Predictive policing: The impact of crime forecasting technology on the performance of the Dutch police force

Master Thesis

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By

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Hereby, I present to you my master thesis with which I will complete the study of Public Administration at the University of Twente. In the past academic years, I have enjoyed delving into the themes presented in the Public Administration programmes. I believe this thesis reflects much of what I have been learning in recent years, both in my bachelor's and master's years. Therefore, I would like to thank all the teaching staff of the Public Administration department, particularly thesis supervisors Caroline Fischer and Guus Meershoek, for their time and effort.

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Abstract

There are more and more algorithmic applications in the public sector which are used to make important decisions affecting the citizenry. In general, algorithmic models are introduced and praised for their objectivity, accuracy, and speed, which are usually capable of lightening the workload of an organisation by taking over tasks or assisting. This also applies to the police organisation, which expects to enhance the safety of the public by the implementation of predictive policing systems.

Even though the concept of predictive policing is widely covered in the literature, the overall efficacy of the strategy is still an underexposed subject. As there is no consensus between the currently existing studies on the impact of predictive policing, especially regarding effectiveness and legitimacy, it is still worth taking a closer look at it. The thesis, therefore, aims to give an overview and potential new insights into the impact of predictive policing upon the police organisation and its ambitions in the Dutch context. As most of the existing research is focused on the United States, the thesis will have value to the existing body of literature on the topic by scrutinizing the concept within a different country. The following research question has been formulated for this: *"How does predictive policing impact the performance of the Dutch police forces?".*

Performance is hereby the extent to which the police organisation can fulfil the proposed performance dimensions; effectiveness, efficiency, legitimacy, and legality, as derived from the literature.

The effects of the use of the Crime Anticipation System on the performance of the police organisation were investigated through semi-structured expert interviews (N=3). Based on the interviews, it was possible to estimate whether the implementation of the CAS would enable the police organisation to better meet the performance indicators. Based on the results, the study concludes that although the current impact of predictive policing software on performance is yet insignificant, there is sufficient potential that should prevent one from discarding the entire concept. This qualitative research provides a glimpse into the topic and could be seen as a new starting point for further research on predictive policing in the Dutch context. Therefore, it is also recommended that future research will focus on how the potential of the CAS system can be better utilised in the future.

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List of Abbreviations

ALPR	Automatic License Plate Recognition
CAS	Criminaliteits Anticipatie Systeem (Crime Anticipation System)
CompStat	Computer statistics
DRIO	Dienst Regionale Informatie Organisatie (Regional Information Organisation Service)
GDPR	General Data Protection Regulation
ILP	Intelligence-Led Policing
LEA	Law Enforcement Agency
NPM	New Public Management
OE Wijk	Operationeel Expert Wijk (Operational district expert)
OpCo	Operatiational Coordinator
OS	Operational Specialist
SyRI	Systeem Risico Indicatie (System Risk Indication)
TC	Team Chef
UCR	Uniform Crime Reporting

1. Introduction

1.1. Topic introduction

In the past, crime prevention tactics have been evolving from reactionary measures to more proactive forms of policing (Brayne, 2021, p.22[1]). Whereas policing was historically primarily concerned with responding to criminal acts, the argument that preventing crime is more valuable to the public than responding to it wins support (Hälterlein, 2021). In line with this development, police evaluations have changed from evaluating based on officers' responses to criminal occurrences and clearance rates to the accuracy of predictions based on data models (Bratton & Malinowski, 2008).

In general, predictive policing uses information technology, data, and analytical approaches to anticipate potential future crime locations and times, as well as persons at high risk of offending or becoming victims of crime (Hälterlein, 2021). Thereby, predictive policing could be seen as complementary to the intelligence-led policing approach (Martens, 2016; Pearsall, 2010). The use of machine learning and updated algorithms is believed to improve traditional proactive policing approaches by allowing the police to track both individuals and locations with better accuracy to forecast when, where, and by whom a crime may be committed (Panelli, 2018). Despite the controversy concerning the actual effectiveness of predictive policing strategies, countries are relying on the strategies regardless (Vepřek, Sibert, Sehn, Köpp, & Friedrich, 2020).

In the Netherlands, much attention was given by the media to the two Dutch predictive systems; the Systeem Risico Indicatie (SyRI) and the Crime Anticipation System, also abbreviated as CAS (Strikwerda, 2020). The Dutch government had to stop with SyRI, a predictive policing technology for anticipating fraudsters, due to a verdict by the District Court of The Hague on Human Rights (Strikwerda, 2020). According to the court, SyRI disproportionately impinges on the private life of citizens which is against Article 8 of the European Convention on Human Rights about respecting private and family life, home and correspondence (European Court of Human Rights 2022; Strikwerda, 2020).

[1] Since the thesis frequently refers to the full book text of *Predict and Surveil* by Brayne (2021) and *The rise of big data policing* by Ferguson (2017), the page numbers are included for clarification.

Also, the scientific literature mainly warns about the negative effects of big data applications on detecting and preventing crimes and nuisance (Schuilenburg & Soudijn, 2021). In the case of predictive policing, for example, attention is paid to the risks of false positives, discrimination against minorities, and identifying risk groups based on certain characteristics and categories. The use of CAS, however, was only planned to be increased since its countrywide implementation back in 2019 (Strikwerda, 2020). It is thereby striking that with the widely available range of literature on big data applications and their risks, much less attention is paid to the possible added value for the functioning of the police organisation itself (Schuilenburg & Soudijn, 2021).

The question remains in what ways the implementation of the predictive policing strategy affects the work of the Dutch police force. As according to Vepřek et al. (2020), it is almost impossible to make general claims about the effectiveness of predictive policing; one could best evaluate the impact of a specific programme used in a specific context to provide actual insights. The Netherlands, in this regard, is a unique case as it is the first country to use a specific predictive policing programme on a national scale (Strikwerda, 2020).

1.2. Objective and research questions

As stated above, the thesis will focus on the underlying influence of the introduction of the predictive policing strategy on the performance of the Dutch police forces. Therefore, this thesis's leading question is formulated as follows: "*How does predictive policing impact the performance of the Dutch police forces?"* Five additional guiding sub-questions have been formulated to structure and build up the answer to the main question. The first three questions are more theoretical and are therefore discussed in the background and theoretical framework chapters. Based on the answers to the theoretical sub-questions, a conceptual model of police performance is set up. This model consist out of the dimensions of effectiveness, efficiency, legitimacy, and legality as together represent both the pursuit of excellent service provision (Rienks & Schuilenburg, 2020; Skogan, 1976; Sparrow, 2015) as well as the social responsibility context in which public organisations operate (Atkinson, 2018; Bradford, Jackson, & Hough, 2013; Gstrein, Bunnik, & Zwitter, 2019). Based on the theoretical findings, hypotheses are formulated regarding these performance dimensions. The final sub-question involves testing the formulated hypotheses and is therefore being discussed in the results section, based on the collected data.

The following questions will be discussed as guiding questions throughout the paper:

1. What does the concept of predictive policing entail?

2. How is predictive policing, as a new policing strategy, used by the Dutch police force?

3. What are the expected pros and cons concerning using predictive policing applications for policing?

4. What are the main prerequisite performance indicators regarding using a predictive policing application within a public organisation*?*

5. What is the value of using predictive policing in terms of police performance, according to experts?

1.3. Social and scientific relevance

The police organisation is inextricably linked to any given society due to the main task of the police organisation being the maintenance of order within that given society (Brodeur, 2010). However, like any public sector institution, the police needs to cope with the limited number of available resources allocated by its government (Brodeur, 2010). Through the Dutch Budget Memorandum 2021, it has been announced that the Dutch government has recently committed to structurally spending an extra 434 million euros on the entire justice chain per year (Ministerie van Justitie en Veiligheid, 2021). For many jurisdictions, however, increasing enforcement expenses are unsustainable, especially given the competing priorities for public funds, such as education and healthcare (Maslov, 2016). As a result, the safety sector organisations are generally under pressure to enhance performance and become more cost-effective (Skogan, 1976). Today's civil servants can simply not take all the workload by themselves anymore, meaning it would take much longer to make all kinds of public service-related decisions (Algemene Rekenkamer, 2022a). On this basis, the Dutch organisation Algemene Rekenkamer (2022) also concluded that the government would not be able to do its job properly anymore without algorithms. Some citizens, however, worry that public organisations will be unable to explain to their citizenry how certain public service-related decisions were made. Therefore, it also becomes increasingly important for organisations like

the police and society as a whole that the performance of policing services is measured and evaluated to ensure that the performance of the service is in line with the set goals (Maslov, 2016).

On the other hand, there is a need for more specific research on the value of big data usage for safety ends, as several authors indicated such a gap in the existing literature (Brayne, 2017; Vepřek et al., 2020; Waters & Dooley, 2021). For example, Brayne (2017) describes that there is still only little known about the use of big data within surveillance practices, while Vepřek et al. (2020) add to this with a statement that there is especially a lack of sufficient work on the effectiveness of the predictive policing strategy. While some authors in the existing literature do point to evidence from the United States that predictive policing may deter crime and promote safety (Pearsall, 2010), there are also signs that this approach may have significant disadvantages regarding skewed depictions of society, possibly resulting in less effective or discriminatory practices (Meijer & Wessels, 2019). Schuilenburg and Soudijn (2021) noted that, within this discussion, not enough attention is paid to the possible added value for the functioning of the police organisation itself. Despite the lack of sufficient evidence and the controversy regarding the police efficacy and possible drawbacks of predictive policing, predictive policing software is already in use by several police forces around the world. For any police organisation, it is important to have a good overview of the discussion to be able to make a good judgment about whether the investments in predictive policing are worth it. The use of predictive policing applications nevertheless leads to the change in work processes which has its effects on the police organisation and its employees (Doeleman, Waardenburg, Melchers, & Willems, 2019). Meijer and Wessels (2019) thereby note that it is important that all the different predictive policing models based on big data usage need to be evaluated individually when researching factors such as its efficacy. Researching predictive policing specifically in the Dutch context is aimed to give more insight into the state of play of the use of predictive policing outside of the United States, where most of the current research has focussed upon. The Dutch situation differs from the Unites States for example, as it was the first country to implement a centralised nationwide predictive policing system. Besides, the Dutch use their own in-house prediction software, thereby being less dependent on improvements made by the tech company providing the prediction software.

1.4. Thesis structure

First of all, a background chapter follows, in which the concept of predictive policing and its facets will be explained. Chapter 3 goes a little further into the often mentioned eventual (social) impact of the use of predictive policing. These two chapters provide the context and basis for the theoretical framework introduced in Chapter 4. It presents the most important insights from the literature regarding these dimensions in relation to big data policing including the conceptual model related to the performance dimension. Subsequently, the methodology chapter (chapter 5) discusses the methods and techniques used in this research. Next, chapter 6 discusses the main results of the data analysis.

In the conclusion and discussion chapter (7), the main question is answered and reflected upon along with the limitations of the research and recommendations for future research.

2. Background

2.1. From a reactive type of policing to proactive policing

During the last decades, Western societies have become increasingly risk-averse (Gemke, Den Hengst, Rosmalen, & Boer, 2019). Criminal activity has become more sophisticated, and since the events of 9/11, security risks have gained high priority (Brayne, 2021, p. 22). However, Gemke et al. (2019) state that next to the effect on the citizenry, these changes have also had their impact on policing. According to Berkow (2011), policing has evolved from the classic "Three Rs"; random patrol, rapid response, and reactive investigations towards "Triple-T", including targeting, testing, and tracking (as cited in Sherman, 2013). This shift is embodied in the policing paradigm of intelligence-led policing (ILP) (Gemke et al., 2019). The literature on policing emphasizes the basic differences between geographical (Where to police), object-related (Whom to police) and time-related (When to police) techniques of predictive analysis (Ferguson, 2017, p.4). Authors such as Brayne (2021) relate to this by claiming that predictive policing represents both a continuation but also a transformation of analogue police practices in terms of time and scale (p.48). Therefore, it is important to shed light on the history, current practices, and modes of predictive policing.

The beginning of quantification in police work

The datafication of policing finds its origins in the early 20th century alongside the efforts to split up local policing from political influences concerning the professionalisation of policing (Sklansky, 2011). Police professionalism consists of three elements: police departments should focus on crime reduction; they should do it objectively and scientifically, free of political interference; and police power should be consolidated and rationalised inside the department (Sklansky, 2011). From this historical viewpoint, the police's use of big data appears to be part of a larger trend in the criminal justice system toward quantification and algorithmic risk assessment (Brayne, 2021, p.48). As an exclusive focus on professionalisation was not yielding the desired results, more community-based and problem-oriented policing approaches were applied later (Sklansky, 2011). These strategies would eventually form the base for the ongoing strategic and operational efforts to implement an effective proactive policing methodology (Clarke, 2006; Weisburd & Majimundar, 2018). Proactive policing is thereby defined as: "all policing strategies that have as one of their goals

the prevention or reduction of crime and disorder and that are not reactive in terms of focusing primarily on uncovering ongoing crime or on investigating or responding to crimes once they have occurred (Weisburd & Majimundar, 2018, p.30). Based on the premise that crimes are not randomly distributed but spatially concentrated into a few small geographic areas, policing also became more evidence-based, with hotspot policing emerging as one of the key patrol strategies (Braga & Weisburd, 2010)

From reactive policing to predictive policing

While during the 1990's evidence-based policing and intelligence-led policing gained popularity, it was the crime control strategy and resource management tool CompStat by (computer statistics) which really enabled police departments to automatically identify crime patterns and hotspots, quantify and incentivise police activities, and direct police resources (Braga & Weisburd, 2010). In advance of the weekly crime control strategy meetings between police executives and commanders, crime is collected in real-time, mapped and evaluated (Ferguson, 2017, p. 59). By plotting crimes, creating heat maps, and focusing police resources on hotspots and other small geographical units where crime is densely concentrated, police could more effectively address crime. These strategies mark the definitive paradigm shift towards proactive problem-oriented policing (Brayne, 2021, p. 60). However, according to Brayne (2021), it was ultimately the events of 9/11, in combination with the everlasting pressure of police departments to lower crime rates, that awakened the age of what Brayne calls the "the age of predictive policing" (p.22).

From Query to Alert-Based

Since the 2010s, predictive analytics have been used for a wide range of law enforcement-related activities enabled by the large proliferation of digitised records (Sherman, 2013). Data from separate institutional sources could easily be merged into one integrated structural system in which disparate data points are displayed, and one could search for relations between these points (Fourcade & Healy, 2016). Law enforcement agencies thereby aim to acquire as much information as possible, getting routine access to a wide range of data on daily activities from non-police databases (Ferguson, 2017, p.52).

Much of the information from non-police sources is obtained through data brokers, whose supply has grown quickly as more information is digitised and personal records are linked across previously separate institutional boundaries (Pasquale, 2015). Besides, the use of dragnet surveillance also causes that data to be collected from large groups of residents rather than just pre-determined suspects. Although the possibility to collect large numbers of data has been around for longer, it was the shift from query-based systems to alert-based systems which is most substantial. Alert-based systems enable users to receive real-time notifications (alerts) when specified variables or combinations of variables are becoming present in the data (Brayne, 2017; Ferguson, p.43). According to Brayne (2017), the transition from query-based to alert-based systems is, therefore, both a continuation of previous practices and a fundamental shift in monitoring operations. When taken as a whole, the usage of alerts involves not only a scaling up of existing police tactics but also a fundamental shift in how patrol officers and detectives gather case information (Brayne, 2021, p. 42). In short, the police would now have easier access to information that has always been available but was harder to obtain (Fourcade & Healy, 2016).

