Master Thesis

The algocracy

Understanding and explaining how public organizations are shaped by algorithmic systems

The construction of a new ideal type illustrated by the case of predictive policing in Berlin

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Abstract

This thesis develops the algocracy, a new ideal type of rational-legal authority, that helps to understand and explain how algorithmic systems shape public organizations. The construction process entails theoretical and empirical exploration. First, the characteristics of the algocracy are derived from scientific literature and compared to related ideal types: the machine and professional bureaucracy as well as the infocracy. Second, based on the developed characteristics the case of predictive policing at the Berlin police is explored in order to refine the ideal type.

The algocracy draws on automated advice that is based on the algorithmic analysis of data to coordinate social action. Uncertainty that is inherent in expertise-based decision-making is reduced and quantified by algorithmic systems. In this way, non-routine work is standardized in algocratic organizations. This allows a more centralized organizational structure and emphasizes the hierarchical order. Thus, higher levels of control and obedience are achieved in organizations that use automated advice instead of standardization of skills (e.g. by training) as their prime coordinating mechanism. It means that the algocracy is a further rationalized organizational configuration of the professional bureaucracy. This has implications for the performance of professional labor which is subjected to more vertical control and requires more analytical and reflective skills in the algocracy.

These characteristics of the algocracy are illustrated by the case of predictive policing. The Berlin police uses a self-developed system called 'KrimPro' which predicts the risk of domestic burglaries on a spatiotemporal level. KrimPro is operated on a central organizational position. The predictions standardize and formalize the work of the police professionals who plan and decide on operative measures also because the use of the automated advice is promoted by rewards and hierarchical mechanisms. The control of the performance of non-routine work increases and even exceeds organizational boundaries. Thus, the case of predictive policing successfully demonstrates characteristics of the newly developed ideal type; the algocracy.

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Foreword

Algorithmic systems have arrived in our lives. They help us to make everyday decisions, for example, on what to watch on television. Since I have a Netflix account, it is way harder for me to decide what I want to watch. There are just too many options. Luckily, Netflix seems to know about this struggle and automatically offers me some advice. The program tells me which series are in accordance with my taste: BoJack Horseman – 97%, Pokémon: XY – only 61%. I really appreciate this convenience, but how does Netflix do that?

To be able to offer this service, Netflix has been collecting data about my and other users' viewing habits and ratings of movies and series. Then, they have put a machine learning algorithm to work that recognizes patterns in the data and categorizes me based on the data. Finally, it predicts the likelihood with which I would enjoy watching particular series. During my previous studies in the field of media and communication science I would probably have asked: What influence does this algorithmic advice have on people's viewing habits?

But what is in it for the field of public administration and organizational science? The answer is: There is a lot to investigate! Not only corporations like Netflix have understood how useful and powerful tools are, that enable these kinds of predictions, but public organizations have understood this as well. However instead of predicting people's taste in television series, government agencies are interested in predicting risks: When and where is there a high risk for crime? Who has a high risk of becoming an offender? Which tax returns have a high risk of being fraudulent? Which high school students have a high risk of dropout? All these questions and many more can be tackled by algorithmic systems. Due to this diversity algorithmic systems can be found in an increasing number of government organizations in various fields: from internal affairs and security, welfare and social policy, to health care. This raises the question for research in the field of public administration and organizational science: What influence do these algorithmic systems have on public organizations?

1. Introduction

This thesis is concerned with the use of algorithmic systems in organizations and their influence on them. Thereby, a new technology is linked to a long-existing development, i.e., that public organizations make use of technology to carry out their work, which has motivated social science research for a long time. In fact, Max Weber has already characterized bureaucratic organizations as "socio-technical systems" (Dunleavy et al., 2006, p.11). Besides the enforcement of rules by organizational mechanisms, record keeping of official documents and files, the information systems of Weber's time, is one of the defining characteristics of a bureaucracy (Dunleavy et al., 2006). It contributes to the rationalization of decision-making as well as ensures the continuity of the organization and its operation over long periods of time (Dunleavy et al., 2006). The written documentation of decision-making promotes the transparency and reproducibility of decisions which are means to reach a more impartial, continuous, and rule-based exercise of authority. However, they are also tools of control, ensuring the obedience of the bureaucratic organization to its (political) master.

In the wake of computerization, the proliferation of digital IT in public organizations changed the bureaucracy's mode of operation so profoundly that Arre Zuurmond (1994) proposed to refer to it as the infocracy. The advancement of the infocracy compared to the bureaucracy has to be seen in the further rationalization of the decision-making process as information systems consider exclusively all the information that is relevant to the formal decision rule (Zuurmond, 1994). In contrast, human administrators might disregard relevant or consider formally irrelevant information due to errors, negligence, preconceptions, stereotypes, personal motives, or emotions. Moreover, information can be processed in less time than by human administrators, information flows can be steered more precisely, and access can be granted location-independently and simultaneously to multiple users (Zuurmond, 1994). In short, instead of bureaucracy's formal functions as well as internalized and incentivized rules, in the infocracy information infrastructures in which rules are enshrined guide decision-making (Zuurmond, 1994). This means that the structural elements of bureaucratic organizations have changed due to the implementation of information systems so that a new organizational configuration has been created. This new type of organization is called the infocracy.

With algorithmic systems a new type of technology has been introduced to public organizations. The algorithmic systems differ from the information systems that constitute the infocracy. This can be demonstrated by taking a closer look at the functioning of algorithmic systems. Instead of information processing, algorithmic systems draw on advanced ways of analyzing data. At the center of these analytical techniques is machine learning. It denotes the automation of decision-making on how data are to be analyzed and it is the basis for many different practices (Kitchen, 2014). For

example, in the field of data mining and pattern recognition machine learning is used to identify structures in large datasets that seem to be meaningful based on correlations between certain variables (Kitchen, 2014). The tasks of recognizing these patterns and limiting huge amounts of data to relevant relationships can be performed more efficiently by algorithms than by human analysts. This advantage promotes the dissemination of the algorithmic technology which means that an increasing part of information retrieval is based on the automated analysis of data. Large amounts of data are the basic prerequisite for the functioning of algorithmic systems (Kitchen, 2014). Applications that can be attributed to the field of artificial intelligence are said to be trained on data which is a circumscription for machine learning processes as described above, but in more advanced ways (Kitchen, 2014). They need these large datasets to identify relationships that are often concealed or at least not self-evident by applying statistical techniques. This process creates decision trees that are used in dynamic algorithmic models to estimate the probability of a single case's belonging to a certain group defined by a characteristic of interest (Kitchen, 2014). Based on this estimation, algorithmic systems provide advice that can be used in human decision-making processes. Algorithmic systems, for example, can help to answer the above-mentioned question: When and where is there a high risk for crime?

