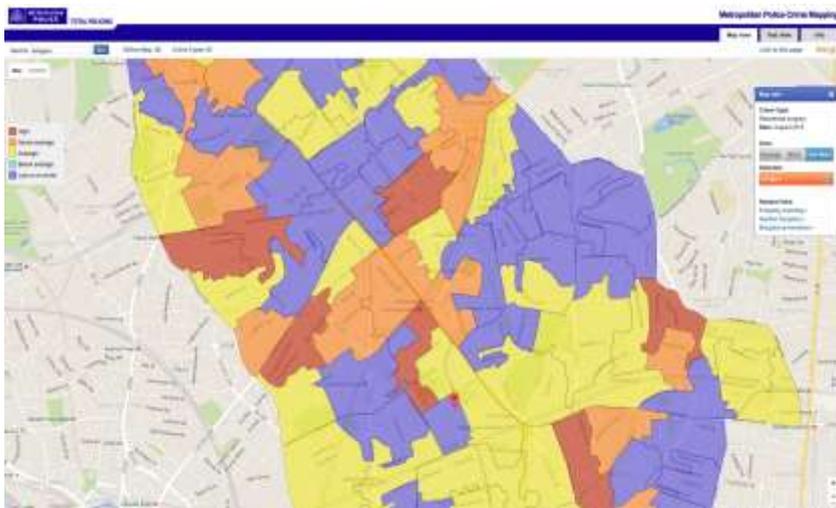
¹⁷⁴ See, for example, Official Norwegian Report (NOU) 2013:2, *Hindre for digital verdiskaping [Barriers to digital value creation]*, p. 114

PUBLICATION OF THE POLICE'S CRIME DATA

The police in Britain have released crime data and data related to the police's crime-fighting work in all the country's police forces.¹⁷⁵ This means that citizens, newspapers, local authorities and developers can download datasets with information about the type of crime that has taken place each month within defined areas of approximately 8 square metres.

The datasets also contain information about whether the case is ongoing, awaiting judiciary decision or closed. If the case is closed, the outcome is also given, for example, "no suspect identified", "suspect charged" or "offender given a caution".

The police have also released information related to their "stop-and-search" activities, including both where and when these have taken place and the self-defined ethnicity of the person stopped. The service also offers an easy way to visualise the datasets without having to download them.



The Metropolitan Police Service in London has also developed a web-based visualisation service that shows developments in various types of crime in different parts of the city during the last month.

¹⁷⁵ <http://data.police.uk>

Figure 6 Online visualisation from the Metropolitan Police Service in London showing which areas of the borough of Islington have had an exceptional number of burglaries in August 2015.

Source: <http://maps.met.police.uk>

APPENDIX

PREVENTIVE POLICING MODELS

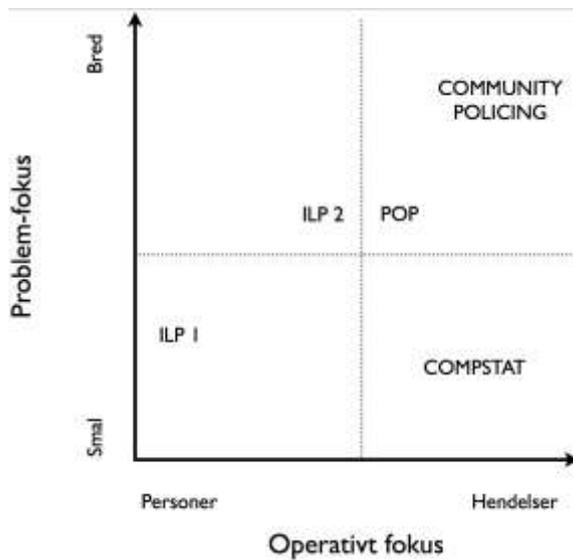


Figure 7 Schematic comparison of various models for policing (ILP 1: previous "intelligence-led policing", ILP 2: current "intelligence-led policing", POP: problem-oriented policing). Adapted from Ratcliffe (2011), figure 4.5.

The strategies and working methods used by the police have always been the

subject of discussion and evaluation. Over the years, however, a number of different working methods for policing have evolved as a counterbalance to a traditionally more reactive style of policing with its focus on prosecution.