The technological developments made the police focus on their objectives based on extensive data analysis. The fundamental principle of evidence-based policing, which places a greater emphasis on testing, evaluation, and discussion of what is effective is still applied to today's police tactics (Sherman, 2013). In light of evidence-based policing, it is therefore important to test whether data-analysis-based tactics can improve public safety and police legitimacy. However, Sherman (2013) argues, also the external demands on police to cut crime, cut costs and build legitimacy, encourage research for evidence on how the increasing availability of innovative technologies can help meet these types of performance demands.

2.2. Dimensions of predictive policing

The concept of Big Data

The definition of big data may differ depending on whether one looks at it from a computer science perspective or a social science perspective. They have in common that most definitions reflect the increased technical ability to acquire, combine, and process an ever-increasing amount, velocity, and variety of data (Ferguson, 2017, p.8). Big data is therefore

defined as large amounts of information (volume), high-frequency observations, and quick data processing (velocity), and comes from a wide range of institutional sensors and entails merging previously separate data sources (variety), state Lazer and Radford (2017). According to Brayne (2021), big data is best defined as a data environment made possible by the mass digitalisation of information and associated with the use of advanced analytics, including network analysis and machine learning algorithms (p.3).

Based on the definitions given by Brayne (2021) and Ferguson (2017), Big Data within the thesis is understood as the collection, usage, and analysis of the datasets, including a variety of data forms, to uncover hidden patterns or insights. As predictive policing specifically entails the usage of large data sources to uncover any hidden crime patterns (Ferguson, 2017, p.14), it can be stated that the predictive policing strategy falls within this scope.

The concept of predictive policing

Predictive policing is a strategy that emerged from proactive policing (National Academies of Sciences, 2017). In line with the definition of proactive policing as the usage of data to identify the presence, scope, nature and origin of a problem to develop interventions to minimise it (Weisburd & Majimundar, 2018), predictive policing emphasizes the gathering of digital data from many sources to evaluate it and use its conclusions to foresee better, prevent, and respond to future crime (Pearsall, 2010).

Predictive policing differs from traditional policing in that it does not only respond to crimes after they have occurred but also analyses data from previous crimes to forecast future crimes (Vepřek et al., 2020). According to Rienks and Schuilenburg (2020), a predictive policing strategy is able to discover any potential criminal behaviour more quickly with several types of crimes, such as pickpocketing and burglaries. In addition, the police force can be advised in this way about the most successful police strategy for combating certain forms of crime (Rienks & Schuilenburg, 2020). Even though there are slightly different descriptions throughout the literature, the three main variants in the literature are based on space, time, and persons (Ferguson, 2017, p.4; Mugari & Obioha, 2021: Rienks & Schulenburg, 2020). The following paragraphs and table 1 give an overview of these predictive policing categories.

Time-based predictive policing

Crimes such as residential burglaries mainly depend on the rhythmic shift of residents away from their homes (M. Felson, 2006). This phenomenon could be explained through the routine activity theory, which describes that the occurrence of crime is determined and facilitated by several factors such as the presence of a motivated perpetrator, the availability of a suitable target, and the lack of adequate protection measures to protect the target (Marcus Felson & Clarke, 1998). According to Egbert and Leese (2020), such a rhythmic interplay of crime would imply that risk estimates for certain types of crimes can be significantly narrowed down in accordance with temporal characteristics. Police agencies can capitalise on this knowledge by segmenting algorithmically generated risk time into parts that correspond to a burglary profile's expected operational hours, consequently allowing them to deploy patrols in a more targeted manner (Egbert & Leese, 2020). The overall temporal reach of pre-generated risk estimates by the predictive policing software remains unaffected by this method, but patrols will only actively cover the anticipated risk area during those hours when near repeats can be fairly expected during the active duration of an alert (Egbert & Leese, 2020).

As most predictive policing software is part of a bigger cloud-based technical and modular framework, including all combined data streams, the technology is able to complement police resource management by real-time tracing (Wilson, 2019). As mentioned above, an automatic alert system can be created to ping the officer that a particular event is going on, such as a particular car entering an area (Brayne, 2021, p.51). Predictive policing therefore also entails automation to the extent that tactical information is constantly, quickly, and conveniently distributed to officers in the streets (Egbert & Leese, 2020). While being carefully regulated through data streams, the real-time officer becomes adaptable, accessible, and seemingly independent (Wilson, 2019).

Place-based predictive policing

The main concept behind place-based techniques is to identify the geographic locations that may be more vulnerable to crime over time (Egbert & Leese, 2020). Based on the spatiotemporal risk estimations generated by the algorithmic model, police agencies can design tactics for preventing or discouraging criminal activity in these regions based on the

spatiotemporal risk estimations generated (Egbert & Leese, 2020). In practice, the hunch of the algorithm gives police officers the incentive to do targeted stops and frisks or patrols to prevent some crimes (Ferguson, 2017, p.78). Through the identification of hot spots and small-scale geographic units that have historically shown higher crime rates than their environment, one can execute predictive mapping based on the assumption that certain forms of crime are likely to be followed by similar offences in the near region in the future (Ferguson, 2017, p. 146).

Situational crime prevention tactics aim to identify potential targets and deterrents based on the notion that crime may be averted if the opportunities and their supporting variables are properly removed from the environment (Egbert & Leese, 2020). Software packages examine historical crime data to identify specific trends that may suggest professional offender conduct (Egbert & Leese, 2020). Future criminal activity is estimated in a second stage based on the presence of "trigger" conditions and models on where and when these triggers may result in actual offences. Environmental risk factors included in the model are past calls for service, parks, type of housing, presence of sit-down restaurants, and commercial zones (Ferguson, 2017, p.67). Using these data to identify environmental crime drivers, a risk terrain algorithmic model could identify the risk factors in multiple areas to eventually reveal the area in which crime is likely to take place (Ferguson, 2017, p.68).

Person-based predictive policing

Predictive policing techniques that focus on individuals address the question of who might become a criminal or a victim of a crime in the future (Egbert & Leese, 2020). Like other types of predictive policing, the software in use by the police department creates models based on empirical data; in this case, it lists attributes of a person's criminal records (Ferguson, 2017, p.38). This also takes into account his/her criminal activity's upward trend, the severity of his/her criminal background, and the history of violence among his/her associates. (Ferguson, 2017, p.38). The methods are founded on the concept that past and present behavioural patterns, individual attributes, and social interactions can be used as indications to forecast the future actions of individuals (Egbert & Leese, 2020). The algorithm ranks these variables to produce a so-called "heat list", showing scores representing how "hot" people are in terms of their probability of being involved with violent acts as offenders or victims (Ferguson, 2017, p. 127).

Predictive targeting based on people is based on two key insights (Ferguson, 2017, p.44). First, police can identify persons most likely to be involved in violence by digitally mapping their social networks. Second, a subset within those networks can be algorithmically identified as being at even greater risk. On the individual level, risk profiling methodologies simulate the likelihood of a person committing a crime or becoming a victim of a crime by identifying certain personal or group-related features that are thought to be risk factors (Egbert & Leese, 2020; Ferguson, 2017, p.44). A strong similarity between the profiles will be taken as a hint that the targeted person may pose a risk or be at risk (De Hert & Lammerant, 2016). Besides, social network techniques use an individual's social contacts, such as friends, relatives, neighbours, or co-workers, to estimate criminal risk. The concept behind social network analysis is that the number of arrests within a person's social circle can be utilised as a predictor of future conduct (Ferguson, 2017, p.56).

Type of prediction	**Main type of prediction**	**Mode of presentation**	**Data involved**
Predicting where crimes will happen	Place-based	- Heat maps	- Geographical data (e.g., Zip-Codes, housing types) - Population data - Cell phone numbers
Predicting when crimes will happen	Time-Based	- Hot times graphs	-Population data - Police files
Predicting offender (identities)	Person-based	- Social network analysis - Automatic License Plate Recognition (ALPR) - Heat lists	- Social media - Governmental data sources - Police files
Predicting victims	Person-based	- Heat lists	- Social media - Governmental data sources

Table 1: Overview of the multiple forms of predictive policing. Based on the work of (Ferguson, 2017; Mali, Bronckhorst-Giesen, & den Hengst, 2017; Waardenburg, Sergeeva, &

Huysman, 2020).

2.3. Predictive policing in practice

As explained in the previous sections, the term predictive policing refers to "analytic techniques used by law enforcement to forecast potential criminal activity" (Brayne, 2017, p.57). Data is used to determine current crime patterns and direct patrol resources, such as where officers should go and whom they should stop (Ferguson, 2017, p. 78). The practice of predictive policing is thereby based on the substantial body of research that shows that crime is not distributed evenly across people or in different places (Brayne, 2021, p.58). Social scientists such as Hannon (2002) use the criminal opportunity theory as a framework to understand the relationship between socioeconomic variables and criminal motivation and, thus, this uneven distribution in crime. The criminal-opportunity theory of crime is thereby looking at the qualities of both offenders and victims, as well as the characteristics of the environment in which offenders and victims are likely to interact (Hannon, 2002). Patterns of placed-based environmental conditions, situational decision-making and social networks shape where crime is likely to occur and who will likely be involved. The predictive policing technology consequently takes advantage of known crime patterns, which is reflected in the data output of the predictive policing software, aiding law enforcement (Brayne, 2017; Hannon, 2002).

Regardless of whether police departments want to focus on locations or individuals, there are four main steps in the practice of predictive policing (Brayne, Rosenblat, & Boyd, 2015). The first stage involves the *collection of data*. These data can range from past basic crime statistics to more complex environmental data such as seasonality, neighbourhood composition, population density or environmental variables often associated with crime (e.g., ATMs and vacant lots) (Brayne, 2017; Brayne et al., 2015). In the second stage, an algorithm performs the *data analysis* based on the collected crime data to produce a continually updated danger map of the area or network models (Brayne, 2017; Ferguson, 2017, p.41). The algorithmic model generates the percentages of likely criminal activity and creates a map as shown in figure 1 (Egbert & Leese, 2020; Ferguson, 2017, p.63). Law enforcement must examine both the type of crime they wish to target and 'heir department's resources when picking which predictive method(s) to deploy (Brayne et al., 2015).

Following up the algorithmic analysis, it comes to the human element in predictive policing, namely the predictive cycle's third stage of *police intervention* (Brayne et al., 2015). Police

intervention entails giving crime estimates to commanders, who use them to determine where cops should be deployed in the field (Brayne et al., 2015). At briefings, patrol officers are given reports that tell them where they should go while on duty (Brayne et al., 2015). The logic goes that the officers can use their uncommitted time to surveil the people and places the models suggest are likely to be associated with future criminal activity (Brayne, 2021, p.57). Officers on patrol can check through the generated maps which type of crime is most common in the area they are in or when they transition to another area with other dominant types of crime. *Target response*, the fourth step, emphasizes how this predictive policing cycle becomes more sophisticated over time (Brayne et al., 2015). Target response refers to the reaction of individuals being policed, which is evaluated as either desistance or displacement (Brayne et al., 2015). While in both situations, the police intervene, in the former situation, the person does not commit the crime he/she may intend (Brayne et al., 2015). In the latter instance, the potential criminal searches for another opportunity to commit a crime with the chance of not committing any crimes in the end (Brayne et al., 2015). Additionally, the very act of predictive policing creates new data which will shape future forecasts (Brayne, 2021, p.57). Figure 2 gives a graphical representation of the entire process.

Figure 1: Examples of risk maps produced by predictive policing software (Egbert & Leese, 2020, p.118)

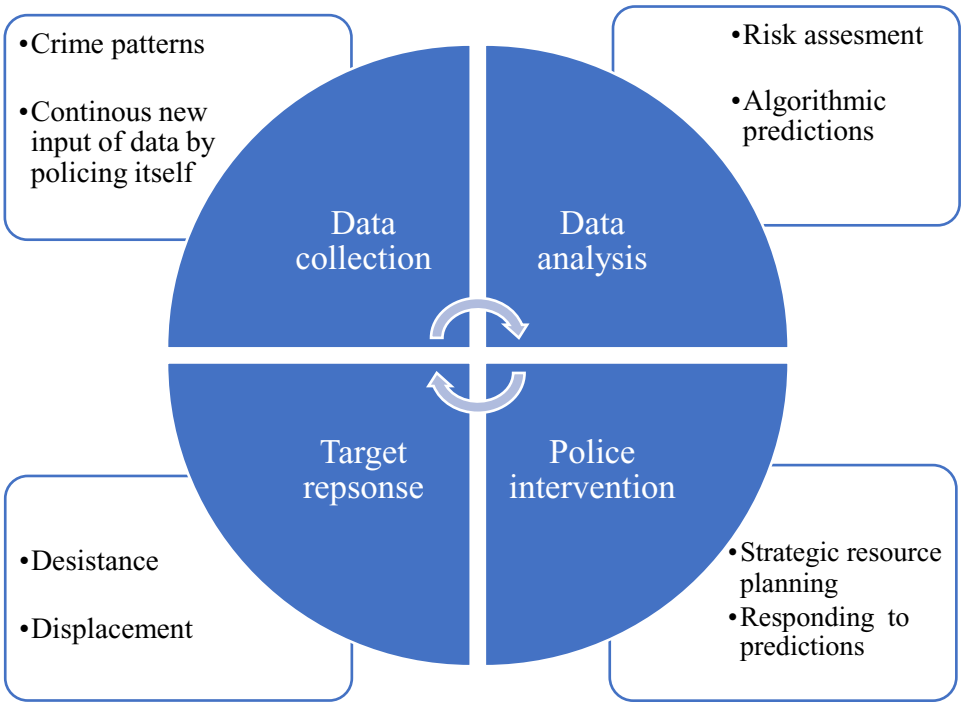

Figure 2: Cycle of predictive policing stages. Based on the work of Brayne (2021) and Brayne et al. (2015).

2.4. Predictive policing in the Netherlands

Predictive policing in the Netherlands takes place via the Crime Anticipation System (CAS) (Mali et al., 2017). The software was developed in 2014 by the Amsterdam police and was rolled out at all 160 basic teams throughout the Netherlands in 2017 after its trial period (Schuilenburg & Soudijn, 2021). The Dutch police started developing their own in-house software CAS because no other system was widely available yet at the time of development start (Mali et al., 2017). Even though the Netherlands uses its own predictive policing software, Mali et al. (2017) state that the process of predictive policing is rather the same as with other currently available software such as PredPol (USA) or Precops (Germany). Although the calculating methods used by these systems vary, the goal is always the same: to give the police data-based automated analyses of where and when the likelihood of an incident is highest (Mali et al., 2017). As the algorithm keeps learning from previous cases, the algorithm used by the police forces falls under technically complex algorithms rather than technically simple ones, such as a decision tree (Algemene Rekenkamer, 2022a). The cycle of predictive policing, as described by Brayne et al. (2015) and Brayne (2021, p.57). can thereby also be applied within the Dutch context. Table 2, at the end of this section, gives an overview of the action and involved actors concerned with the use of the Crime Anticipation System.

Data collection

As stated before, predictive policing software works on a multitude of data, from crime statistics to more complex environmental data (Brayne, 2017; Brayne et al., 2015). The CAS software is no exception from this, as one of the software its tasks is to use crime data and link it to other data that is potentially relevant for crime (Mali et al., 2017). All data regarding such relevant variables are brought together in a data warehouse where data from different sources can be linked and interrogated integrally (Mali et al., 2017; Willems & Doeleman, 2014). On the national level, the CAS is connected to a national data warehouse called the Basisvoorziening informatie (Basic information provision). This warehouse is continuously updated by extracting the new current data from the various underlying data sources (Mali et al., 2017). Besides, the CAS also uses data from the Dutch Centraal Bureau voor de Statistiek (Central Agency for Statistics), especially regarding population data. Some of the data are dynamic in nature, which changes over time, and some are static in nature, which change little over time (Mali et al., 2017).