This logic which is based on data, algorithmic analysis, and probability is inherently different from the functioning of both bureaucracy and infocracy. They rely on information about a single case to come to a rule-based decision which is made with absolute certainty given the basis of information. This means that they cannot give answers to the question when and where there is a high risk for crime. A bureaucratic or infocratic question should ask: When and where has crime occurred in the past? Taking the organizational change into consideration that resulted from the implementation of information systems into bureaucracy raises the question: How does this shift in logics and perspectives introduced by algorithmic systems shape the functioning of public organizations?

1.1 Making use of ideal types

Motivated by this question, this thesis will make use of ideal types as a research approach. An ideal type is a thought construct that entails the main, symptomatic characteristics of an empirical phenomenon (Zuurmond, 1994). It can be used to understand and explain cultural developments, or in the words of Weber, it is a "concept with which the real situation or action is *compared* and surveyed for the explication of certain of its significant components" (Weber, 2011, p.51). This purpose is in line with this research's interest in understanding the consequences of algorithmic systems for the functioning of public organizations. An ideal type can, therefore, be understood as a lens looking through which algorithmic systems in public organizations can be studied in practice.

The already mentioned bureaucracy is probably the most prominent example of an ideal type in modern social science research. Nowadays, the bureaucracy seems to be the traditional and almost ever-existing way of organizing government institutions. At the turn of the century, 19th to 20th, however, Weber's bureaucracy marked the most recent and novel stage of a modernization trend that had taken thousands of years. In fact, Weber introduced three ideal types of authority of which the bureaucracy, the rational-legal type, has become the most popular, arguably because it resembled closest the functioning of modern Western public administrations. Power is rule-based and legitimized by the legality of the order, e.g. the functions in an organization. A function holder is allowed to exercise only that power that is assigned to his or her particular function. For example, a superior has authority over the subordinate's professional obligations; e.g. a superior can distribute tasks and oversee their execution. However, a superior has no authority over the subordinate's private life; e.g. a superior cannot decide whether and whom the subordinate must marry. In Weber's other two ideal types, traditional authority as found in tribes and charismatic authority as found in religious sects, a superior might be allowed to exercise this form of power over, what modern Western societies regard as, subordinates' private lives.

This brief example illustrates that the bureaucracy should not be viewed in isolation from the other Weberian ideal types of authority, but it should be contrasted with traditional and charismatic. Only in this way, it is possible to recognize the shifts in logics and perspectives and the consequences for organizing the exercise of authority in society. However, observing the proliferation of information technology in governmental institutions, Zuurmond (1994) found that none of the existing ideal types of authority reflected this development. This makes the ideal types unsuitable for understanding and explaining the consequences of increasing informatization. To be able to explain the shift in logics and perspectives Zuurmond (1994) constructed a new ideal type highlighting the characteristics of information technology in public organizations and their consequences for social action. Again, the infocracy only illustrates this shift clearly when demarcated from other ideal types of authority; especially from the bureaucracy.

As shown above, algorithmic systems introduce a new reasoning to the public administration that is neither reflected in the bureaucracy nor in the infocracy. This makes the existing ideal types unsuitable for understanding the shift and explain consequences for organizing the exercise of authority introduced by algorithmization. Therefore, it is necessary to construct a new ideal type. It must contain the characteristics informed by the increasing proliferation of algorithmic systems in public organizations and it must be in contrast to the ideal types of bureaucracy and infocracy. From this, the following research question can be derived:

What are the characteristics of an ideal type that helps to understand and explain how algorithmic systems shape public organizations?

1.2 How to make use of ideal types

To answer this research question; namely, to develop an ideal type; this thesis will draw on theoretical and empirical explorations. In a first step, literature from the scientific field will be discussed to assess the existing ideal types with which the to-be-constructed ideal type will be compared. The value of an ideal type can only be determined by taking a comparative perspective. Moreover, literature on algorithmic systems and their impact on organizations will be discussed. However, as the phenomenon has only recently emerged, this strand of literature is still relatively young and unconsolidated. Therefore, interviews with academic experts who have conducted research on information and algorithmic technology in the context of public organizations will be held. This ought to ensure the validity of the literature review process from which the ideal type will be constructed. Hence, this part of the research process will be guided by the following sub-question: *What are the characteristics of the algorithmic ideal type that can be inferred from scientific literature?*

In a second step, the theory-based ideal type will be illustrated by means of an empirical analysis. This ought to work out the most typical characteristics of the ideal type. For this, the case of predictive policing at the Berlin police in Germany will be studied. By making use of observations, interviews, and document analysis, an in-depth understanding of the functioning of the predictive policing system 'KrimPro', its use in the organization, as well as the system's effect on the police organization will be gained. For the analysis of the empirical material, it will be made use of the literature-based ideal type. This step of the construction process of the ideal type will be guided by the following research question: *Which characteristics of the algorithmic ideal type are demonstrated by the case of predictive policing at the Berlin police?*

In a final step, the theory-based characteristics of the ideal type will be brought together with the insights from the case of predictive policing at the Berlin police to draw a conclusion and to answer the main research question. The resulting ideal type will promote the understanding of the ways in which algorithmic systems shape organizations. By investigating the effects of this latest wave of technological advancement, the thesis contributes to a long-standing strand of scientific literature that examines the role of technology in public organizations. The ideal type approach has been chosen for this study because it allows a broad assessment of algorithmic systems in public organizations without being technology-determined. This perspective enables the production of well-

funded knowledge that has the potential to inform future research as well as societal debates on what kind of public organizations we want to have.

1.3 Outline of the thesis

The remainder of this thesis will be used to answer the above-presented research questions in the following way. In chapter 2, the research approach will be discussed. This will be done first because the construction of ideal types is not a consolidated research method. Therefore, a research approach that is appropriate for the specific purpose of this thesis must be developed. This will be done in the following chapter. The ideal type construction will be mainly informed by the approaches of Max Weber and Arre Zuurmond.

In chapter 3, scientific literature will be presented. First, the existing ideal types, i.e., machine bureaucracy, professional bureaucracy, and infocracy, will be discussed. They will be used as a frame of reference for the construction of the new ideal type for which literature on algorithmic systems and their effect on organizations will be reviewed. Moreover, the insights gained from the interviews with academic experts will be presented. At the end of chapter 3, the theory-based characteristics of the new ideal type will be demonstrated.