Instead of focusing on how to respond to crimes after they have occurred, these theories emphasise *preventive and preemptive* measures. Below we describe the five main models that both have and will continue to dominate police work internationally:

- **Community policing** is a strategy that attempts to address the underlying causes of crime in collaboration with stakeholders in the community. The local community relates to the same police officers, and these police officers get to know the residents, the local community and the surroundings. Together the police and the local community identify problems and develop strategies to combat them. In this way the focus shifts from a reactive service, to one where problems are solved in collaboration with the local community and where the community is involved in deciding priorities.¹⁷⁶
- **Broken windows** is a theory that stipulates that clear signs of environmental degradation, such as broken windows in an abandoned building, for example, give the impression that nobody cares about the area and that general law and order are not upheld.¹⁷⁷ This kind of impression can give rise to fear of crime and make people stay away from the area, which in turn can provide a seedbed for crime and further reinforce the impression. According to the theory, to avoid the area becoming locked in a downward spiral of degradation, the police must address seemingly minor environmental problems and crime promptly and not only focus on serious incidents¹⁷⁸. According to the theory, this kind of strategy will prevent serious problems from taking root and growing.
- **Problem-oriented policing** (POP) also emphasises the importance of dealing with the underlying problems that give rise to crime, but distinguishes itself by attaching importance to mapping and analysis as tools to identify and get to the root of these problems.¹⁷⁹ According to the POP model, a recurrent problem, such as vandalism in a park, should be ad-

¹⁷⁶ <http://www.cops.usdoj.gov/Default.asp?Item=36>

¹⁷⁷ See, for example, Wortley and Mazerolles (2011), chap. 13

¹⁷⁸ COPS (2009), "Broken Windows and Community Policing"

¹⁷⁹ See, for example, Balchen (2004), p. 13

dressed by first using the available data and experience from patrol operations to analyse exactly where and when the incidents take place, who uses the park, why it is a preferred place for vandalism, and whether there are any environmental circumstances that pave the way for precisely this kind of activity. Once this has been done, the police can implement tailored, preventive measures in collaboration with the local community, other government agencies and businesses. Both the analysis and the measures must be documented and evaluated thoroughly so that other police districts can draw on and learn from the insights and experiences.¹⁸⁰

- **CompStat** was introduced in the police in New York in 1994 as a new management model and has subsequently spread to several other police organisations in the United States.¹⁸¹ The goal was to coordinate a data-driven approach to fighting crime with problem-oriented policing. At the same time, the model was to establish a clear distribution of responsibilities. Once a week each of the police districts in the city produces a statistical overview of the week's activities, such as reported crimes and arrests, as well as an overview report covering important cases, crime patterns and police activities. This information is entered into a central database and compared with information from other districts. The result is a report that draws a relatively detailed picture of the crime pattern and police activities in the city, divided into different focus areas such as murder, robbery, car theft, etc., and over various time horizons. Twice a week, the chiefs of police and managers from the various stations meet to discuss the developments in light of the weekly COMPSTAT report, evaluate ongoing strategies and identify new measures that need to be taken. In this way, the management is able to assure itself, on the basis of up-to-date statistics, that resources are being allocated appropriately and in line with the defined objectives, at the same time as they are made responsible for setting clear targets and strategies for the police work in their respective geographical areas of responsibility.
- **Intelligence-led policing** has become more prevalent in the last decade, primarily in Great Britain and North America, but also in countries such as Australia, New Zealand and the Netherlands. This model borrows many elements from *community policing*, *broken windows policing* and *POP*, but in addition seeks to use data analysis and intelligence more ex-

¹⁸⁰ <http://www.popcenter.org/about/?p=elements>

¹⁸¹ PERF (2013)

tensively as decision support in the police's work.¹⁸² It is the data that tell the police what problems exist, how the available resources should be managed, and which priorities and follow-up actions need to be taken. In its early days in the 1990s in Great Britain, a key driver behind the emergence of *intelligence-led policing* (ILP1) was the acknowledgement that a large share of crimes were committed by a small number of criminals and that by concentrating on these individuals and not the criminal acts themselves, the police would be better able to work proactively and preventively. In recent years, a revised model (ILP2) has evolved with a more holistic slant, with a particular focus on illuminating problems using information from a wide number of sources in order better to understand the context in which they arise.¹⁸³

The models described above approach crime problems in different ways. Some have a broad focus on problems that involve many players, while others have a narrower focus and only involve the police or a single patrol. In some models, the operational focus is on incidents, while in others it is on the people who carry out criminal acts. Figure 7 provides a schematic comparison of the various models described above. In practice, police organisations often use elements from several of the models or use different models for different purposes.

However, all the models are based on the fact that crime is rarely distributed evenly in the landscape, but tends instead to be concentrated in small restricted areas and time slots that account for the bulk of the offences. There are often clear environmental factors that dictate the interaction between the offender and the victim, and different places will therefore facilitate crime to differing extents.

¹⁸² See, for example, Wortley and Mazerolles (2011), chap. 14

¹⁸³ Ratcliffe (2011), chap. 4. See also the presentation "Defining intelligence-led policing" by J. Ratcliffe: <http://www.jratcliffe.net/wp-content/uploads/2014/02/Chapter4.ppt>

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