Only the potentially relevant data should be stored in a data warehouse (Willems & Doeleman, 2014). Data, thereby, needs to be technically suitable and tactically relevant (Mali et al., 2017). This former condition refers to the requirement that the data contains one or more variables on which the CAS system relies, as well as that the variable can be somehow linked to a location box (Mali et al., 2017). Furthermore, the factors must be tactically useful by having some degree of predictive potential as it becomes important for the whole process to understand why the risk of criminal activity in a certain region and at a certain time is high (Mali et al., 2017). Next to technical suitability and tactical relevance, it should be noted that only legally accepted types of variables can be analysed. The Dutch police organisation has various digital intelligence teams within the 'Dienst Regionale Informatie Organisatie (Regional Information Organisation Service)', also abbreviated as DRIO (Mali et al., 2017; Politie, n.d.-a; Staffeleu, den Hengst, & Hoorweg, 2011) These teams are responsible for the smooth collecting, processing and improving intelligence information (Politie, n.d.-a).

Data analysis

Corresponding to the second stage of predictive policing, the CAS generates its predictions from the available data in the data warehouse (Brayne, 2017; Mali et al., 2017). The CAS

divides its operational area into squares of 125 by 125 meters (Rienks & Schuilenburg, 2020). Uninhabited squares such as meadows and open water are then disregarded by the system as the risk of incidents here is considered negligible (Mali et al., 2017). Research by Caruana and Niculescu-Mizil (2006) thereby states that such automated systems can make use of various calculation methods to generate predictions. The most common methods identified by being Logistic Regression and Decision trees (Caruana & Niculescu-Mizil, 2006).

Mali et al. (2017) describe that, in the case of regression analysis, data of multiple reference moments from the past is used by artificial neural networks that can learn to recognise patterns. The neural network makes a draft prediction for each reference point based on the data from the previous six months and compares this prediction with the actual statistics from that period (Mali et al., 2017). It determines where the largest deviations were, thereby teaching itself to do better. This process is repeated until changing the links in the network no longer leads to a better prediction. Each square within the operational area is then given a risk score for the upcoming two weeks. Therefore, a prediction in this context is operationalised as a risk score.

The risk scores are used to construct so-called heat maps or CAS maps, which are maps with warmer (darker) colours assigned to places with higher incident risks (Egbert & Leese, 2020; Mali et al., 2017). According to Waardenburg et al. (2020), there is also the presentation of the so-called CAS hot times divided into four-hour long time slots. A line graph is used to represent the hot times. The higher the peak, the greater the chance of future crime (Waardenburg et al., 2020). Given that it must stay operationally feasible to patrol all risk areas, only the top 3% of high-risk areas will be coloured in one of the available colours (Mali et al., 2017; Oosterloo & van Schie, 2018). The data officer starts with these visualisations in CAS and tries to investigate and extract the background of the high-risk level in specific areas (Oosterloo & van Schie, 2018). As specified by Oosterloo and van Schie (2018), rather than purely relying just on CAS results, the intelligence specialist enhances the results provided by CAS by using their contextual understanding of the region and their expertise. The use of big data in an investigation can differ greatly in its complexity as an algorithm could be used as a simple tool to set up completely new digital infrastructures, which could be required for complicated criminal investigations (Schuilenburg & Soudijn, 2021).

Next to the responsibility for generating the CAS heat map, the DRIO of a participating unit draws up a piece of deployment advice based on the CAS predictions (Mali et al., 2017; Politie, n.d.-a). As an example, Schuilenburg and Soudijn (2021) mention the creation of a

template for advised neighbourhood research. What expectations are and are not shown to the operational management significantly impacts the use of the CAS because management makes action plans accordingly (Politie, n.d.-a; Waardenburg et al., 2020). An important notion of Waardenburg et al. (2020) with this is that there are no actual standards concerning the presentation towards the operational team; the intelligence specialists determine the boundary between high risk and medium risk themselves. The lack of standards creates another layer of interpretation by the intelligence specialist (Oosterloo & van Schie, 2018; Waardenburg et al., 2020).

Police intervention

The intelligence specialists and management discuss the selected enriched CAS outcomes, and strategies based on it, in a weekly management meeting (Waardenburg et al., 2020). Mali et al. (2017), therefore, mark the starting point of the steering process as the moment when the enriched information has been handed over to the operational management team. Within this team, one can distinguish the functions of team chef (TC), operational coordinator (OpCo), operational district expert (OE Wijk) and operational specialist (OS) (Mali et al., 2017). The TC is responsible for the general direction of the basic team, while the OpCo does the briefing (Mali et al., 2017; Waardenburg et al., 2020). Waardenburg et al. (2020) emphasize that the briefing is a key moment to communicate to the police officers what to do during a shift and what to pay attention to. Although it is the OpCo who is primarily responsible for the process of developing the enriched forecasts into a concrete assignment that the street-level officers will have to act on, the OpCo also needs to incorporate multiple factors and requests from others during this process (Mali et al., 2017; Waardenburg et al., 2020). During the final briefing, the street-level officers are informed and instructed on what is important for their service by means of a presentation and handing out deployment assignments (Mali et al., 2017). The street-level officer thereby also informs him or herself about past events of the previous shifts by reading daily reports. Officers can get assignments in between emergency calls as going on surveillance in the by CAS labelled high risk area or the officer has a so-called ‘Gebiedsgebonden Politie’ shift, in which it is mainly one’s task to surveil rather than respond to emergencies and could possibly be filled in with predictive policing work assignments (Mali et al., 2017).

Target response

As described by Brayne et al. (2015) the fourth stage refers to the reaction of individuals being policed, which can result in either desistance or displacement. The former refers to a situation where the police intervene, and no crime is committed. The latter refers to police intervention, where a person moves on to find another place to commit the crime. Still, it is plausible that no crime will be committed after all. To complete the circle, the very act of predictive policing creates new data and shapes future forecasts. Theoretically, the effectiveness of predictive policing could therefore be evaluated by drops in crime rates (Brayne,2017, 2021, p.60). In the Dutch context, the pilot study of Mali et al. (2017) concluded that CAS could correctly predict around 30 per cent of burglaries in Amsterdam, which was claimed to be 'good enough'. Since the pilot of 2017, no empirical research on the effectiveness of the CAS has been published.

Predictive policing stage	**Actor**	**Outcome**	**Actions**
Data collection	- Intelligence Specialist	- Information document for management	• CAS findings are analysed, and possible explanations for the high-risk areas are sought. • A police management information document is being created.
Data analysis	- Intelligence Specialist - Police management - External parties	- Short-term planning of police actions - Long-term planning of shifts	• An intelligence specialist sends an information paper to police management. • Enriched CAS forecasts are used to assess police deployment and duty utilisation.
Police intervention	- OpCo - Officers	- Briefing	• Briefing includes the most important CAS outcomes. • The OpCo presents the findings and operational plan he/she decided upon for the shift.

Table 2: Action and actor summary regarding the use of the Crime Anticipation System. Based on the work of Brayne, 2021; Mali et al., 2017; Oosterloo & van Schie, 2018 and Waardenburg et al., 2020.

2.5. Chapter conclusion

This chapter has described the background of predictive policing as a strategy that finds its place within a greater transition from a reactive type of policing to a proactive type of policing. That is, from random patrol, rapid response, and reactive investigations to more targeting, testing, and tracking under the paradigm of intelligence-led policing. Big data is seen as the main facilitator for the predictive policing strategy as it represents the values of volume, velocity and variety needed to make predictions. Regarding the first sub-question, "*What does the concept of predictive policing entail?"* one should understand that there is not one exclusive definition for predictive policing. Although the term can be referred to as law enforcement's analytical techniques for predicting possible criminal conduct, the literature emphasizes the fundamental contrasts between place-based, person-based, and time-based predictive analysis methodologies. The core message conveyed by the concept of predictive policing is that crime is not evenly distributed between people, times, and locations. Focussing on either one, two or all these predictive policing aspects, the literature describes the *process* of predictive policing as a four-step itinerary involving (1) the collection of data, (2) data analysis, (3) police intervention and (4) target response. However, the exact outline of these practices is still much dependent on the context it is applied in, bringing us to the second sub-question; "*How is predictive policing, as a new policing strategy, used by the Dutch police force?"*.

Even though the Dutch police force has its own predictive policing software, the four-stage predictive policing process also applies in the Dutch context. The CAS benefits from the Dutch centralised national instances as the data warehouse is continuously updated by extracting the new data from the various underlying data sources, such as the Central Agency for Statistics. The CAS and the data analysts construct heat maps and hot times to indicate the hotspots during a certain shift. It is thereby important to note that the Dutch police only practice time-based and place-based predictive policing. Despite the possible great potential of the system, operationally, it is impossible to check out every hotspot. It has been found that the Dutch predictive policing process concerns several choices and interpretations of the data scientist, which are interwoven with the use of the CAS algorithm. From that, it can be concluded that the Dutch CAS is not (yet) a ready-made package but comes to life through the actions, commitment, and judgment of the involved actors assisted by the CAS. Therefore, the role of the algorithm itself may be smaller than the interpretations/conclusions drawn by the human actors involved.

3. Implications of big data policing

Next to this debate on the effectiveness, the usage of predictive policing by law enforcement also leads to debates in the social domain (Gstrein, Bunnik, & Zwitter, 2019). Meijer and Wessels (2019) point out the lack of transparency, accountability and the potential danger of bias and stigmatisation as the most prevalent potential drawbacks of predictive policing in their literature review. However, it is not only within the literature where the concerns about these potential drawbacks are discussed. Back in 2018, the same was already identified as possible violations of the fundamental rights of data subjects and risks to the integrity of the investigation (Commissie modernisering opsporingsonderzoek in het digitale tijdperk, 2018). In 2020, follow-up written questions about accountability and bias in relation to AI and predictive policing were asked by the Dutch Justice and Security Committee to the former Minister of Justice and Security Grapperhaus (Grapperhaus, 2020).

Even though most authors emphasize the above-mentioned potential dangers, it should be considered that the overall goal of the research is to make a trade-off between the various factors regarding the impact of predictive policing, both advantages and disadvantages in this domain must be weighed up. Hence, the formulation of the sub-question: "*What are the expected pros and cons concerning using predictive policing applications for policing?"* The coming paragraphs will therefore give an overview of these drawbacks and benefits of using predictive policing software by law enforcement agencies.

3.1. Lack of transparency and accountability

Ferguson (2017) describes in his book that every police force using big data, no matter which predictive policing software they use, will share the problem of "black data" (p.7). Concerning the rise of data-driven policing, Ferguson (2017) thereby refers to multiple overlapping concerns, among which is the lack of transparency (p.131). Transparency, defined as the availability of information about an actor that allows other actors to monitor this actor's workings and performance, is also closely linked to accountability (Pasquale, 2015). As for most users within law enforcement, almost all data systems are black boxes; it is hard for them to understand and interpret the outcomes of the software while they do deem the outcomes as sufficient input for decision-making (Ferguson, 2017; Gstrein et al., 2019; Moses & Chan, 2016). According to Moses and Chan (2016), it is hard to hold the law

enforcement agency accountable as they mostly do not have a comprehensive understanding of the reasons for any given decision. Meanwhile, the companies that designed their proprietary predictive algorithms want to preserve their secrets (Ferguson, 2017, p.136).

As a result, the decision-making process by law enforcement, including its dependence on software, can not be subjected to scrutiny, criticism, feedback, or formal discipline where appropriate (Moses & Chan, 2016). This situation could create an accountability gap if police personnel are unable to comprehend the models and thus cannot identify any potential biases (Meijer & Wessels, 2019). Moses and Chan (2016) argue, therefore, that, while complete transparency and comprehensibility are ideal, one needs to settle "good enough" in reality. Ferguson (2017) hereby notes that when police forces seek to overcome the black data transparency problem, they must realise that citizens do not necessarily need information about the mathematical formula underlying the algorithm but do need an explanation about why the algorithm is being used in the context of legitimacy (p.137).

3.2. Bias and inequality

Because of the lack of transparency, using a predictive police model for profiling may result in the stigmatisation of individuals and groups, as well as types of algorithm-based prejudice (Meijer & Wessels, 2019). Although the topic of race and policing has long been a cause of concern, law enforcement officers may still overlook or underestimate the impact of when predictive models are employed ineffectively, which could lead to stigmatisation of persons (Schlehahn et al., 2015). Namely, even if law enforcement authorities or the general public already associate certain sections of a community with higher crime rates, the use of statistics could exacerbate such prejudice (Weisburd & Majimundar, 2018). Place-based can be considered problematic because of its high margin of error and can be used to justify racial and socioeconomic profiling (Ferguson, 2017, p.131-132). The argument goes that individuals and groups living in such locations suffer from this 'evidence-based stigma,' which has a negative influence on their development prospects (Gstrein et al., 2019; Weisburd & Majimundar, 2018). Although the CAS is not used for decisions against individual citizens and therefore has no legal consequences for citizens, it cannot be ruled out that the algorithm will see patterns between minority neighbourhoods and crime based on historic input data (Algemene Rekenkamer, 2022b; Ferguson, 2017, p. 133). Given the risk of false positives and

unfounded assumptions, complex algorithmic decision-making is identified by the Commission on Modernizing Criminal Investigation in the Digital Age (2018) as a particular risk to citizens' fundamental rights and the integrity of investigations.

According to Ferguson (2017), admitting that algorithmic policing can be prejudiced challenges the simplistic assumption that the racial profiling problem can be handled simply by employing more "objective" data-driven police or that newer big data technologies can prevent racially biased effects (p.142). Furthermore, acknowledging that big data might be skewed demands a serious review of how one needs to deal with the data (Ferguson, 2017, p.137). Hence, it is important to take into account not only the data and processes used to generate the predictions but also how they are stored, for how long they can be retrieved, with whom they are shared, and when they are finally destroyed in accordance with the law (Gstrein et al., 2019). According to Algemene Rekenkamer (2022a), public organisations could have done a Data Protection Impact Assessment to find out whether all risks are covered. However, the Dutch police organisation explains this choice by the claim that their algorithms do not need to be tested from the privacy legislation, the General Data Protection Regulation (GDPR), perspective as the CAS system would fall under the powers that the organisation is granted by the Dutch 'Wet politiegegevens' [police data law] (Algemene Rekenkamer, 2022b).

3.3. Big data to the police organisation

One of the primary claims made in support of predictive policing is that resources may be spent more precisely in terms of place and time (Meijer & Wessels, 2019). Predictive policing approaches are used to identify high-risk regions and therefore rely on both historical crime data and other wider ranges of data. Approximately two years' worth of historical data is enough for an algorithm to make predictions (Hardyns, 2022). By acquiring prediction telling criminal activity is most likely to occur, the police force is skilled to adequately respond, in turn promoting safety in the area (Moses & Chan, 2016).

Despite the often-described drawbacks concerning transparency and bias with the use of big data for policing ends, the rise of big data also offers a new opportunity to collect so-called "blue data" (Ferguson, 2017, p.143). Blue data refers to the collection of everyday police data to assess efficiency, potential bias, and methods to increase accuracy and justice in policing (Ferguson, 2017, p.143). Discovering underlying correlations can thereby provide value to

policing, which makes it important for the police what to do with the feedback they receive (B. Böing, personal communication, May 30th, 2022). The purpose of blue data is thereby to systemise as well as tackle recurring issues in modern policing (Ferguson, 2017, p.144).