The empirical exploration will follow in chapter 4. After a brief discussion of the predictive policing literature and the status quo of the phenomenon in Germany, the chapter will turn to the case of predictive policing at the Berlin police. First, the police organization will be described. Second, the emergence of predictive policing at the Berlin police will be presented. Then, the technology and usage of KrimPro, the predictive policing system, will be explained in detail. In section 4.4, it will be shown how KrimPro shapes the Berlin police. Finally, results of the empirical exploration will be discussed.

In chapter 5, the main research question will be answered by providing a consolidated description of the new ideal type. In the following sections, the ideal type will be discussed and its contributions to science and society will be explained. Finally, the limitations of this thesis will be described and avenues for future research explored.

This thesis ends with the list of references and three appendices that contain a more detailed account of the expert interviews, the consent form used for the interviews at the Berlin police, as well as a list of direct quotes in their original German version that have been translated for their use in this thesis.

2. Research approach

It is the aim of this thesis to develop an ideal type of organizations that are shaped by algorithmic systems. In this chapter, the steps that will be taken to develop this ideal type will be discussed. Contrary to the habit, the research approach is presented before the literature has been reviewed as this is one of these steps that will be discussed here. This chapter contains two parts. In the first section, the ideal type in its Weberian understanding and its development process are discussed in general. In the second section, the specific steps that will be taken to achieve the research aim, i.e., to develop the ideal type, are presented.

2.1 How to construct an ideal type

This chapter will take a closer look at ideal types in the Weberian sense, what they are and how they can be constructed. To answer these questions, it will be presented on what motives this research approach is based. For this, we will revisit the impacts on Weber's thinking and the conditions under which he conducted his research.

'Methodenstreit'

At the end of the 19th and beginning of the 20th century, the social sciences were having fundamental debates that concerned their relationship with the natural sciences and their methods, the epistemological aim of and the role of values in social science research (Eliaeson, 1990; Bonazzi, 2014). Opposing positions in these debates were taken by representatives of positivism and historicism in Germany (Eliaeson, 1990; Bonazzi, 2014). To break down these complex issues; positivists like Carl Menger viewed the social sciences as not distinctively different from the natural sciences and argued, therefore, that social scientists should use the methods known from natural sciences to build universal and objective social theories and laws (for a detailed account see Eliaeson, 1990). In contrast, historicists like Gustav von Schmoller argued that the social sphere is in fact distinctly different from the natural world so that the social sciences have to have and use their own methods (Eliaeson, 1990). For them, this meant a focus on single cases that were treated as unique instances in their historical contexts (Eliaeson, 1990). Consequentially, they denied "the possibility of timeless, general valid laws and norms" (Eliaeson, 1990, p.16). This epistemological perspective was very limiting as a logical way of aggregating knowledge on a higher conceptual level was missing (Eliaeson, 1990). Concepts were not merely seen as tools of knowledge production, but as real artefacts (Eliaeson, 1990). Concepts and reality were, therefore, indistinguishable (Eliaeson, 1990).

This so-called 'Methodenstreit', the dispute over methods, affected Weber's work. Both schools of thought had considerable influence on him. Weber was a pupil of von Schmoller, but Menger's

school shaped his understanding of theory-building (Eliaeson, 1990). From this position, Weber was able to mediate between the two camps. He rejected the positivistic approach, especially the idea of universal laws in the social sphere, and reformed the historicist perspective, in particular the idea that generalization was not possible in view of unique social phenomena (Bonazzi, 2014). On the contrary, on the basis of generalization and systematic comparison it is possible to gain knowledge about historical epochs, institutions, forms of government, social and political movements, religious convictions or forms of economies (Bonazzi, 2014, p.174). Thus, Weber argues it is possible to come to abstract constructs in the social sciences. This solves the issue regarding reality and concepts of the historicist perspective, but the question remains: How are these concepts supposed to be constructed?

Social action

Before answering this question, it is helpful to turn to the subject matter of the social sciences first which is different from the natural sciences as Weber (2006) argues. Social sciences are confronted with the behavior of humans which is called social action by Weber (2006). More specifically, action is defined as human behavior to which subjective meaning is ascribed by the acting individual (Weber, 2006). In turn, action is called social if the action is geared towards and the subjective meaning is related to the behavior of others (Weber, 2006). Weber (2006) distinguishes four (ideal) types of social action that differ with respect to the actor's reasoning for ascribing meaning to the action:

a) Means-end rational action: The actor acts in a way that he takes for being rational with regard to an to be accomplished goal in the outside world (Bonazzi, 2014, p.176).
b) Value-rational action: The actor acts in a way that he takes for being in accordance with his or her belief in an intrinsic value regardless of the potential consequences of the action (Bonazzi, 2014).
c) Affectual action: The actor acts in a way that is determined by impulses, affects, and emotional states (Bonazzi, 2014, p.177).
d) Traditional action: The actor acts in a way that is determined by internalized habits (Weber, 2006, p.32).

These types of social action are the basis for understanding the meaning of social action, which is the main objective of the social sciences, from Weber's perspective (Weber, 2006; Bonazzi, 2014).

Understanding and explaining

Weber argues, that social sciences have to produce scientific knowledge about social action that can be generalized and empirically verified (Bonazzi, 2014). In order to come to ideally objective statements, to truths, on which in principle everyone agrees, and which can be shared by everyone who wants to understand social action regardless of their personal convictions and values (Bonazzi, 2014, p.175), social action has to be understood and explained. Understanding ('Verstehen') and explaining ('Erklären') are two more fundamental Weberian terms. Weber (2006) distinguishes two types of understanding:

> First, it can mean the situational understanding of the subjective meaning of social action (Weber, 2006). For example, the proficient reader of this sentence understands the meaning of these words.
>
> Second, understanding can also mean the explanatory understanding (Weber, 2006, p.16) of the motives of social action and its subjective meaning in the given context. For example, the proficient reader might not only understand the meaning of these words, but also that the writer has chosen these words to illustrate the differences between the two types of understanding because this distinction is crucial for presenting the following points.

Thus, from Weber's perspective, understanding and explaining are parts of the same process that aims to capture the motives of social action by contextualizing it to reveal its subjective meaning in the given context (Weber, 2006; Bonazzi, 2014). This process can be applied to three different settings (Weber, 2006): First, capturing the subjective meaning and context of a single case. Second, capturing the average meaning of a large number of cases. Finally, capturing the scientifically constructed meaning of an ideal type representing a common phenomenon. Ideal types are the results of a generalizing and comparing research approach focused on the investigation of social action and its attributed meaning (Bonazzi, 2014). The following part will present ideal types in more detail.