With the help of GPS and bodycam technologies, administrators can acquire real-time, detailed information of every officer walking or driving every beat in the city if they so desire in map format (Ferguson, 2017, p.146). Besides, this real-time tracking of crimes and police resources could yield useful information about the relationship between crime and policing (Ferguson, 2017, p.146). On the other hand, guidelines derived from the CAS system could give more focus to their work (B. Böing, personal communication, May 30th, 2022). Overall, more data collection on the police side would improve the efficacy and accountability of the police force (Ferguson, 2017, p.155).

On the flipside, extensive data usage for policing has a built-in tendency towards to keep intensifying surveillance and control (Sherman, 2013). As described above, the day-to-day work of the officer can also be monitored, and direct instructions can be passed in real-time assuming it makes police work more effective (Ferguson, 2017, p.146). While data-driven policing is fully committed to collecting data on the largest possible scale to create actionable intelligence, for the officer its effects are harder to spot (Sherman, 2013; van Beek, Taris, & Schaufeli, 2013). Given the fact that predictive policing focuses on crime prevention, it is difficult to verify whether monitoring the predictions has really had an effect. According to Drenth and van Steden (2017), this leads to some of the officers feeling that their work is less meaningful than before. Moreover, the routine of the street-level officer is rather subject to the judgments of data analysts and team leaders than its own decisions, which could contribute to feelings among agents that their professionalism and autonomy are not valued (Chan, 2001). The use of a predictive policing system could therefore lead to technostress, the feeling of being hindered by devices that would not function properly, among the street-level officers (van Beek et al., 2013).

3.4. Chapter conclusion

The actions and tools of the police organisation are inextricably linked to society. Therefore, it was important to shed light on the argumentation often mentioned in society and (social) science about the use of algorithms in the public sphere. First of all, it has become clear that a lack of transparency regarding the so-called “black box” algorithms make it seemingly

impossible to subject the police's decision-making process to proper scrutiny, criticism and feedback. A lack of explainability to the general public makes it also hard to hold the law enforcement agency accountable for their decisions as there is no sufficient understanding creating an accountability gap. This lack of transparency and accountability potentially leads to systematic forms of profiling under which people fitting into this profile description can suffer from 'evidence-based stigma', which cannot easily be fixed with more data.

On the other hand, the use of big data for policing end can also be beneficial for the law enforcement agency in two ways. First, from a crime control perspective, it makes sense for the police to make use of the information that the predictive policing software can provide based on statistics that (a combination of) a specific group, location or time frames or a combination of these are related to higher crime risk. This can give the police officers on the street more focus on what to watch out for. Besides, with the use of other technologies, one might now have more information about these patrols and the ensuing police-citizen encounters than ever before. If they wish, officers can be watched and steered by administrators who potentially can retrieve real-time about every police driving or walking. Data thereby also enables the law enforcement agency to be better informed about their efficacy.

These insights answer the third subquestion, *"What are the expected pros and cons concerning using predictive policing applications for policing?"* It is important to note that these identified potential advantages and disadvantages of using a predictive policing system lie at the root of the theoretical part of this thesis and the chosen theoretical dimensions on which the focus lies from the next chapter onwards.

4. Organisational performance

4.1. Why and how to measure organisational performance?

Neely, Gregory, and Platts (1995) describe 'performance' as a measurement which quantifies the efficiency or effectiveness of certain actions. Performance measurement is a vital component of good management in both the private and governmental sectors (Maslov, 2016). Organisations benefit from having defined objectives since it is impossible to tell when an aim has been met without knowing what the organisation wants to achieve (Maslov, 2016). Therefore, Maslov (2016) argues that organisations should evaluate how success will be measured as a corollary of this approach in order to know if the objectives have been reached. According to Hodgkinson, Caputo, and McIntyre (2019), the increasing emphasis placed on police performance measurements and other public institutions can be attributed to new public management (NPM), a business-like approach applied to public administration. Since the rise of NPM in the early 1990s, the impact of the NPM-inspired policies and the accompanied police organisation can not be overstated (Rainey, 2014). Following the NPM approach, organisational performance imperatives are focused on the rubrics of efficiency and effectiveness as one expects value for the invested money (Hodgkinson et al., 2019). The police thus started using predictive analytics for many of the same reasons as other institutions did, namely, to improve efficiency and accountability (Brayne, 2021, p. 23). Looking at the implementation of predictive policing strategy-related software from an NPM perspective, any monetary investments within the systems should, in the end, be balanced by any returns in effectiveness and efficiency (Rainey, 2014).

Brayne (2017), however, states that law enforcement does not only adopt big data analytics because there is empirical evidence but also to conform to this pressure to keep up with other institutions which have also started to marshal big data and algorithmic predictions for their decision-making processes. This statement about resembles the literature on the concept of institutional isomorphism, which is described in institutional theory as the restraining procedure that makes a population unit resemble other population units that experience the same set of environmental conditions (Hawley, 1968). According to DiMaggio and Powell (1983), coercive isomorphism is therefore a product of cultural expectations placed on the organisation by organisations in the field.

Berthod and Sydow (2013) claim that institutionalisation and isomorphism will, in turn, reinforce that a certain new practice among organisations will be taken for granted. A consequence of this, as described by the concept of path dependence, is that it becomes harder to make changes or get rid of certain strategies as organisations get stuck in so-called institutional lock-in (Berthod & Sydow, 2013; de Vries, 2016). As a result, even if the efficacy of the adapted systems has not been assessed, organisations may continue to utilise them because they are locked in once in use (Brayne, 2021, p.27; de Vries, 2016). This sometimes leads to situations where even when systems would be ineffective, organisations continue to use them (Brayne, 2021, p.27; de Vries, 2016).

When police effectiveness and efficiency are assessed in line with NPM, policymakers and police authorities have traditionally relied on current police measures, such as crime rates and clearance rates (Hodgkinson et al., 2019). However, these Uniform Crime Reporting (UCR) statistics, including the traditional crime rates, clearance rates, response times and productivity or workload statistics, only have a very narrow focus on crime and the police response to it (Hodgkinson et al., 2019). The traditional NPM-related police metrics of effectiveness and efficiency do not have priority concerning crime prevention and other actions that can improve community safety and police-stakeholder partnerships (Wells, Horney, & Maguire, 2016). The Federal Bureau Investigation (2017) thereby also concludes that clearance rates and similar measures should not be the only factors when performing an assessment of the performance of any law enforcement organisation.

As effectiveness and efficiency fail to address the social demands related to policing (Federal Bureau Investigation, 2017; Hodgkinson et al., 2019), the concept of police performance within this thesis will, therefore, not solely focus on effectiveness and efficiency as performance indicators. In line with the work of Hodgkinson et al. (2019) and Maslov (2016), assessments of the performance of a police organisation should, namely, also be made based on whether and to what extent it is achieving its stated goals. Hodgkinson et al. (2019) thereby suggest an approach that includes the context of the broader community safety goal when evaluating police organisation performance, boosting the potential for more accountable policing. For this thesis research, it is therefore chosen to compliment the traditional NPM performance indicators of effectiveness and efficiency with the factors of legitimacy and legality to include the Dutch police force's goal to make the Netherlands safer while being "vigilant and subservient to the values of the rule of law" (Politie, n.d.-b).

4.2. Dimensions of police performance

The dependent variable within the main research question concerns the performance of the Dutch police force. The focus will be on police force performance in a multi-dimensional way, as indicated in paragraph 4.2. The work of Maslov (2016) underlines this multi-dimensional approach when measuring performance, as that is necessary to fit the multi-dimensional nature of the policing work. Police performance, therefore, consists of multiple indicators, both direct and indirect, which should both be considered in any research concerning police performance (Maslov, 2016). For the thesis, it is chosen to divide performance into the elements of effectiveness, efficiency, legitimacy and legality. This combination is chosen on purpose as a sizable number of today's police forces are still narrowly focused on effectiveness and efficiency as indicators which have dominated the sector for decades (Sparrow, 2015). On the other hand, this combination allows to include the insights of Hodgkinson et al. (2019) by accounting for the broader community safety goal as part of the performance.

Effectiveness

Organisational effectiveness by itself is defined as high when the organisations approach meeting their operational goals (Skogan, 1976). Effectiveness should therefore be understood in the context of its importance in policing strategies and tactics (Ferguson, 2017, p.17). When it comes to police performance, effectiveness is also one of the included factors in Neely et al.'s (1995) definition of performance. Rienks and Schuilenburg (2020) add that effectiveness is often seen as one of the most important dimensions concerning police performance as it is often suggested that changes in the police force, such as the implementation of predictive policing, are legitimised because of the expected increase in effectivity. According to Mali et al. (2017), the effectiveness of predictive policing is expressed when targeted deployment based on a prediction was able to prevent the prediction from occurring. The definition of police effectiveness thereby reflects the police's mission to prevent and fight crime besides guarding public order supported (Skogan, 1976). As prescribed by the focused deterrence strategy, police could especially focus on the prevention of recidivism by confronting earlier offenders that recidivism will not be accepted and that there is a good chance of being caught (Ferguson, 2017, p.35). If the perception of potential offenders changes concerning the apprehension risks, crime rates will potentially drop

(Ferguson, 2017, p.37). The societal demand that the police force solves crimes and put criminals to trial asks for evermore effective police responses (Brodeur, 2010). The effectiveness of the police force is, therefore, inextricably linked to clearance rates and crime statistics (Brodeur, 2010; Sparrow, 2015). Therefore, especially reductions in the number of crime reports have come to dominate many departments' internal and external claims of success as the closest thing to a true crime-control outcome metric available. According to Sparrow (2015), effectiveness and crime statistics have always retained their prominence even though this approach may be seen as too narrow, as crime control is just one of several components of the police mission (Sparrow, 2015).

Generally, the expected effectiveness of crime rates by the police forces has been the main driver for experimenting with the development and implementation of predictive policing in various countries, including the Netherlands (Moses & Chan, 2016; Schuilenburg & Soudijn, 2021). Based on the narrative followed by police forces all around the world, including the Dutch police force, one could formulate the first hypothesis relating to the impact of predictive policing upon performance, namely:

H1: The use of predictive policing technologies will increase the effectiveness of the police organisation in terms of dropping crime rates.

Efficiency

While the concepts of effectiveness and efficiency often go hand in hand when proposing organisational changes inspired by new public management, they should be treated as distinct concepts (Lapuente & Van de Walle, 2020). Where effectiveness is about to what extent an organisation could meet its goals, organisational efficiency is characterized in terms of processing activity (Skogan, 1976). Skogan (1976) describes that efficient departments reach a degree of input-output convergence where less effort is necessary on the side of the organisation. In short, this means that police tasks can be carried out faster and with less staffing, equipment or subsidy (Wetenschappelijke Raad voor het Regeringsbeleid, 2016). Because of the often-limited allocated resources available, it is for public organisations especially important to function as efficient as possible (Skogan, 1976).

Besides, efficiency is especially crucial in the context of policing since the goal of the contemporary police is also to reduce the expenses that society may suffer as a result of future criminal behaviour (Ericson & Shearing, 1986). Therefore, like other public institutions under modern statehood, police forces need to adapt to the expectation that more can be done for less and expect "value for money" for the cost they do make (Hodgkinson et al., 2019).

In previously inconceivable ways, modern data mining tools and sophisticated computers can scan the police's collective data memory for relationships and correlations (Sagiroglu & Sinanc, 2013). Furthermore, the collective memory assures that many more experiences are available than any police officer would ever have on their own. This not only creates a completer picture but also makes it easier to make judgments that are not reliant on time or location. Regarding efficient performance, the police would theoretically be able to enhance public safety with fewer (human) resources. Based on this premise that predictive policing software can save the police organisation resources and manpower to perform their tasks, the following hypothesis has been formulated:

H2: The use of predictive policing technologies will increase the efficiency of the police organisation.

Legitimacy

Even though legitimacy may not be the most prominent performance indicator from a public management standpoint, authors such as Bradford, Jackson, and Hough (2013), argue that measures such as legitimacy should be at the centre of policy assessments concerning police actions and behaviours. From a public administration perspective, Atkinson (2018) writes that public organisations operate continuously on a balance wheel. Organisations such as the police are supposed to be subordinated and accountable to the will of current political leaders but are also sensitive to the requirement that they remain above the fray and professional, avoiding political meddling in rule enforcement (Atkinson, 2018). Besides, the public has a widespread expectation that managerial goals should not take precedence over acceptable levels of attention to broader societal norms (Atkinson, 2018). Legitimacy is, therefore, a subjective interpretation found in people's and groups' views and perceptions of others' acts and behaviours (Wallner, 2008).

The legitimacy of public institutions can be understood as a system that is more or less in equilibrium across time (Atkinson, 2018). When a government agency interacts with other agencies, branches of government, and the general public, it will be seen as more or less legitimate at times (Atkinson, 2018). Legitimacy is lost when one is not able to uphold the norms and values which belong to one's position (Atkinson, 2018). In the end, the power of policing becomes legitimate when it conforms to established norms and values, when it is justified by shared beliefs and when the subordinated party has consented to it (Beetham, 2013). Research by Tyler (2004) concludes that people's decisions regarding whether to accept police decisions were more heavily reliant on evaluations of the procedural justice of police activities. Complementing the statements of Atkinson (2018) and Wallner (2008), Tyler (2004) points out that when people evaluate authorities like the police, they assess whether they use fair procedures when engaging in policing activities. These procedural evaluations are separate from those regarding the effectiveness or fairness of the activities' *outcomes* (Tyler, 2004).

The procedural justice approach is the most appropriate choice for the analysis within this thesis since Big Data technologies are actual procedures of the police, and this approach fits best with the definition of legitimacy, which emphasizes compliance with the shared norms, especially among the subordinated party (Beetham, 2013). Legitimacy thereby refers to the quality of (internal) governing processes of institutions and people involved in policymaking (Schmidt, 2012). More specifically, it is throughput legitimacy which focuses on what goes on inside the "black box"' between the input and the output from a system (Schmidt, 2012). Widlak, van Eck, and Peeters (2021) thereby note that for any algorithmic-based decision-making process to be legitimate, there should be clarity regarding the principle of accountability and transparency.

From the predictive policing perspective, legitimacy is a must in the sense that if the police's actions are accepted and found trustworthy, their actions can legitimately be set forth (Bradford et al., 2013). The perceived legitimacy of an organisation and its policies has, in return, an impact on whether it achieves its stated aims and objectives, as well as its ability to maintain public stability and gain support for future undertakings (Wallner, 2008). The perceived relationship between the police organisation and the citizenry is, therefore, crucial to what extent the police can perform optimally (Bradford et al., 2013; Wallner, 2008).

Keeping in mind the conceptualisation of the legitimacy dimension as the compliance with the shared norms among the subordinated party (Beetham, 2013), one should take into consideration the indicators of transparency and accountability by which legitimacy is formed. Although one may think that the police make sure that their technological tools in use are as transparent as they can be within the boundaries for safety reasons, the emphasis on the potential social disadvantages[2] within the scientific literature cannot be ignored. The existing literature indicates that still too little is known about what is going on inside of the so-called "black box". Therefore, the expectation is that police legitimacy would be generally disadvantaged regarding the use of predictive policing technology. In line with this expectation, the third hypothesis is formulated as follows:

H3: The use of predictive policing technologies will decrease the legitimacy aspect of the police as an organisation.

Legality

Even if the usage of predictive policing technology would be proven effective, the haphazard inclusion of random variables that are technically possible should be avoided (Mali et al., 2017). According to Mali et al. (2017), the tactical choice for included calculation is thereby not limited by computation time limits but rather through legal limitations and acceptance of resources used. According to the former minister of Justice Grapperhaus (2020), there should always be a legal basis for the actions of the police, following the principle of legality. Although applications such as the CAS, in this sense, can be regarded as technical development tools for tasks for which the police force is already authorised to do so by law, all actions of the police with these tools must be legally justified (Grapperhaus, 2020). Therefore, all of the usual legal frameworks apply to the application of CAS, including both the Police Act and the Criminal Code (Grapperhaus, 2020).

The data analysis regarding the CAS predictions has focused on place-based (heat maps) and time-based (hot-times) policing rather than person-based policing. Normally, in cases where no specific suspects have been identified, a reasonable suspicion that a criminal act has been committed is necessary for the deployment of investigative powers under Article 96 in the Code of Criminal Procedure (Hoving, 2019). As reported by Hoving (2019), the explanation

[2] With 'social disadvantaged', it is referred to matters such as a lack of transparency, bias and inequalities as described in chapter 3

of this non-personal suspicion requirement is often in line with the requirements set for the ‘reasonable presumption of guilt’ in Article 27 of the Dutch Criminal Code. In general, this concept of 'reasonable presumption of guilt' consists of the following elements: the suspicion must relate to a criminal offence, the suspicion must be reasonable, and the suspicion must arise from facts and circumstances (Corstens, Borgers, & Kooijmans, 2018). However, as Gstrein et al. (2019) states, the use of predictive policing software still enables policing based on predictions of crime prevalence and thereby “effectively transforms the legal concept of “innocent until proven guilty” into “predicted guilty until proven innocent” (p.11). Again, the haphazard collection of data should, therefore, not become an end in itself (Mali et al., 2017; Rienks, 2015). Also, the data and information must be collected in a legally valid manner if it is to be seen as evidence (Rienks, 2015).

Although a prediction of an algorithm is, in principle, not sufficient to give rise to reasonable suspicion, it can be supplemented with an additional observation which the investigating officers must determine based on their own knowledge and experience (Hoving, 2019). This is because, as specified by Hoving (2019), reasonable suspicion can be legally based on a prediction resulting from the application of general rules of officer experience and facts of general knowledge to a particular event. Gstrein et al. (2019) thereby claim that the simple existence of a crime prediction system, therefore, pushes law enforcement agencies to respond with at least surveillance or even interception practices to confirm any criminal activity. In the context of safety, it is namely also expected by law that the concerning law enforcement agency does everything in its power to forecast crimes in order and minimise criminal activity (Hoving, 2019). It is thereby presumed that a public entity like the police uses the applicable laws as a guide to enable the police to function with the aid of predictive policing while also keeping it at an acceptable level. From this presumption the following hypothesis is made:

H4: The use of predictive policing technologies enables law enforcement agencies to execute their proactive capabilities while being compliant with the rule of law.

The paragraphs above have outlined the four dimensions related to the concept of police performance on which the thesis is focussed. As stated before, whether the police performance is either benefitted or disadvantaged using predictive policing technology is determined by the extent the Dutch police organisation is capable of fulfilling its goals. Based on the theoretical dimensions and the related hypotheses, figure 4 presents a visual of both the concept of police performance as well as the hypotheses given above. When one weighs up the expected impact on the described indicators, it is therefore expected that predictive

policing will increase most of the performance dimensions linked to the police's goal to make the Netherlands safer while being vigilant and subservient to the values of society and law. On that note, it can be expected that the implementation and usage of predictive policing technologies will overall increase police performance in the Netherlands.

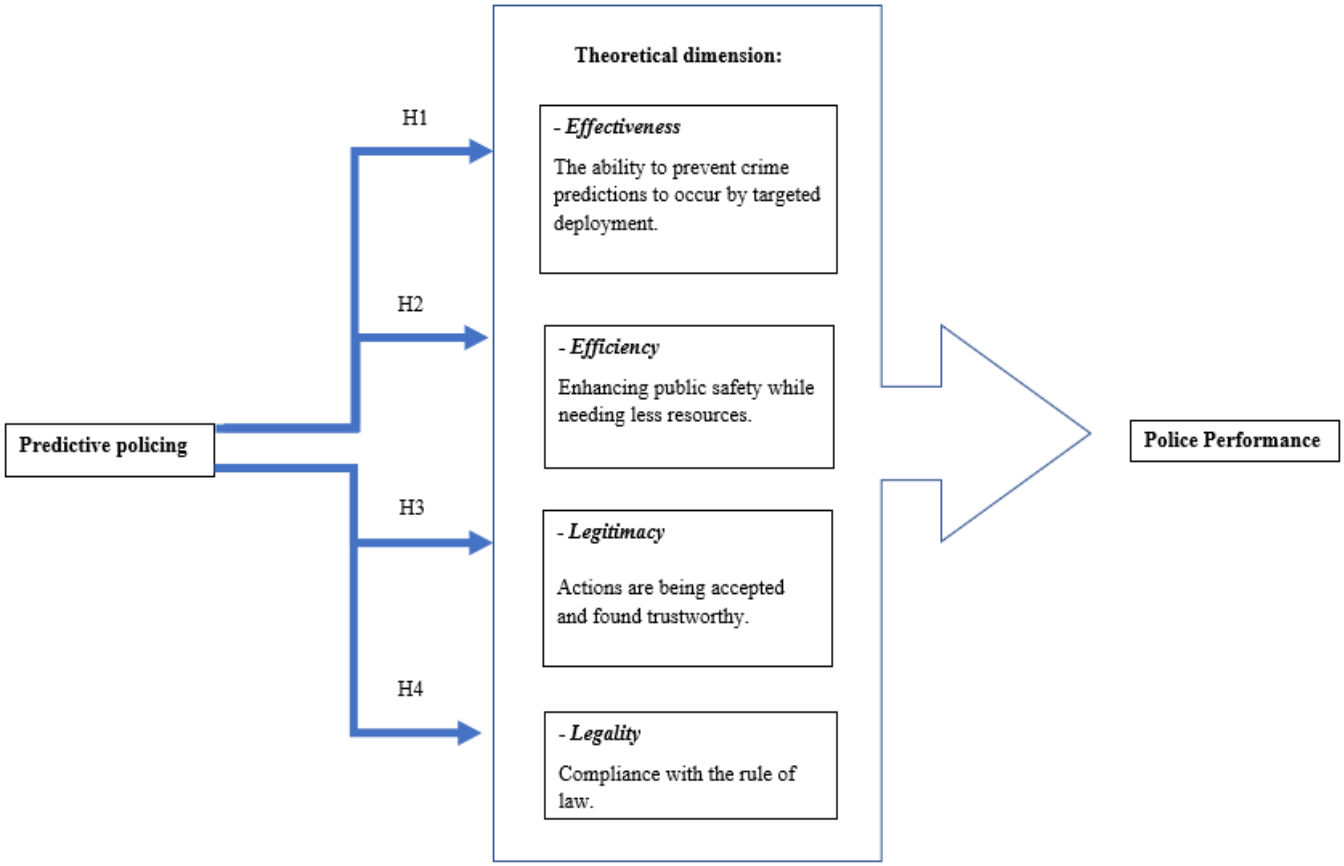

Figure 4: Overview of the hypotheses and performance dimensions. Note: The more of these dimensions are fulfilled when working with CAS, the greater the police performance is positively impacted.

4.3. Chapter conclusion

In this chapter, the sub-question "*What are the main prerequisite performance indicators regarding using a predictive policing application within a public organisation?"* was central. Based on the literature, the four dimensions of effectiveness, efficiency, legitimacy and legality were explained in combination with their role in the concept op police performance.

Partly due to the influence of the new public management philosophy, performance assessment has become a critical component of good management in the public sector under the assumption that organisations benefit from having clearly defined objectives to reach. Organisations are thereby always on the lookout for operational models that allow for more

flexible resource allocation, issue solving, and performance assessment. The police organisation is no exception to this. Proactive data analysis and predictive policing therefore seem a logical step to pursue this proactiveness.

It is thereby also not surprising that one expects a return from these investments in the form of effectiveness and efficiency, especially regarding the early lock-in and sunk costs involved with the creation and adoption of a certain predictive policing system. From the literary analysis, however, it can be concluded that effectiveness and efficiency alone are not sufficient in a public organisational context. The additional aspects of legitimacy and legality are necessary to include the social goals of the police organisation in the assessment. In the end, therefore, all four factors, effectiveness, efficiency, legitimacy, and legality, are found to be crucial factors regarding organisational performance in the public sector. It is expected that both the effectiveness and efficiency of the police organisation are positively influenced using predictive policing while the legal boundaries can be optimised and respected. Although predictive policing can legally be accepted, legitimacy is based on the public's shared beliefs. It is therefore expected that the use of predictive policing would only negatively affect the legitimacy aspect of the police organisation.

5. Methodology

5.1. Research design

In this thesis study, qualitative research was conducted to answer the question of how the implementation of the predictive policing strategy impacts the police performance of the national police force in the Dutch context. The performance of the police force can thereby be seen as the dependent variable, which is influenced by the usage of predictive policing technologies, which will be examined based on the insights obtained via the interviews rather than numerical measurement. The choice for this qualitative approach is based on the nature of the research and the associated research question. According to Cleland (2017), qualitative research is the greatest choice of how" and "why" research questions the greatest choice for "how" and "why" research questions as it enables the researcher to comprehend both the context and experiences regarding the phenomenon one is writing about. In addition, qualitative methods such as interviews will guarantee a thorough understanding of the topic in a social science domain, state Islam and Faraj (2021). For this research, therefore, it was chosen to execute semi-structured 'expert' interviews to get more insights into the opinion and experiences of experts on the topic and test the formulated hypotheses

The semi-structured interviews are characterized by open-ended questions and the use of an interview guide in which the themes of interest, and the performance dimensions, were defined (Hijmans & Kuyper, 2007). The pre-defined topics in the interview guide were derived from the literature, which means they refer back to the identified performance indicators and their characteristics (Busetto, Wick, & Gumbinger, 2020). The semi-structured interviews, however, also allowed more unexpected topics to emerge and to be taken up by the researcher (Busetto et al., 2020).

Respondents were questioned about their first impressions of the concept of predictive policing and the work of the police force, followed by questions regarding their views on the effectiveness, efficiency, legitimacy, and legality in combination with the predictive policing concept. The expert respondents can answer the interview questions from their own work and or research experience related to the four performance dimensions.

To make the answers easier to compare and combine during the analysis, an attempt was made to discuss the four dimensions in the same order throughout the interviews. However, due to the semi-structured nature of the interviews, sometimes it was more natural to make a

transition to another dimension than in the preconceived order since a respondent's answer was already linked to this (Döringer, 2020).

5.2 Operationalisation

In order to measure the performance dimensions from the conceptual model, the dimensions needed to be transformed into subtopics and questions for the interview guide. Therefore, all dimensions were operationalised as shortly explained below.

What was clear from the beginning was that from the identified dimensions only, *effectiveness* can be measured by direct measurements in terms of crime rates as an indicator. For this reason, it is chosen to measure the effectiveness by the expectation that predictive policing will lead to a drop in crime rates, as described by Mali et al. (2017). Also, the extent to which the police force is focused on prevention and predictive policing could serve as an indicator. A large focus on the prevention of criminal activity would indicate performance in the sense that the organisation shows their best efforts to keep crime rates lower (Ferguson, 2017, p. 116).

As described by Skogan (1976), an *efficient* organisation reaches a point where less effort is needed to get to the desired output. In the policing context, this desired output would be maintaining public order and safety with the use of fewer resources (Brodeur, 2010). According to Vepřek et al. (2020), the police generally operate under the primacy of doing more with less. Indicators for efficiency in this context are faster responses as more data is analysed in a short amount of time, possibly leading to more arrests in a smaller time frame. With the introduction of big data analysis in policing, officers can be more focused on places where crime is expected instead of aimless patrols. Also, when on the beat, quick data analysis could help determine officers whether a person could be seen as a potential threat or not, establishing an appropriate way of proceeding with the right amount of support.

For the *legitimacy* aspect, the introduction of Big Data policing might pose a problem. As the processes regarding the predictive policing software and its algorithms are usually not accessible to the citizenry, it is made difficult for citizens to judge the fairness of the treatment (Tyler, 2004). Therefore, one of the most important indicators to evaluate legitimacy is to assess whether the transparency aspect is met by predictive policing technologies. On the one hand, this means measuring whether there is enough information available for the citizens to comprehend why certain actions are taken based on which variables (Bradford et al., 2013). If

there is not enough public information available, the police might be seen by the public as less legitimate as the police are not able to uphold the public norms and values of transparency and accountability (Atkinson, 2018).

At its core, *legality* means that the execution of any (governmental) power takes place within the established rules (Beetham, 2013). The police are both empowered and limited by the legal framework, which describes their rights and activities (Gstrein et al., 2019). An important indicator of legality is, therefore, the extent of legal space for the police to do their work more effective and efficient than before the usage of predictive policing software. To test whether the current Dutch legal framework allows for the expected optimalisation, respondents were asked whether the current rules are perceived to be guiding the predictive policing strategy or if they are perceived to be too restricting to reach a level of sufficient effectiveness. For the legitimacy dimension, questions have been asked to the respondents about their vision of the potential black box issues and the understanding of big data/predictive policing within the public. Based on the collected data, one can evaluate the status of the performance indicators regarding the police force applying the predictive policing strategy.

5.3. Data collection

The research was conducted mainly using online face-to-face interviews through the Microsoft Teams software. Ethical permission was granted by the BMS faculty's Ethics Committee regarding the execution of the data collection and analysis process. The recording of the interview conversation only started after the explicit permission of the interviewee.

In total, three respondents were interviewed in the period between May 20th and June 10th. Experts were selected based on their expertise on the topic of public safety, particularly big data applications and policing. Based on the position of the respondent and academic output, it could be determined whether the person would be a suitable respondent. An attempt was made to select experts as diversely as possible, e.g., in terms of academic background, current employer and side-line activities. There was no focus on departments within the police unit, mainly due to the fact that when writing the thesis, one is dependent on which persons were willing and available to conduct an interview. Before the above-mentioned period, the researcher tried various ways to get in touch with the Dutch police organisation, both directly

and through contacts within the academic setting. Unfortunately, it was not possible to get in touch with the right people within the organisation within the time frame.

Although one may argue that the sample is less representative of the police organisation itself, the 'expert' interview is also to be considered an appropriate method to refine concepts and to answer the research (Döringer, 2020). According to Kaiser (2014), experts can namely be considered as considered knowledgeable of a particular subject under research and can be identified by virtue of their specific knowledge, their community position, or their status (as cited in Döringer, 2021). Furthermore, expert knowledge can also offer practical, local knowledge derived from the professional as well as personal experiences the expert has gained during their careers, in addition to the insights of the relevant scientific discipline (Meuser & Nagel, 2009). Based on the statements in the work of Döringer (2020) and Meuser and Nagel (2009), it is assumed that believed that the expert interview approach will be able to represent both scientific insights as well as the practical insights concerned with the topic of predictive policing.

In terms of time, the interviews took around 45 minutes to 60 minutes at max. This frame offered enough time to keep the planned in-depth interviews to extract information.

5.4. Data analysis

In order to analyse the interview data, all (online) interview conversations were recorded with the explicit permission of the interviewees. Although the interviewer made several notes during the interview conversations, it was the recording which gave the opportunity to create a full transcript of the interviews. When using such automatic functionalities, one should keep in mind that the quality of the audio must be sufficient, and that the software may deal better with English conversations than Dutch-spoken recordings. Partly for this reason as well as other imperfections by automatic transcribing software, it was important to check the text and improve it where necessary. To reduce the amount of time finishing the transcription process, it was decided to transcribe the interviews intelligent verbatim. With this form of transcribing, everything that is said is written down, but hesitations, catchwords and stuttering are omitted. As much as possible. The disadvantage of this method is that information is lost about how someone has said something. However, as it is not the main goal of the research to observe or investigate the interviewees' behaviour, transcribing verbatim should suffice (Fossey, Harvey,

Mcdermott, & Davidson, 2002).