The ideal type

An ideal type is defined as a thought construct that entails the main, symptomatic characteristics of an empirical phenomenon (Zuurmond, 1994, p.23). This very general statement requires further explanation as it entails two important aspects:

Firstly, an ideal type is a concept, thus an abstraction of reality (Bonazzi, 2014). All of us use types in our everyday lives to cope with the complexity of reality by simplifying it. When we take a walk through a city we encounter a bewildering variety of people that we do not know. To make sense of

this messy reality we subconsciously categorize people according to characteristics that we take for being typical for a certain group: a businesswoman wearing a pantsuit and carrying a briefcase, a tourist in casual wear and with a city map, or a homeless person in worn clothes carrying his few belongings. And we have certain expectations associated with every group: The businesswoman might be in a hurry, so we expect her to engage with other people on the street as little as possible. Other the tourist and the homeless person. We expect that the tourist might ask us for directions or that the homeless person might ask us for money. We behave accordingly.

Secondly, an ideal type is a particular kind of type which is marked by the first part of its name which must not be understood as a normative attribute. An ideal type is not an optimal or best version of a phenomenon. In the words of Weber (1904, p.57): “An "ideal type" in our sense (…) has nothing to do with any type of perfection other than a purely *logical* one.” This means that the ideal type highlights those characteristics that are at the core of the empirical phenomenon and leaves out irrelevant characteristics. The main characteristics must be logically coherent and consistent. Due to this “conceptual purity, this mental construct cannot be found empirically anywhere in reality” (Weber, 2011, p.48). This means that ideal types are not used to classify empirical phenomena, but to compare them to reach a more in-depth understanding (Bonazzi, 2014).

Thus, a type depicts (a simplified) reality, whereas an ideal type transforms reality (Kim, 2017). Another way to think about ideal types is a mathematical function, for example, a regression line. The regression function transforms empirical data into a model. On a scatter plot, the data points do not lie on the corresponding regression line, but the function helps to understand and explain the data. Precisely this is also the purpose of an ideal type. Even though it is not a way of analyzing data statistically, it provides a qualitative approach (Bonazzi, 2014).

The purpose of the ideal type is to help understanding an empirical phenomenon by depicting a logically coherent version of the phenomenon (Weber, 2011). In this way social action can be understood in its particular context, compared and typical patterns identified (Weber, 2011). An ideal type is useful as long as it fulfills this purpose (Weber, 2011). Therefore, an ideal type must not be seen “as an end but as a *means.*” (Weber, 2011, p.50) Thus, one empirical phenomenon can be represented by many different ideal types. “*Each* of these can claim to be a representation of the "idea" (…) to the extent that it has really taken certain traits, meaningful in their essential features, from the empirical reality of our culture and brought them together into a unified ideal-construct.” (Weber, 2011, p.49)

The construction of ideal types

As shown above, Weber used ideal types in his research and reacted thereby to the methodological and epistemological debates of his time. However, his work should not be mistaken for "a systematic epistemological treatise" (Kim, 2017). In fact, ideal types were rather a pragmatic research approach for Weber (Kim, 2017). This is also in line with his not always consistent conceptualization of ideal types (Eliaeson, 1990; Watkins, 1952). Instead, "Weber regards his ideal-type as a codification of a procedure in use, nothing that he really himself invented" (Eliaeson, 1990, p.22). This procedure is described by Weber, for example, in his essay 'objectivity in social science and social policy' like this:

> "An ideal type is formed by the one-sided *accentuation* of one or more points of view and by the synthesis of a great many diffuse, discrete, more or less present and occasionally absent *concrete individual* phenomena, which are arranged according to those one-sidedly emphasized viewpoints into a unified *thought* construct." (Weber, 2011 p.48)

This accentuation is done by the so-called stylization ('Steigerung') which "is the most important characteristic of the ideal type" (Eliaeson, 1990, p.23). As described above, the ideal type is not a description of reality, but a transformation into a logically consistent version of an empirical phenomenon which will therefore never be found like this in reality. This is done by stylization which is the "purposive overstressing of typical elements, making them over-explicit for demonstrative purposes" (Eliaeson, 1990, p.23).

To build this accentuated concept, Weber makes definitions in "formal, legal, or institutional terms" (Bonazzi, 2014, p.180) by "listing the fundamental social conditions (rules, norms, expectations, functional mechanisms and logics)" (Bonazzi, 2014, p.180). Moreover, he includes "the economic and technical conditions" (Bonazzi, 2014, p.181) that allowed the phenomenon to emerge as well as "the potential consequences (…) in economic or social regards" (Bonazzi, 2014, p.181). These conditions illustrate the many requirements that have to be satisfied in order that a social order is called bureaucracy, as it will be shown in the following chapter. By gradually adding characteristics to the ideal type that become increasingly specific a more and more detailed construct is formed (Bonazzi, 2014). That means that the construction of ideal types is done by generalization and by individualization (Bonazzi, 2014). If a high degree of individualization seems necessary, this leads to multiple ideal types or sub-types that differ on particular aspects (Bonazzi, 2014). However, only discrepancies from the ideal typical characteristics that seem of crucial importance should be taken for a reason to construct a separate ideal type (Bonazzi, 2014).

Where to start with the definitions and increasing characterization of the ideal type is determined by the question and aim of the research (Zuurmond, 1994). Additionally, the researcher can make use of

his or her “fantasy, personal experiences, and intuition” (Zuurmond, 1994, p.26). However, as the ideal type requires logically consistency and as it will be judged by its usefulness with regard to understanding and explaining empirical phenomena, the utility of inputs from these sources is probably limited. Consequentially, the construction of ideal types is primarily based on the analysis of cases in their historical context, findings from scientific literature, and insights from policy documents (Zuurmond, 1994, p.26). Moreover, Weber presented the ideal types to and discussed them with academic and political experts (Zuurmond, 1994).

In the first section of this chapter, the ideal type in its Weberian understanding has been discussed. To do this, the historical context in which the ideal type originated has been presented. Moreover, the basic Weberian concepts of social action as well as understanding and explaining have been introduced. Finally, a general way of developing an ideal type has been presented. In the following section, this approach will be further elaborated and specified for the actual construction of the ideal type which will follow thereafter.