The completed transcripts allowed for to use of a focused analysis of interviews strategy which aims to summarize the data and reduce its complexity (Rädiker & Kuckartz 2021). The most important methodological step in this analysis is thereby the coding of the interview data (Flick, 2014). The coding process, which was fully executed within the environment of the QDA-miner software, started with the development of the basic coding categories. The method of focused interview analysis is mainly a deductive, theory-driven approach where one starts out with a set of predetermined categories in mind (DeCuir-Gunby, Marshall, & McCulloch, 2010; Rädiker & Kuckartz 2021). Therefore, the first stage in creating theory-driven codes is to produce codes that are derived from the theory that is directing the research (DeCuir-Gunby et al., 2010). Based on the conceptual model, these theory-driven codes resemble the performance indicators of effectiveness, efficiency, legitimacy and legality.

Reviewing and updating the codes in context is the second step in creating theory-driven codes (DeCuir-Gunby et al., 2011). Therefore, it was necessary to think about whether the code labels were appropriate and how to use them with the acquired data. All interviews are gone through and coded one after another, section by section (DeCuir-Gunby et al., 2011; Rädicker & Kuckartz, 2020). Sections that are relevant to the research issue were highlighted and categorised accordingly. Some text passages contained multiple codes if applicable. As the interview guide was also structured by the themes of the several performance indicators, it was assured that the interview data would to a certain extent match the categories (Rädiker & Kuckartz 2021).

During the interviews, some of the open questions asked allowed the interviewee to raise their own ideas. Because of this, there have been instances where interviewees have brought up a number of points that are important to the research issue but were not specifically requested by the researchers. As prescribed by Rädicker & Kuckartz (2020), such sections that did not have statements that are primarily belonging to one of the pre-set categories were coded openly and temporarily put in an “other” category for the time being. In contrast to the previous coding round, the labels in the category “other” were assessed for similarities to subsequently create a new data-driven category (DeCuir-Gunby et al., 2010; Rädiker & Kuckartz 2021). The category "other" has been reformulated in this way to the category *future and recommendation.* On the next page, table 3 displays an overview of the assigned codes per category. Furthermore, appendix E gives a more detailed overview of the coding and

interview data by also displaying the frequency of a certain code and the corresponding respondent along with a few fragments from the transcripts.

Coding category	**Assigned codes**
Effectiveness	Effectiveness narrative
	Predictive power
	Proving effectiveness
	(Quick) Sharing of information
Efficiency	Efficiency narrative
	Flex-team
	Standardisation of work
	Support working staff
Legitimacy	Accountability
	Bias
	Explainability
	Organisational culture
	Politics
	Support base among officers
	Transparency
	Trust citizenry
Legality	Dutch rule of law
	Legal background
	Legal task police
	Privacy Rights
	Proportionality
Future and recommendation	Appreciation of officer expertise
	Citizen awareness
	Evaluations
	Legal experimentation space
	Local strategy
	Public debate

Table 3: Overview of the coding categories and code words which were assigned to text fragments from the interview conversations

5.5. Validity and reliability

Regarding the chosen research methods and operationalisation, several considerations can be discussed concerning validity and reliability. Validity in research methods generally refers to whether the research truly measures what it was intended to measure (Golafshani, 2003). Therefore, it should be assessed whether the research instrument allows it to reach the research objective. Since, for this study, it was decided to focus on the relationship between predictive policing and police performance, the interview guide's themes and questions were specifically prepared for the previously identified dimensions keeping in mind the operationalisation of these dimensions based on the literature. In this sense, the interview guide was there to keep the researcher on track to ask the questions closely related to the predictive policing concept and performance and was refined throughout the data collection process while the interviewer learned more about the field (Busetto et al., 2020).

A potential threat to the validity of qualitative research, however, could, for example, be the so-called 'researcher bias', a problem within qualitative research in which researchers only focus on the results they wanted to find and write about those results (Johnson, 2019). Although the chosen semi-structured interview approach is prone to such bias, the interactive characteristic of the interview approach partially counteracts this (Busetto et al., 2020). Namely, as already described in the research design, the semi-structured interview style also allows unexpected topics to arise to be subsequently included by the researcher in the results even if that information would disconfirm the initial expectations and explanations (Busetto et al., 2020; Johnson, 2019). '

Regarding the external validity and the generalisability of the research, it should be stated that the sample size is too small to adhere to the rules of random selection. However, this is no exception for qualitative research as Rädiker and Kuckartz (2021) describe that it is only seldom possible to generalise from a qualitative interview study in the same way as from a survey-based quantitative study due to the sample size.

Reliability in research is, on the other hand, mainly concerned with reproducibility and obtaining similar results (Golafshani, 2003). DeCuir-Gunby et al. (2010) describe that with qualitative interview research, especially the coding process relies on the interpretation of the data by the individual coding. Therefore, the results of similar research by other individuals or groups may lead to different outcomes. Reliability, in this case, can therefore best be

guaranteed by describing the circumstances of the research, providing insights into the coding process and, if possible, making the transcripts available. In the previous methodology sections, therefore, an attempt was made to give a good picture of how the research is executed and have the transcripts have been added to the appendix.

6. Results

In this chapter, the results of the interviews will be presented[3]. The whole chapter is structured according to the pre-identified performance dimensions on which the interviews were based. Every paragraph ends with a section describing the outcome of the interviews in relation to the overall police performance.

6.1. Effectiveness

The effectiveness narrative

The importance of effectiveness within the policing context has already been underlined several times throughout the thesis. In the literature, it is thereby also emphasized that effectiveness could be seen as the most important performance dimension for the police organisation (Rienks & Schuilenburg, 2020). According to the literature, police organisations are influenced by this new public management value which seems to be the foundation of several innovative steps taken toward more proactive policing actions by law enforcement agencies in general such as stopping people at their own initiative, rather than waiting for calls (Brayne, 2021, p.13; Hodgkinson et al. 2019). Interviewee Strikwerda confirms this movement toward more proactive policing and considers it as a broader movement towards a control culture where we have come to see crime more and more as a risk which needs to be avoided (appx. C).

The strategic police top management, in particular, likes to believe in the effectiveness of forecasting, and it is also sold well to them, according to Spithoven (appx. D). Spithoven thereby also refers to the innovation and adaptation of predictive policing as *"created for the sake of efficiency and effectiveness, because of new public management like thinking"* (appx. D, par. 58). The belief in effectiveness thereby especially refers to an expected drop in crime rates, specifically by using *"probabilities of burglaries and vehicle thefts and bicycle thefts and all of these types of things"* (appx B, par. 67). Gstrein even describes this belief of the police as following:

[3] Statements of the Dutch-speaking respondents were translated into English by the researcher himself for this results section. The original statements can be found in the transcripts which can be found in the appendices.

"This is all going to work because it is like fancy things, throwing data together and using very fancy statistical methods, etcetera. And then we are all going to be happy because there is going to be less crime somehow miraculously" (appx. B, par. 26).

Gstrein's statement points to the absence of a clear reason why predictive policing would be so effective. For this, Spithoven refers to the, in his opinion *"very close relationship between the strategic top that decides on this and the technicians who really want to sell this"* (appx. D, par 18).

Strikwerda, however, suggests that the underlying principle of an explicit police presence can indeed lead to more safety when combining predictive policing with "spotting" (appx. C). Spotting thereby entails having police officers stay put while being clearly visible in their uniform, overviewing a busy place which may scare off people with bad intentions (appx. C, par 27, col. 103). The police could also apply this principle in certain high-risk neighbourhood states Strikwerda (Appx. C). "*I just let a car like that drive around the neighbourhood. Really visible. Then maybe they don't dare anymore"* (appx. C, par.35).

Proving the effectiveness of predictive policing

Next to the reasons why the Dutch police started working with predictive policing in the first place, the respondents were also asked about their view on how the effectiveness narrative resonates with reality. In line with the definition of 'predictive policing effectiveness' by Mali et al. (2017), all interviewees were asked whether they would expect a (significant) drop in crime rates due to the adaptation of predictive policing.

It became clear that the answers to this interview question were not as black and white as one may initially expect. Strikwerda stated that her thoughts on the effectiveness of predictive policing are dubious as past evaluations of predictive poling and the CAS have shown that it did not work that well in the end (Appx. C). Gstrein and Spithoven, however, mainly point out that there is no reliable way has yet been found to empirically test the effectiveness of predictive policing in the first place (Appx. B; C). "*There are no clear criteria right from the start on how to measure effectiveness. Even in the broadest terms"*, states Gstrein (Appx. B, par.26, col 57). Spithoven thereby also generally advises against conducting these kinds of empirical experiments on the effectiveness of predictive policing (Appx. D). *"But in what*

way do you want to approach that empirically? Because then you have to deal with so many variables. How can you check for that?" (Appx. D, par. 34).

Although the evaluative pilot study by Mali et al. (2017) can be seen as valuable as it is the only known attempt to actually try empirically research the effectiveness of the use of the CAS in the Dutch context, the experts make critical remarks. Spithoven, for example, states the following:

"And I think it's so complex and dependent on so many factors that you couldn't do a pure experiment. And even if you do that, I would be very critical of how you do it" (Appx. D, par. 34).

While all three experts are sceptical about proving the actual effectiveness of the predictive policing models, it is also acknowledged that there is a need to test the effectiveness of the models. According to Strikwerda, the quality of the prediction model is essentially on which the whole predictive policing stands or falls (Appx. C). However, the attempts that have been made to assess the effectiveness of different prediction models do not seem to yield any notable results (Appx. B). Empirical research like the one from Mali et al. (2017) seems not to be able to really find clear evidence that the use of predictive policing models explain the ongoing drop in the physical traditional crime rates in Western Europe and label the model with the label "good enough" (Appx. B). Spithoven thereby states that the type of research is mainly supporting the supposed effect that also seems to be based on the narrative, while it cannot be really substantiated (Appx. D).

All in all, the respondents agree that it was primarily the perceived effectiveness of the prediction model (the effectiveness narrative) which has played the most important role in the implementation of the CAS within the Dutch police organisation. "*The other thing is about believing in the power of prediction"*, so says Gstrein (Appx. B, par. 26).

Future potential

Because all respondents were sceptical about a possible beneficial effect of predictive policing on crime rates, the experts were asked or offered their own opinion on the ways in which predictive policing can have an impact on the effectiveness of police work.

Strikwerda noted that the development of technology has always shaped police work and that technology plays a role in several phases of the investigation (appx. C). Although the prediction model regarding will therefore continue to be part of this, Strikwerda especially

sees potential in the retrospective use of person-based predictive policing by being able to link potential criminals to a crime afterwards (Appx. C).

According to Spithoven, if one wanted to stick to the current Dutch predictive policing strategy, consisting of exclusively place-based and time-based predictive policing, further technological development would have to be done, and extra information such as weather conditions and crowding would have to be linked (Appx. D). However, the expectation is that the 250 x 250 meters grids will be especially useful in the busy urban setting (Appx. D). Police work is and will remain locally customised, which means that what works and what does not work should actually be figured out locally (Appx. D).

Conclusion

The expected improvements in the effectiveness of the fight against crime were one of the main motives for the investment and implementation of predictive policing in several countries, including the Netherlands. The pre-formulated hypothesis regarding the effect of predictive policing upon police effectiveness was, therefore, also positive. The first hypothesis was therefore formulated as:

H1: The use of predictive policing technologies will increase the effectiveness of the police organisation in terms of dropping crime rates.

Based on the interviews held with the experts, it can, however, not be stated that there is enough evidence that the implementation and use of predictive policing, in particular the CAS, is responsible for drops in the crime rates for traditional crimes like burglary. The first hypothesis can, therefore, not be confirmed.

6.2. Efficiency

The efficiency narrative

Besides the presumed effectiveness of the implementation of the predictive policing strategy, increased efficiency is the second most mentioned reason to make more use of forecasting models. The idea of predictive policing often reappears in times of budget cuts, the time when the public sector often chooses to focus on the NPM philosophy (Appx. D). According to

Spithoven, the NPM way of thinking is still rampant within the police organisation. However, it would mainly be problems such as an ageing population and a shortage of skilled personnel that push the organisation into a kind of permanent institutional crisis while expectations remain high (Appx. D*). "A continuous pressure really on capacity and overflow of work and a pressure to keep up and work efficiently"* is what Spithoven describes it as (Appx. D, par.24). The argument behind the efficiency claims thereby refers to the fact that it would ultimately be advantageous if one could use the technology only to deploy the police where it is expected it will be necessary (Appx. C).

Efficiency in practice

Investing in the development of the CAS costs many resources, while one should consider that one can not always expect immediate returns when investing resources or time (Appx. B). According to Spithoven, the flexibility of the implementation and the extent to which the professional is ultimately supported by the system are, therefore, also important factors when evaluating predictive policing (Appx. D). However, just as it is empirically difficult to prove the effectiveness of predictive policing, it is practically impossible to prove the efficiency of this story with figures (Appx. D).

Spithoven describes the idea of the CAS flex team, a team of officers that would only be deployed based on CAS predictions instead of being part of a fixed neighbourhood-based team (Appx. D). Although, in theory, if one would indeed get the officers at the places where the CAS thinks the risks are the highest, the organisation would be more efficient by not wasting staff less risky places. However, Spithoven also refuted this argument by telling that this line argumentation would imply that the regular officer in the area would not be able to be at the right place and time if the CAS would not be in exitance (Appx. B). Moreover, according to Spithoven, there is already an enormous overflow of case history available in the urban setting to guide officers. Therefore, also for efficiency, there is the presumed effect that can not yet be substantiated in practice (Appx. D). Gstrein, therefore, notes that it, in a way, it could be seen as actually very naive to put so many resources into the CAS system and the accompanying narrative (Appx. D).

Potential Support

Overall, all respondents hinted that they do not believe that using the CAS or predictive policing, in general, is able to eliminate any capacity issues (Appx. B; C; D). Spithoven thereby emphasizes that we cannot yet afford to have fewer police officers and that we should certainly invest in new personnel (Appx. D). However, there does seem to be potential to combine the act of predictive policing with a more community policing strategy (appx. D). Strikwerda further explains hereby that the CAS can be used to alert citizens themselves when residing in a high-risk area (appx. C). For example, if a CAS analysis shows that there is a high risk of burglary in a particular neighbourhood, this can be shared publicly via social media and in neighbourhood watch apps (appx. C). In this way, the police can call on citizens to pay extra attention within a specific time frame and to act quickly in suspicious situations instead deploying in extra people themselves (appx. C).

Gstrein foresees an overall pivot shift away from predictive analytics and capacities and being able to predict things towards thinking more about information sharing and networking as effectively as possible (Appx. B). As an example, one can think of the already existing "driehoek" (triangle) consisting of the local police, mayors and the public prosecution office in crisis situations (Appx. B). The point of Gstrein here is that in a centralised country such as the Netherlands, it would be relatively easy to access multiple national databases while the system can combine and analyse these data pointing out potential risks. Gstrein adds: *"And that is what I found really really interesting because it is still based on this idea of predictive policing and data analysis. And all of this plays a role, but it only plays a role"* (Appx. B, par. 19, col. 138). Therefore, if the focus were more on knowledge collection, information sharing, and making an attempt to include the appropriate parties, the police's goal mission to fight crime and guard the public order may be supported in a more indirect way.

Conclusion

Next to an improvement's effectiveness, increased efficiency plays a part in the overall expectation of better police efficacy through the implementation of predictive policing software. This should mainly manifest itself in better estimation of where, when and how many men should be deployed to prevent crime. The pre-formulated hypothesis regarding the effect of predictive policing upon police efficiency was, therefore, also expected to be a positive relation. The second hypothesis was therefore formulated as:

H2: The use of predictive policing technologies will increase the efficiency of the police organisation.

Similar to the outcome of the first hypothesis, the interviews do not provide the necessary evidence to claim that the efficiency of the Dutch police organisation has significantly improved since the national rollout of the CAS system. When the average police team is not fully committed put its teams almost exclusively on the places predicted by the CAS system, for example, by having CAS flex teams, it can be concluded that the investments in the system do not outweigh the possible time and resource gain yet. The second hypothesis can therefore, in the light of the efficiency operationalisation, not be confirmed.

The respondents, however, do not think that the investments in the data collection and analysis should be seen as completely wasted. In the case of risk, other actors can also play a role in the prevention of crime, such as the citizen him/herself. Instead of continuously deploying flex teams in places where an expected high risk applies, more can be done to warn residents at risk or to be able to quickly pass information on to other safety authorities in order to be able to act more quickly if necessary.

6.3 Legitimacy

Transparency and accountability

A much-heard argument against the use of algorithms, in general, is the lack of transparency. As described in section 3.1, the algorithm using various sources of data and variables to formulate its predictions is like a black box, making it hard for non-technicians to understand on what basis predictions are created on which operational decisions are made (Ferguson,

2017, p.136; Gstrein et al., 2019; Moses & Chan, 2016). The question that thereby arises is about who should be responsible for these presumed unexplainable decisions. During the interviews, the respondents were asked about their perception of algorithmic transparency and who should be held accountable for the final decisions made based on the algorithmic procedure.

Strikwerda gives a clear answer regarding the definition of transparency in the predictive policing context. *"The moment something is public, it is transparent",* Strikwerda states (appx. C, par. 92). On this basis, one can conclude that when one does not want to want to make the variables for the forecasting model publicly, it is considered not transparent (Appx. C). Following the line of thought of Gstrein, the argumentation for not being transparent can be understood in the way that the police do not want to share their modus operandi with (potential) criminals (Appx. B).

However, the transparency discussion regarding the CAS in this sense does also resonate with the more general discussion of whether algorithmic transparency will actually lead to more transparency and trust in the organisation in general (Appx. B). Revealing the variables that the system works with does namely not explain the procedure in which the variables are used and understanding this process would need specific expertise. Gstrein says about this:

"I am not sure about this in general because, I think to really understand and scrutinize those variables, you have to be extremely digitally literate. You need to know a lot about the technicalities of the system and technology, how it works, etcetera. And most people are simply not" (Appx. B, par. 57).

Strikwerda also points out that in the case of a machine learning algorithm that is implemented, it is actually not even possible at all to understand what is happening, even if the default variables are published. *"But in itself, it is, of course, a problem that you have a self-learning algorithm. Especially if you are going to apply all kinds of machine learning and such. Then as a human being, you can no longer check what that computer exactly is."* states Strikwerda (Appx. C, par. 96).

An important note by Spithoven is, however, that it would be too simplistic to assume that the CAS predicts crime like that as a machine learning application (Appx. D). Spithoven summarizes the process of the CAS as follows:

"The CAS actually indicates where historically it is most likely that the most crime of a certain type would arise in a certain temporal and geographical distribution. And that is also based on cohesion and an algorithm that I know and which is not really rocket science" (Appx. D, par.14).

This comment form Spithoven provides an important insight into the current sophistication of the CAS. At the moment, the CAS is not yet an actual machine learning algorithm that is used for effective predictive policing but rather is supported in real-time policing (Appx. D). Gstrein and Spithoven, thereby, both express their preference for the in-house developed CAS over an external programme such as HunchLab (Appx. B; D). Gstrein states that the more an organisation externalises software development decisions, the more likely it is that the organisation does not actually understand what is happening or why you are using the software (Appx. B, par. 72).

In terms of accountability, all experts, therefore, agree that humans should always remain accountable for the system outcomes and that one can thus not hide behind the technology itself (Appx. B; C; D). Since more and more political influence has been exerted on the police apparatus since the nationalisation of the police, including the need to look at such predictive policing systems, Spithoven places some of the responsibility on the Dutch House of Representatives (Appx. D). Normatively, Spithoven, therefore, thinks that the House of Representatives should monitor this more closely, even though most members of parliament do not yet have the know-how and the capacity for it.

Gstrein, however, understands that from an outsider's perspective, it will always be more challenging to understand what is going on inside an institution carrying out intelligence work due to its secrecy (Appx. B). Politicians are also too far removed from this to really understand the technical details to get to the heart of the matter (Appx. B). Gstrein, therefore, believes that accountability should lie in the organisation itself, understanding its practices best (Appx. B). However, there is an important condition for this. Namely, the public and politicians must allow sufficient organisation autonomy, time and money to think about difficult questions such as: "What does it really mean for us as an organisation?" and "Where does it work and where does it not work?" (Appx. B, par. 67). This also requires a culture of checks and balances and where it is accepted to be critical (Appx. B). In that case, it is quite improbable that you would find yourself in a situation in which technology is thrown upon society (Appx. B). People who are only following the computer's instructions since they have

no genuine understanding of how to operate it (Appx. B; C). Unfortunately, the practical feasibility of this idea does seem far off (Appx. B).

Bias

The second well-known argument against algorithms and predictive policing is the likelihood of certain biases resulting in the stigmatisation of certain groups or individuals (Meijer & Wessels, 2019). Now, it should be taken into consideration that the Dutch CAS makes up its predictions in temporal and geographical distributions (Appx. D). As the CAS does not address any specific individuals when making predictions, there is no question of explicit person-based predictive policing. As a result, the algorithm may be superior to the police officers themselves pinning maps or listing known individuals (Appx. C).

However, according to Strikwerda, one should look further at the other variables on which the time-based and place-based predictions are based (Appx. C). Even though the main focus is not on it, Strikwerda namely still warns against any underlying selections (Appx. C).

"But I think that with those variables you also have to have a lot of understanding of "how does this work exactly? Are there not also hidden, say, you can also select something which ultimately comes down to nationality or ethnicity or origin, while that is not very clear" (Appx. C, par. 95).

In addition, one can argue that it is the potentially biased Dutch police force which created the algorithms or those prediction models, making it possible that prejudices are transferred into the algorithm (Appx. C). As an example, both Gstrein (Appx. B) and Strikwerda (appx. C) refer to a past police experiment in Roermond called 'Sensing'. According to Strikwerda, 'Sensing' is another type of predictive policing tool that selects suspicious license plates for cars which may have to do anything with shoplifting (Appx. C). Despite that the nationality of the persons in the car was not a variable by itself, German rental cars and Eastern-European license plates were the indicators, based on the presumption that mainly people from the Eastern Bloc commit these acts (Appx. C).

Conversely, Strikwerda foresees that the algorithm can also presumably colour the agent's gaze. "So, if you walk through a neighbourhood that you think is at a very high risk of burglary, you will also interpret things in that light. And if someone comes by with a large weekend bag, you may be much more inclined to do a bag check than elsewhere", states

Strikwerda (Appx. C, par. 55).

Lack of democratic legitimation

Whereas in previous paragraphs the input of the interviewees about possible problems that are often involved in the discussion was mainly discussed; it is also important to go back to the core of the concept of legitimacy, as explained in chapter 4. As stated in that chapter policing becomes legitimate when it conforms to established norms and values, when it is justified by shared beliefs and when the subordinated party has consented to it (Beetham, 2013). As the Netherlands is a democratic country, this would imply that the citizens subject to the Dutch police should have their (indirect) say when implementing such systems. This is the point where one should carefully consider whether the perceived benefits in effectiveness and efficiency are worth it and fit within the norms and values (Appx. C).

Especially Strikwerda (appx. C) and Spithoven (appx. D) are hesitant about the attitude of citizens towards simply accepting new developments. Spithoven brings up our relationship with the smartphone, not correctly understanding that we do not sufficiently think about the impact of the technology on our values of privacy and other matters, just because it connects us and makes us feel better (Appx. D). Strikwerda thereby adds that filling everything up with cameras, following people and making all kinds of predictions can eventually, in contrast to this freedom, give an oppressive vibe, not knowing whether people would realise that (Appx. C). Gstrein, therefore, describes that matters as predictive policing are highly connected to societal trust (Appx. B).

Next to the note that the general public should think more about the democratic constitutional state, the Netherlands and digitisation, according to the experts, more space should also be given to this kind of fundamental discussion (Appx. B; C; D*). "And it has to be, because society is digitising, and you cannot stand still. But if we really want this to be part of police practice, we must have had a fundamental discussion about it",* summarizes Spithoven (Appx. D, par. 60). Now both Strikwerda and Spithoven note that within the academic world there is already much more attention for predictive policing, including the field of public administration and law (Appx. C; D). However, the current problem is that the translation of that theoretical thinking toward understandable practice just does not seem to be there yet (Appx. D).

However, in the context of democratic legitimisation, we must still be able to have an opinion about those things and thus be able to have an opinion about them (Appx. D). According to Spithoven, this, therefore, requires different mechanisms of accountability and transparency, partly because politicians are unable to make a sound judgement (Appx. D).

"Yes, I would welcome it if there was just more of a public debate about it, huh? If you're really a tough cop, you do it at the local level. Invite your citizens to the city of: "By the way, we are working on this, what do you think?" And [then] you are actively involved in that, in order to also seek out the debate from within the police and you are busy telling what you are doing. Then you are in a kind of continuous dialogue", states Spithoven (Appx. D, par.96).

Spithoven continues by stating that during and after the necessary democratic legitimisation process, one should thereby be transparent about the involved elements and expectations evaluations, and it should be possible to enable the critical thinking ability beyond effectiveness and efficiency (Appx. D). The question of Gstrein, however, remains to what extent one can engage the community, assuming that it is too utopian to believe that every voice will be heard. Gstrein, therefore, concludes that we should suffice with a sort of privileged access for those who really know what they are talking about, a community which is interested in a safe and secure environment (Appx. B).

Organisational police culture

Not only the citizen is subordinated by the predictive policing practices. Also, the street-level officer also must deal with the strategic plans of the top management and is therefore also subject to the orders arising from the CAS.

From the interview conversations, it has become clear that the image of the police officer, as described by Waardenburg et al. (2020), can be confirmed. Police officers are people who rather act than think. What they do is very much based on gut feeling. "Dit is een vak waar je waar je in moet groeien", says Spithoven (Appx. D, par.12). As a result, Gstrein noticed during his own research during the cutting crime impact project that there was only little engagement among officers regarding the actual usage of the predictive policing directions (Appx. B). Spithoven says that most officers just give up when they feel that the decision is thrown at them from above under the guise that the system can predict crimes:

"Actually, already on gut feeling, it doesn't work well. In the conversations I have had with people who have worked with it or should work with it, they actually say as the police do in plain terms; "It's just bullshit. You cannot predict this" (Appx. D, par.14).

Gstrein noted, however, that it cannot simply be said that all police officers do not believe in the power of prediction (Appx. B). Although there is only a minority of the officers who are really eager to work with the CAS, they will still be very selective on what to devote attention too, meaning that this technology really needs to prove valuable to them (Appx. B). The problem is that many reject the idea before they even delve into it, as it seems that the predictive models go against the norms and values of the officer's craftsmanship which is mostly based on their gut feeling (Appx. D). According to Spithoven, this proves once again that it is essential to actually involve the implementing side in the development of such systems from the very start because there is support for that, and you could be in much trouble during the implementation (Appx. D).

What therefore stands out is that regarding the legitimacy both within and outside the police organisation, there seems to be a lack of sufficient knowledge and involvement from the actors outside of the police top and data analysts that eventually do have to deal with the software (Appx. B; D).

Conclusion

As a public organisation, it should be especially important for the Dutch police organisation to balance out the political will versus the accepted organisational and societal norms. As Wallner (2008) states, the legitimacy of the organisation is dependent on the subjective interpretations found in the general views and perceptions of the subordinates. Due to the amount of attention spent both in the literature and society in the past years concerning a presumed lack of transparency, unclear accountability and chance of bias; it seemed likely that the legitimacy aspect of the police organisation would cause the organisation's image of legitimacy to suffer from the implementation of predictive policing. The third hypothesis was therefore formulated as follows:

H3: The use of predictive policing technologies will decrease the legitimacy aspect of the police as an organisation.

Based on the interviews held with the experts, it can indeed be stated that in the implementation of predictive policing, the CAS does not only seem to be actively compliant with the norms and values of the democratic state but also non-compliant with the values and the well-established modus operandi of the street-level officers. As a consequence, when expressing the level of legitimacy as this compliance with the shared norms among the subordinated, the level of legitimacy can only decrease.

As expected, with innovations such as predictive policing, specific threats should be accounted for. Full transparency seems to be an unachievable goal due to the secrecy of the police organisation. On the other hand, simply revealing the variables with which CAS works does also not seem to be a complete solution due to a lack of subject-specific knowledge among the general public. Due to this lack of overview and understanding, it can not be entirely ruled out that there may also be bias in the system. The ambiguity and lack of knowledge make it hard for citizens to have a well-formed opinion and thus check whether the newest developments fit societal norms and values.

6.4 Legality

Regulation

It is the legal aspects and legislation which determine the frameworks within which the police organisation must act (Rienks, 2015). Despite the fact that the police also have special powers from a legal point of view to support the investigation, they also have to comply with the applicable law such as the Police Act and Criminal Code (Grapperhaus, 2020).
In the context of continuous developments in the field of digitalisation and safety, all the respondents referred to the rule of law and the position of predictive policing in this. According to Strikwerda, the collection of digital data by itself in the modern days should not be legally treated much differently than how one collected data physically in the past (Appx. C). Where the police used to come out with crates full of paper, it now mostly concerns the data from a USB, laptop, or smartphone (Appx. C).

"Traditionally, the lawyer would say, OK: 'Where is the legal basis?'; 'What can you do?'; 'What are the competencies?'; 'What can you not do?'; 'What are the restrictions?' and 'Based on the rule of law, what can this be used for?' That is it.", states Gstrein about the legal competencies of the police force.

In general, the tasks and powers of the police are also clearly laid down in the law when it comes to their legal task of providing assistance to those who need it and enforcing the legal order (Appx. C; D). This last note is, therefore, precisely the area of tension. Despite the fact that the enforcement of the legal order can be interpreted in different ways, it mainly indicates a reactive function (Appx. D). According to Spithoven, the police, therefore, do not have the legal task at all to work predictively and should therefore not be able to do this at all (Appx. D). Strikwerda, however, notes in this regard that the police organisation specifically invokes their general supervisory powers for these practices, which do allow them to stop and check someone (Appx. C). Legally speaking; however, the control powers of the police are not the same as starting an investigation (Appx. C). However, predictive policing would mean that one is using the power of inspection actually to start an investigation, notes Strikwerda (Appx. C). Both Strikwerda and Spithoven, therefore, resent the fact that the police use methods that are not legally defined, to which Strikwerda adds that the presumption of innocence can certainly be jeopardised (Appx. C; D).