2.2 How this ideal type is constructed

After illustrating the historical background and the influences on Weber’s ideal type and its construction in the preceding part, the following section will illustrate which steps will be taken to construct an ideal type in this study. The process is thereby closely orientated towards what has been described above. In particular, the construction will be undertaken in two stages:

Literature review

As described above, ideal types are a way of abstraction; i.e., building a higher-level construct. To do this, in the first step insights will be drawn from academic literature. Existing scientific knowledge will be used to make definitions of the, especially social and technical, conditions that seem to be the basis for the phenomenon in question. This will result in a range of characteristics that define the ideal type.

Scientific literature will be selected on the basis of this purpose. Therefore, instead of a systematic review, this thesis will make us of literature that is beneficial for the construction of the ideal type. This means that literature is then especially suitable if it highlights the characteristics of either bureaucracy, infocracy, or of the to-be-constructed ideal type or if it already makes assumptions or presents evidence about the differences between these ideal typical phenomena. Literature will be obtained from keyword searches on google scholar and in scientific journals, from references in the

already included literature, and from recommendations made by academic experts from the relevant field.

Academic experts play an important role in the literature review also beyond this. Informal interviews with them will be conducted to discuss the insights drawn from the literature review. This is done to evaluate the findings of the literature review as this is an important step for the construction of the ideal type. Furthermore, the field that investigates the use of algorithmic systems in organizations and its effects is growing, but still relatively young which therefore lacks a consolidated corpus of literature. Literature is contributed from various disciplines (e.g. data science, computer science, and management) and therefore takes diverse perspectives which can make it challenging to draw conclusions for this work that is rooted in the field of public administration and organizational science. Hence, discussions with academics that are experts on the interplay of information and algorithmic technology and public organizations are regarded as a reliable way to assess the initial version of the ideal type based on the previously conducted literature review.

Experts interviews have been held with prof. dr. Mark Bovens (Utrecht University), prof. dr. Stavros Zouridis (Tilburg University), dr. Marlies van Eck (Leiden University), and Martijn Wessels (master graduate from Utrecht University). All of them have been chosen due to their professional knowledge on IT, automation, and algorithms in public administration. This enables them to critically assess the initial version of the ideal type and to make recommendations on potentially necessary changes to refine the ideal type. Moreover, their expert knowledge of the field and their overview of the scientific literature allows them to assess the use of literature for the development of the ideal type.

Besides the expert, the initial version of the ideal type will also be presented to and discussed with a peer group (three fellow students from the research master public administration and organizational science). This will be done to refine the ideal type with regard to its clarity and relevance not only for the narrow field, but also for the broader public administration discipline.

All interviews were semi-structured as statements about the ideal type were prepared to be discussed (see Appendix A). The outcome of the discussions will be a refined version of the ideal type which will be used in the next step. A more detailed account of this refinement process can be found in the appendix (see Appendix A). In this thesis, text passages that directly refer to statement from the expert interviews are marked with an ‘EI’ plus an identifying number for each of the experts.

Empirical illustration

The second step of the construction of the ideal type is based on empirical findings from a case which fulfills, first and foremost, the function of accentuation (Weber, 2011). As discussed above, this is done by the so-called stylization which describes the over-emphasizing of typical characteristics (Eliaeson, 1990). The characteristics that will have been identified from scientific literature and refined by the expert discussions will then be illustrated by the empirical findings. To do so, the use and effects of KrimPro, a predictive policing system at the Berlin police, will be investigated. This case has been selected as it is regarded as a typical case of algorithmic systems in public organizations. Typical cases are defined as "typical examples of some cross-case relationship" (Seawright & Gerring, 2008, p.297). This case selection strategy is used to purposely identify cases that are "representative of a population of cases" (Seawright & Gerring, 2008, p.300) which responds to the first aim of case selection. Typical cases are chosen when theoretical assumptions have already been made of a particular phenomenon and are to be further explored by means of the case (Seawright & Gerring, 2008). Then, an analysis can be conducted "in which the evidence at hand (in the case) is judged according to whether it validates the stipulated causal mechanisms or not" (Seawright & Gerring, 2008, p.299).

The case of predictive policing in Berlin shows typicality with regard to organizational and technological aspects. For one, the police can be considered an archetypical bureaucratic organization (e.g., police organizations are known for their hierarchical structure) that carries out tasks that are central to a state's functioning, i.e., maintaining and safeguarding public safety and order (Kugelmann, 2012). Moreover, the predictive policing system that has been developed and is used by the Berlin police fits the typical case design. From the technology point of view, KrimPro is an accessible form of predictive policing. Its practical application is not very advanced, but it is rather standard compared to other German states and European countries. Additionally, as KrimPro has been developed internally at the Berlin police and is therefore not proprietary, the Berlin police can share insights into the program and especially the algorithm with researchers. This is a huge advantage over predictive policing systems purchased from technology corporations. However, as the development of the algorithmic system has been oriented towards existing predictive policing software KrimPro makes use of technology, i.e., machine learning algorithms, that is widely used. In sum, KrimPro at the Berlin police appears to be in line with the key aspects of a typical case for algorithmic systems in public organizations.

In order to reach a comprehensive and thorough understanding of the case, research was conducted on site. Acknowledging the organizational diversity, different organizational departments of the Berlin police were visited to get a holistic impression. The combination of interviews, observations,

and policy documents allowed to gain in-depth insights into the organization and the predictive policing system. For the semi-structured interviews, a topic list was prepared. Six interviews have been held with a total of 12 respondents from different levels of the police organization (see table 1). All interviewees gave their informed consent. A protocol (see Appendix B) had been handed out to all respondents to inform them about the research, data protection measures, and their rights before the interview was conducted.

Table 1

Overview of interviews with staff of the Berlin police

Interview number	Number of respondents from organizational level:			
	Leadership	Middle management	Analytical department	Operational department
1	1	-	-	-
2	-	1	-	-
3	-	-	1	-
4	-	-	-	2
5	-	1	1	3
6	2	-	-	-
Total	**3**	**4**	**2**	**3**

Notes: own depiction

After four interviews had been conducted, their outcomes were preliminary examined, and the topic list was adjusted for the remaining two. As interviews 1, 2, 3, and 6 took place at the workstations of the respondents, observations were made, especially with regard to the respondents' use of (the results of) the algorithmic system and computerized information technology. Moreover, documents in particular reports, internal evaluations, presentations and communications were provided in interviews 1, 4, and 6.

As mentioned at the beginning of this section, empirical findings are to be used to accentuate typical characteristics of the theory-based ideal type. Therefore, the ideal type will be broken down into its key aspects, especially regarding its effects on the organization. These will then be used to deductively analyze the empirical material. Methodologically, this analysis is inspired by the type-creating qualitative content analysis (Kuckartz, 2014). This form of analysis is often built on the preparatory work of a preceding content-structuring or -evaluating coding (Kuckartz, 2014, p.115). This will be done here as well. The characteristics that have been identified from the literature review and discussed with the experts will be used as codes. The coding will be performed by means of the software Nvivo.

For example, if the literature review suggests an increasing centralization of organizations that make use of algorithmic systems, 'increasing centralization' will be used as a code to identify corresponding

social action, that has been observed at the Berlin police or reported in the interviews and in the documents, as well as to categorize it. By doing this, each ideal typical characteristic will be empirically substantiated and detailed. Moreover, the prevalence of particular characteristics can be assessed. The analysis will be guided by the following question: *Which characteristics of the algorithmic ideal type are demonstrated by the case of predictive policing at the Berlin police?*

In the second part of this chapter, the approach that will be taken to develop an ideal type of organizations that are shaped by algorithmic systems has been discussed. The research approach consists of two steps. First, a literature review will be conducted that will be completed by interviews with experts who assess the literature-based construction of the ideal type. Second, empirical findings from the case of predictive policing at the Berlin police will be used to accentuate the theoretical characteristics of the ideal type. In the following chapter, the first step will be taken.

3. Literature-based construction of the ideal type

In this chapter, the scientific literature will be reviewed to construct the ideal type of organizations shaped by algorithmic systems. The chapter consists of six parts. In the first section, the Weberian notion of authority will be presented as this is the basis for the following ideal types. In the subsequent part, the bureaucracy as introduced by Weber and further specified by Mintzberg will be discussed. The bureaucracy is the first ideal type from which the to-be-constructed ideal type has to be demarcated. This is followed by the description of the second ideal type; i.e., the professional bureaucracy. In section four, Zuurmond's infocracy will be discussed as this is the third and final ideal type that informs the literature-based development process. In the fifth part, literature on algorithmic systems and their use will be reviewed from which the ideal type of organizations shaped by algorithmic systems will then be developed. Moreover, the insights drawn from interviews with experts who assessed the literature-based version of the ideal type will be added. In the final part, the key characteristics of the new ideal type will be presented as the basis for the following empirical analysis of the case of predictive policing at the Berlin police.

Organizations' structural elements do not exist arbitrarily. They can tell us something about underlying goals and values. Organizations structure social action and are structured by it. Thus, social scientists study the structures of organizations to examine social action and its meaning. One way of doing so is by making use of ideal types. Weber introduced the ideal type of rational-legal authority to make sense of a cultural process that increasingly shaped the structure of (public) organizations in modern Western societies: the rationalization. Through the lens of Weber's bureaucracy, structural elements of organizations and their functions can be identified, understood,

and explained as typically bureaucratic (e.g. rule-based standardized working procedures ensure efficiency and calculability).

The emergence of new organizational structures raises the question whether existing ideal types help to understand and explain them. The proliferation of information and communication technology (ICT) and particularly the (personal) computer in (public) organizations has motivated the construction of a new ideal type. Through the lens of Zuurmond's (1994) 'infocracy', information architecture in organizations and their functioning can be identified, understood, and explained as typically infocratic (e.g. information systems standardize working procedures to ensure efficiency and calculability).

In recent years, once again new structures in organizations have been proliferating: algorithmic systems. They are motivating this study's construction of a new idea type. With this freshly sharpened lens, it will be possible to identify, understand, and explain algorithmic systems in organizations and their influence on them. Before this ideal type will be developed, the existing ideal types and their common basis will be discussed.

3.1 Ideal types of authority

In his posthumously published book *Economy and Society*, Weber begins the chapter in which he presents his ideal types with the following definition:

> *»Herrschaft« soll (…) die Chance heißen, für spezifische (oder: für alle) Befehle bei einer angebbaren Gruppe von Menschen Gehorsam zu finden.* (Weber, 2006, p.214)

Weber uses the German word „Herrschaft" which has been translated into English with authority or domination (Stanford Encyclopedia of Philosophy, 2017). Domination seems to be the more literal translation, but authority the more established concept in social science. In the remainder of this thesis, authority will be used in the here presented Weberian meaning.

So, Weber (2006) defines authority as the chance that a command will be obeyed by a particular group of people. In case this is a large group of people, Weber (2006) explains that administrative staff is required to exercise authority. The staff is, in turn, a (smaller) group of people that is expected to obey and implement the commands. To distinguish authority from power, he specifies that authority means only the chance that a command will be obeyed and not any chance that someone will be forced to act in a particular way (Weber, 2006). This means authority is based on a command and obedience relationship (Bonazzi, 2014). To obey a command means to act in accordance with it only because the authority of the commanding person is accepted by the obeying

person. There are different reasons why authority is accepted. Weber (2006) mentions instrumentally- and value-rational motives, but he concludes that there is mostly one other dominant factor: the belief in the legitimacy of the authority. Legitimacy can be attributed to authority for different reasons (Weber, 2006). Weber (2006) argues, that types of authority can be appropriately distinguished by these reasons, or in other words, how they typically claim legitimacy. This feature is used by Weber (2006) to distinguishes between three ideal types of legitimate authority. Each of them draws its legitimacy from one of the following sources (Weber, 2006):

> First, traditional authority is based on the faith in traditions and the order resulting from them. This means that authority is accepted as legitimate because authority has always been organized as it is. For example, a tribal leader's authority is believed to be legitimate due to the tradition of inheriting the authority.
>
> Second, charismatic authority is grounded in the devotion to a person and the order promoted by him or her. This means that authority is accepted as legitimate because the person that exercise authority is believed to be the true leader. For example, a sect leader's authority is believed to be legitimate due to his or her godlike position and the worship of his or her person.
>
> Third, rational-legal authority is based on the faith in the legality of statutory order and the right to command held by those appointed to exercise the authority (Weber, 2006, p.218). This means that authority is accepted as legitimate because a person has been chosen for a formal position of authority in a process guided by universal laws and regulations. For example, a major's authority is believed to be legitimate due to his or her direct democratic election or rule-based appointment by a democratically elected parliament.

This rational-legal authority is most interesting in the context of this thesis as it is the basis for the bureaucracy; in fact, for all the following ideal types.

Rational-legal authority

In contrast to traditional and charismatic authority, rational authority is an impersonal order (Weber, 2006). It is independent from individuals. This order is characterized by a series of attributes (Weber, 2006):

- Law is laid down rationally and raises the claim to be obeyed by administrators and citizens.
- Law is an abstract and deliberately chosen rule that is used to make case-to-case decisions.