Partly because police powers and criminal law still leave a lot to interpretation, other matters such as human rights and privacy legislation with regard to predictive policing are often considered. For example, Strikwerda claims that there are also dangers lurking for the rights to privacy, non-discrimination and stereotyping and the like (Appx. C). On the basis of these rights, people can go to court, after which a decision must be made about whether someone has really been harmed (Appx. B). For example, following a lawsuit against SyRI[4] by a privacy organisation, the civil court ruled that this programme had to stop (Appx. C). However, Gstrein also notes that when we have to talk about more general issues like human rights, this is a clear indicator of a lack of more specific legislation and that we can only think of principles and regulations about how this *should* actually be done (Appx. B). In practice, the lack of a specific legal framework regarding new proactive police practices seems to give the police room to experiment with new methods, but on the other hand, the same lack of a legal framework may cause these developments are not sufficiently led in the right direction.

[4] SyRI, abbreviation for Systeem Risico Indicatie [Systematic Risk Indicator] was a legal instrument that the government used to combat fraud in, for example, benefits, allowances and taxes (Rechtbank Den Haag, 2020). The Dutch court concluded that the SyRI legislation in its form did not withstand the test of Article 8 paragraph 2 of the ECHR (Rechtbank Den Haag, 2020).

Proportionality

When an organisation tries to do predictive policing, the first thing one wants to turn to is all the historical crime data and other data you can get, says Gstrein (Appx. B). In the Dutch context, the police would be able to gather a fair amount of personal data from multiple governmental agencies and statistical offices (Appx. B). Gstrein describes it as following: *"In a Federated system such as in Germany, where there is a lot of talk about competences and the "who can do what?" and the relation between the federal state and the national state. Then you just have more of a tendency to use less data. Because every time you want to tap into a National Register or European register, it is a fight over competencies, and you have to have a long debate about whether you can do it or not. In the Netherlands, however, the situation is so different because the standard of aggregating administrative data is on a national level"* (par. 49).

As a result of having national-level registers in combination with the police being a national entity, the tendency to put data sets together is much higher, especially within a strong culture of thinking about efficiency (Appx. B). An important legality aspect for the respondents was, therefore, also the proportionality in regard to predictive policing. Does the end justify the means? Strikwerda indicates that she clearly draws the dividing line at the point where people could be arrested or convicted purely on the basis of the prediction models working on aggregated data and specific variables which we cannot understand (Appx. C). Specifically, in person-oriented cases, the chance that the right to privacy has not been respected is very high, while a judge cannot properly assess whether this has been proportional (Appx. C).

In the Netherlands, however, person-based predictive policing is not yet an issue in the Netherlands (Mali et al., 2017). The important thing, according to Gstrein, is that it should be debated whether to blanket ban person-based policing systems in all circumstances (Appx. B). All in all, Spithoven thereby states that one should not instantly wipe out the whole concept of predictive policing (Appx. D). "[I] am the first to say that we have to do that in a balanced way. Certainly, with a focus on the foundations of the democratic constitutional state.", says Spithoven (Appx. D, par. 8).

For further application and developments in the field of predictive policing by the police, both Gstrein and Spithoven, therefore, suggest having a kind of legal room for experimentation for a certain period while giving the organisation a certain degree of autonomy and money to think about what predictive policing can be worth to the organisation (Appx. B; D). Gstrein describes that in a situation where the police are granted the necessary time and recourses, it

will be "*very unlikely that you end up in a scenario where technology is just being dropped upon [us]. People who do not really know how to use it, and they are doing things because the computer tells them to."* (Appx. B, par. 67).

Conclusion

According to the police organisation, the use of predictive policing is subject to the same rules and laws that the rest of the police organisation works with. It is presumed that a public entity like the police uses the applicable laws as a guide to enable the police to function with the aid of predictive policing while also keeping it at a level that is acceptable. Unlike SyRI, no legal ruling has been made on a ban on CAS. Therefore, up until a judge declares the current practices of the police organisation unlawful based on any other legislation, it should be possible for the police to proceed with their current practices in a legal manner.

The formulated hypothesis regarding the legitimacy dimension was as follows:

H4: The use of predictive policing technologies enables the law enforcement agencies to execute their proactive capabilities while being compliant with the rule of law.

Given the current status of the advancement of the CAS system, together with the fact that analysed data does not target individuals, it can be concluded that the current way of working with CAS does fit within the current frameworks of the (police) law. What did become clear from current legislation, however, is that not all resources may be added to the prediction software. Although it may be tempting for the police to collect as much data as possible from national authorities and use it in the context of effectiveness and efficiency, there are still legal limitations. In the absence of a court decision and specific legislation, however, it remains a guess which interpretation of predictive policing should apply and thus were those limitations precisely lie.

Still, the lack of clear and more specific regulations regarding predictive policing does not hinder the police's practice. While the respondents were critical of this lack of clear guidelines, they were also not in favour of a complete ban on these practices. To make any further development of predictive policing, one will therefore need to wait until the legislation has been amended in such a way that it can be used as a guideline for both the development and the limitation of this new form of police action.

In the end, therefore, it can be stated that the current predictive policing practice does indeed make the Dutch police as proactive as they can be while still being compliant with the rule of law. Given the impact of predictive policing on the police organisation, the hypothesis can therefore be confirmed, mainly on the basis of the police organisation's own interpretation of the law.

7. Discussion and Conclusion

Focusing specifically on the Dutch predictive policing tool CAS, this thesis has described predictive policing as part of the shift from reactive policing towards the practice of more proactive policing. In general, predictive policing entails obtaining information from many sources, analysing it, and drawing conclusions to anticipate better, prevent, and address future crimes. For this study, therefore, qualitative research was performed to assess the impact of using predictive policing software. More specifically, it was investigated to what extent the four performance dimensions of effectiveness, efficiency, legitimacy and legality of the Dutch police organisation are affected by predictive policing. The accompanying research question addressed in this thesis was therefore as follows: *How does predictive policing impact the performance of the Dutch police forces?*

It was hypothesized that the overall organisational performance would be favoured by using predictive policing to increase organisational effectiveness and efficiency within the current legal frameworks. Despite the expected legitimacy-related disadvantages, the balance would therefore favour the positive impact of predictive policing.

Overall, the interview results showed that the overall impact of predictive policing on performance does not appear to be as great as was expected by the researcher at the start of the study. During the interviews, it became clear that the implementation of predictive policing is related to the expectations of increasing effectiveness and efficiency based on the narrative that working with new technologies will instantly increase organisational efficacy. An expectation is in line with the new public management philosophy in the policing context, as described by Hodgkinson et al. (2019). In line with the mixed results in the (empirical) literature, the interviews reflected ambiguity as respondents were dubious about the effect of predictive policing on potentially declining crime statistics. In addition, it cannot be proven whether the system ensures that police forces are in the right place and time more often than before implementation. Although the interviews' results may disprove the truth of this narrative, it is still debatable how effectiveness and efficiency can best be measured in practice, as no method is described as perfect in the literature yet one can imagine that a decrease in crime statistics can be caused by several factors rather than predictive policing software.

Furthermore, there are still points to discuss regarding the legitimacy and legality dimensions. Corresponding with the work of Ferguson (2017, p.191) and Moses and Chan (2016), it was

expected that the legitimacy of the police as an organisation would be negatively affected due to the lack of clarity regarding the principles of accountability and transparency in combination with a fear of algorithmic prejudice. However, when one looks at the broader process from the data collection stage towards the actual police intervention stage, the argument that purely the algorithm is the culprit may be regarded as too short-sighted. Ultimately, the algorithm is only one part of the entire process in which continuously choices have to be made about which data is and is not relevant enough to ultimately make it into briefing to the street-level officers, as described by Waardenburg et al. (2020) and Mali et al. (2017). This observation is in line with the work of Ferguson (2017, p.132) and Moses and Chan (2016), who expected that in reality, one instead needs to settle for "good enough", acknowledging that the system is not perfect. Less expected, however, was the great role of internal legitimacy and the relationship between the more strategic top layer of the organisation and the street-level officers. Although the literature supports that a lack of support can hinder the implementation of changes, the technostress problem was not expected to be present to such an extent within the police organisation. The interviewed experts who had their own experiences with interviewing officers on the subject thereby explained that there is a feeling that a calculation model is replacing their craftsmanship and experience.

Another point of discussion concerns the legality dimension. Although it is possible to operate the CAS system within the current legal boundaries, it is still questionable whether the results also give sufficient reason for claims that predictive policing has made it possible for the Dutch police organisation to maximise their proactivity within the existing legal framework. Although the article of Hoving (2019) has shown that the current legal framework can indeed be applied to the use of the CAS system, the results show that the current legal situation is far from optimal. Due to the current regulations, in which a suspicion does not yet give rise to the legal concept of reasonable suspicion, the police are given the responsibility to confirm these suspicions. In line with the work of Hoving (2019), the law is guiding law enforcement on what can be done with algorithmic predictions and where the legal power of a prediction ends.

However, the results of this study have also shown that there is still a risk that, in the light of the prediction, there will be a proactive search for evidence for this prediction which (unconsciously) could lead to a situation of "predicted guilty until proven innocent" as was described by Gstrein et al. (2019). The main explanation for this mismatch between the predictive policing tool in question and the law is the lack of more specific legislation on predictive policing yet. The absence of a clear legal framework for new proactive police

practices appears to provide the police leeway to try out novel approaches. However, on the other hand, the same absence of a more specific legal framework can also cause friction between the broader, currently applied legal frameworks and the system's further development. In this situation, it is therefore also difficult to say whether the police have the right to, for example, keep system functions or variables secret to a certain extent or whether it is better to make such matters public in the context of transparency.

Despite the fact that the results of this study do not agree with the expected positive impact of predictive policing on police performance, the research also showed that predictive policing should not yet be seen as a lost cause. Especially in these areas of legitimacy and legality, there are possibilities enhance the potential of the predictive policing practice. These changes could, however, not be achieved overnight.

The key point with the further development of predictive policing within the Netherlands is that, on the one hand, there must be more space to experiment with developments. On the other hand, there must also be room to be critical of these developments. This research, therefore, showed that the police organisation, the policymakers and the citizenry should become aware of their role in the development phase in which predictive policing still finds itself. All parties should start thinking about how far predictive policing should go concerning data collection and the legal status of a prediction as potential evidence to have their input in a more open debate.

In addition, the discrepancy between the expectations derived from the New Public Management movement and the results of the research also makes one think whether the evidence-based NPM way of thinking is still of relevance when making decisions about matters potentially influencing the performance of organisations such as the police such as predictive policing. The reason for this note is related to one of the important points that emerged during the interviews for this study and are therefore also included in the results. On the one hand, the potential shift in focus from predictive analytics to effective information sharing and networking. On the other hand, the importance of the involvement of societal actors.

Looking at the phenomenon of predictive policing from the NPM perspective means an expectation and focus on a continuous improvement of the effectiveness and efficiency of public sector performance. In the policing context, scientists and top management of the police continue to focus on the supposed decrease in crime rates that the predictive policing software would bring while this cannot yet be empirically proven. As a result, there seems to

be an ongoing debate about whether the investment in this technology is worth it instead of considering other aspects which predictive policing brings along.

Although in terms of efficacy, predictive policing can still be seen as an innovation helping the police become more effective regarding its operational goal of combatting crime, it should not be considered a new strategy on its own. The study emphasizes once again that predictive policing in itself is neither a goal nor a requirement for the functioning of the police organisation but can rather be a supplement to other policing strategies. A paradigm shift from a specific focus on NPM values towards a more new public governance perspective seems therefore inevitable in the long run both in the scientific world as well as in practice. New public governance, namely, has its focus more explicit on improving any inter-organisational cooperation than NPM which will be essential. Based on the thesis results, it is therefore recommended that the organisation acknowledges its interdependence with other organisations to acquire and share the knowledge as the police organisation is growing its practices of big data and predictive policing. Only by involving the right stakeholders, the police organisation can become an effective organisation in the light of new public governance. This theoretical perspective, however, does also take into account more interaction with the society, and therefore the importance of the legitimacy and legality aspects more into account.
Collaboration between science and the police organisation could lead to new frameworks that can on the one hand develop further on the creation of a suitable evaluation method regarding effectiveness and efficiency and on the other hand, can investigate how citizens and other relevant actors can be more involved in the process.

Limitations

Like any study, also this thesis study has its limitations. The data collection process ended with an imbalance between the respondents concerning their background and experience. All three respondents are employed in an academic setting rather than being active within the organisation under research. Although two of the respondents have been in contact with the Dutch police organisation about this subject several times for their own research, it can not be guaranteed that their information will accurately represent the police organisation.
It is a known fact that it is difficult for researchers and students to get a good picture of what is happening within the police, especially with big data. This is partly due to the secrecy

within the police but also because there is much interest from students and researchers in conducting interviews and surveys within the organisation. Getting in touch with persons within the organisation mainly depends on the contacts who can help you get to the right persons. Unfortunately, it was impossible to plan an appointment with key persons in the limited time frame of the thesis despite the efforts of multiple contact persons. Another point is that the research did purely look at the Dutch police organisation while neglecting any other relevant organisations connected to policing in the Netherlands, such as the Public Prosecution Service, Royal Marechaussee or the tax authorities.

In addition, as is noted multiple times throughout the research, predictive policing is very much context-dependent. As a result, the results of this research can not be generalised on an international scale. During the interviews, some respondents mentioned that the CAS system is received with mixed reactions even within the Netherlands. Some of the police regions barely use the system anymore, while it is in full use in other regions. While the results of this research may answer the question of why certain teams chose not to use the system fully, it does not provide any insights into the differences between multiple regions in predictive policing. It is, therefore, not possible to state that the described impact of predictive policing on police performance is the same in all the regions despite the forces' centralisation on paper.

Recommendations for future research

Like most papers, the goal of this thesis was to make a contribution to the existing body of knowledge regarding the concept of predictive policing and its impact. Throughout those years, many researchers have described the concept and implications of predictive policing in the Dutch, international or more general setting. This case concerned the multiple performance indicators necessary to the police as a public organisation. What makes this research special is that it provides an overview of the new public management-inspired values of effectiveness and efficiency in combination with the societal values of legitimacy and legality to take stock of police performance regarding predictive policing ultimately. Although the thesis was primarily intended to give an extensive overview of the current state of affairs concerning predictive policing in the Netherlands, it does not explicitly contribute to the general need for more empirical research on the effectiveness of predictive policing. The last empirical finding in the Dutch setting was the CAS pilot study by Mali et al. (2017),

published five years ago. For further research, I, therefore, recommend reviewing predictive policing in the organisation in a more empirical way every few years for effectiveness in combination with the other performance indicators. On the other hand, as stated in the limitations section, the use and impact of predictive policing may differ across departments, as it turned out that every department has its own way of working with the software if still in use. Further evaluative research could, therefore, also focus on only one of the departments, gaining more in-depth into the practices of predictive policing within that department.

Furthermore, as predictive policing is so context-specific, it lends itself well to comparative studies. One could, for example, look further into the performance indicators between multiple police forces, such as the relatively unique Dutch context where they use their own in-house system versus international departments using commercial predictive policing systems. Is an in-house system perceived to be more legitimate than software from a US-based company?

As a second point, following the last notes of the discussion section, it is found that the extent of citizen participation in policing plays an essential role in the organisation's legitimacy. Necessary for the police is, therefore, to inform citizens about the processes associated with the work in a comprehensible manner. However, it is still difficult to say how this can best be organised. Therefore, for further study, it would also be recommended to go deeper into the citizen-police relationship regarding introducing new technologies and strategies.

Although these questions were beyond the scope of this work to answer, it does indicate that predictive policing and its underlying concepts still need additional attention and examination from multiple scientific disciplines.

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Appendix

Given the length of the interview transcripts, the full content of the appendix is displayed in a separate document.