- The person who exercises authority is the superior whose commands are in accordance with the impersonal order.
- The person who obeys the commands is a citizen and as such obeys only commands that are in accordance with the law and the impersonal order.
- Citizens are therefore obligated to obedience only if the command falls within the rationally limited jurisdiction of the superior.

Thus, commands of the superior are obeyed not because of the person who gives the command, but because it is believed that he or she exercises his or her office by virtue of a lawful appointment, that he or she is capable of exercising this office, and that his or her orders comply with legal regulations (Bonazzi, 2014, p.185). As mentioned above, to exercise this rational-legal authority, an administration consisting of public organizations is necessary (Weber, 2006). The administration is supposed to safeguard the values of this order. Besides ensuring obedience, official functions are to be performed in a continuous, effective, calculable, efficient way (Zuurmond, 1994). The administration's functioning is based on rules to be applied in a jurisdiction which determines the distribution of obligations, the assignment of authority to meet the obligations, permissible means of coercion and the conditions for their application (Weber, 2006). "The purest type of rational-legal authority is the one with a bureaucratic administration" (Weber, 2006, p.222). This means the bureaucracy is a special case of exercised rational-legal authority that shows a particular set of characteristics. These will be examined in the following part.

3.2 Bureaucracy

The word bureaucracy is a composition of the word 'bureau' and the suffix '-cracy' which is derived from the ancient Greek word krátos (κράτος) meaning authority or power and which is today probably most commonly used in the word 'democracy'. Weber defines bureau as the central point of modern organized social action (Weber, 2006, p.221). Simply put, bureau means office which makes bureaucracy: authority exercised through the office. According to Weber (2006), a bureaucratic organization is characterized by two attributes:

1) 'Dienstwissen' and 'Fachwissen'

On the one hand, "bureaucratic administration means authority by virtue of knowledge" (Weber, 2006, p.224). Two forms of knowledge can be distinguished. First, written procedural rules define the obligations of and how they are to be met by the administrative staff (Perrow, 1986). This type of knowledge is called know-how or expertise ('Fachwissen') which is seen as the central

reason for the bureaucracy's superiority compared with other forms of authority and its position of power (Weber, 2006). Second, knowledge is stored in the form of "written records (files) of acts and decisions already taken" (Perrow, 1986, p.47). Moreover, all information that is required by the written rules for the decision-making process, is on record (Weber, 2006). According to Weber (2006), this from of knowledge ('Dienstwissen') reinforces the powerful position of the bureaucracy.

2) Continuous operation ensured by civil servants

On the other hand, bureaucratic administration means continuous operation which is ensured by civil servants who implement the procedural rules (Weber, 2006). Civil servants are defined by characteristics that put them in sharp contrast to administrative staff in a system of traditional or charismatic authority, for example a feudal system (Perrow, 1986, Weber, 2006): a) Civil servants operate with public resources (e.g. money, assets) which are separated from their private money and property. b) Civil servants work in an office which is not their private home. c) Civil servants work in a particular function and therefore hold an office for the time being. They are not entitled to this position. d) Holding an office is a civil servant's "sole or primary occupation" (Perrow, 1986, p.48) for which he or she receives a salary.

These specific forms of knowledge and the continuous operation ensured by the civil servants make up the bureaucracy as envisioned by Weber (2006). The bureaucracy is the formally most rational type of exercise of authority (Weber, 2006, p.224) because it maximizes its predictability and the stability of expectations for the (political) master, administrators, and citizens. These characteristics of bureaucracy are the reason, according to Weber (2006), that this type of authority becomes omnipresent in all forms of modern mass administration in public organizations promoted by representative democracy and in private organizations by capitalism. In the following part, the parts and structures of the bureaucratic organization will be discussed.

Organizational structures and parts

Weber distinguishes between five structural elements of bureaucratic organizations: hierarchization, centralization, standardization, specialization, and formalization (Zuurmond, 1994; Weber, 2006).

First, a bureaucratic organization is characterized by a hierarchy which is a permanently existing system of checks and balances that consists of supervisory and subordinate functions within the organization and between organizations (Weber, 2006). Set rules determine these functions and regulate the filing of appeals (Weber, 2006). Thus, tasks and competences are systematically divided between organizational layers (Perrow, 1986). A high degree of hierarchization ensures obedience as

"every function within the bureaucracy answers to a higher level" (Zuurmond, 1994, p.302). In turn, obedience guarantees effectiveness as goals that were chosen at the top must be fulfilled at the bottom of the organization (Zuurmond, 1994).

Second, the formal positions within an organization are arranged so that there is a central function at the top that has the ultimate formal decision-making power (Zuurmond, 1994). The limits of this centralized authority, i.e., which decisions are taken at the top, are defined by laws and rules (Weber, 2006). Decentralization refers to "extent to which power over decision making in the organization is dispersed among its members" (Mintzberg, 1980, p.326) vertically or horizontally.

Third, standardization means that "all work is rule based and follows strict standard operating procedures" (Zuurmond, 1998, p.264) which promotes efficiency and calculability of decision-making (Zuurmond, 1994).

Fourth, the implementation of the procedural rules requires specialization (Zuurmond, 1998). Civil servants have to be familiar with these rules to maximize the bureaucratic organization's rationality. Therefore, they have to be trained accordingly (Weber, 2006). Each particular organizational function requires a particular specialization. Aspirants have to demonstrate this qualification to become civil servants (Weber, 2006).

Fifth, "social actions within the organization and the rules that direct these actions are formalized" (Zuurmond, 1994, p.302). In forms and reports, information required for the decision-making processes, decisions and commands are documented and stored in files and registries (Weber, 2006). The separation of private and public assets makes it necessary to account for all expenses in form of written documentation (Zuurmond, 1994; Weber, 2006). Formalization ensures continuity (Zuurmond, 1994).

Thus, according to Weber a bureaucratic organization consists of these structural elements. However, the Weberian ideal type does not make a distinction between sub-types of bureaucratic organizations. These five structural elements are the characteristics of the bureaucracy as the purest form in which rational-legal authority can be exercised. This form is contrasted with the two other forms of exercised authority, namely, traditional and charismatic. This means that any organization that shows these above-described structural elements is regarded a bureaucratic organization and not an 'organization' of traditional or charismatic authority like a tribe or a sect. To make this distinction, Weber's conceptualization of the five structural elements is sufficient. However, to distinguish different kinds of bureaucratic organizations that exercise rational-legal authority, the Weberian conceptualization of bureaucracy is less suitable. This has already been noticed by Mintzberg (1980) who observed more bureaucratic organizational diversity than what could be

covered by the existing ideal type. Therefore, he introduced refinements to Weber's bureaucracy (Mintzberg, 1980). One of Mintzberg's (1980) additions is a distinction between separate parts of organizations. Accordingly, organizations consist of five basic parts (Mintzberg, 1980, p.323-324):

a. strategic apex: top management,
b. middle line: intermediate management,
c. operating core: production or service provision,
d. technostructure: analytical work,
e. support staff: indirect contributions.

Figure 1: parts of organizations; own depiction based on Mintzberg (1980)

An organization is "pulled in five different directions, by each of its parts" (Mintzberg, 1980, p.329). Thus, depending on the distribution of power between the parts, the organization's structure takes different forms (Mintzberg, 1980). This means that each structural element can be more or less pronounced. For example, one organization might have a very hierarchical structure, whereas another might show a high degree of specialization. Moreover, Mintzberg (1980) introduced the distinction between standardization of work and standardization of skills. The prevalence of different organizational parts and correspondingly different organizational structures leads to five different ideal types of bureaucratic organizations: simple structure, machine bureaucracy, professional bureaucracy, divisionalized form, and adhocracy (Mintzberg, 1980). The machine bureaucracy that further specifies Weber's bureaucracy shows the following characteristics.

Machine bureaucracy

The machine bureaucracy is an organization that mostly performs routine tasks and is characterized by a high standardization of work (Mintzberg, 1980). This means that the coordination of tasks which is necessary due to the division of labor is done by "the imposition of standards to guide the doing of the work itself" (Mintzberg, 1980, p.324). Standardization can also be promoted by "regulating technical systems, since these routinize work" (Mintzberg, 1980, p.333). As the creation of standards is analytical work done by the technostructure, it becomes a key part of the organization (Mintzberg, 1980). In contrast, less standardized work either increases the discretion of the operating core or is subjected to direct supervision or the standardization of outputs both of which promote the

dominance of the management levels (strategic apex or middle line, respectively) (Mintzberg, 1980). However, the standardization of work leads to a "limited horizontal decentralization" (Mintzberg, 1980, p.332) meaning that the (informal) power of the technostructure increases (Mintzberg, 1980). Nevertheless, the organization is still rather centralized. The specialization of jobs indicates the division of labor and can be either high or low on two dimensions (Mintzberg, 1980): High job specialization mans that the personnel has to perform few narrowly defined tasks (horizontal) which are subjected to high levels of vertical control (Mintzberg, 1980). These jobs "usually fall into the category called *unskilled*" (Mintzberg, 1980, p.325) labor and are highly formalized. This is linked to the high standardization of work as formalization denotes the regulation of how tasks are to be performed in written form (Mintzberg, 1980). Therefore, highly trained personnel are not needed (Mintzberg, 1980).

Table 2

Comparison of the characteristics between machine and professional bureaucracy

Rational-legal authority	Machine bureaucracy	Professional bureaucracy
exercised through…	the impersonal order and its formal functions	
Information from…	own files	
processed by…	civil servants	
on the basis of…	laws and rules	professional expertise
to deal with…	routine tasks	non-routine tasks
Uncertainty is…	erased by decision-making based on applying laws and rules	reduced by decision-making based on experts' interpretation of information
Prime coordinating mechanism	standardization	(re-)training, experience

Notes: own depiction

In sum, this organizational configuration is characterized by high control through written rules, standardized work, and a centralized hierarchical structure (Mintzberg, 1980). Machine bureaucracies are subjected to considerable external control (Mintzberg, 1980) and can be found in

the field of "government agencies (…) such as post offices and tax collection departments" (Mintzberg, 1980, p.333).

In order to develop an ideal type that is of value, it has to be demarcated from existing ideal types. Therefore, in this section, the bureaucracy has been presented. From Weber's perspective, the bureaucracy with its five structural elements is the purest form in which rational-legal authority can be exercised. Later, the bureaucracy has been further specified by Mintzberg who has called it machine bureaucracy. This ideal type is the fundamental frame of reference for the construction of the new ideal type. The following part will turn to the professional bureaucracy.

3.3 Professional bureaucracy

In this chapter, the ideal type of the professional bureaucracy will be explored. It is an important counterbalance to the machine bureaucracy as it conceptualizes organizations that are tasked with non-routine work. By contrasting these two ideal types, the meaning of both becomes clear. Therefore, this ideal type is also a valuable addition for the development of the ideal type of organizations that are shaped by algorithmic systems which has to be differentiated from the existing ideal types.

Table 3

Comparison of structural elements between machine and professional bureaucracy

Rational-legal authority	Machine bureaucracy	Professional bureaucracy
Standardization…	of work	of skills
Specialization	unskilled	professional
Centralization	high; limited horizontal decentralization	low; horizontal and vertical decentralization
Hierarchization	high	low
Formalization	high	low
Key part	technostructure	operating core

Notes: own depiction based on Mintzberg (1980)

Another ideal typical configuration of a bureaucratic organization identified by Mintzberg (1980) is the professional bureaucracy. It mostly performs non-routine tasks and is characterized by a high standardization of skills (Mintzberg, 1980). This means that the coordination of tasks is done "by the internalization by individuals of standard skills and knowledge, usually before they begin to do the work" (Mintzberg, 1980, p.324). These highly trained professionals perform their tasks freely and autonomously in the operating core making it the key part of the organization (Mintzberg, 1980). "Not only do the professionals control their own work, but they also tend to maintain control of the administrative apparatus of the organization." (Mintzberg, 1980, p.334). In fact, professional knowledge is so important that only professionals become managers in the middle line who continue to work closely with the operating core, even sharing administrative tasks with them (Mintzberg, 1980). Consequently, the organization is vertically and horizontally decentralized (Mintzberg, 1980). The specialization of jobs is high on the horizontal dimension meaning that the personnel has to perform few narrowly defined tasks. On the vertical level, the specialization is low indicating a limited control over the tasks (Mintzberg, 1980). This high horizontal and low vertical specialization is attributed to professional labor (Mintzberg, 1980). In contrast to the unskilled jobs of the machine bureaucracy, tasks in this configuration can neither be routinized by technical systems, "easily formalized, [n]or its outputs standardized" (Mintzberg, 1980, p.334). This means that work in the professional bureaucracy is rarely governed by written rules and requires only little documentation.

In sum, this organizational configuration is characterized by professionals that must be highly trained and retrained (Mintzberg, 1980). This promotes the professionals' autonomy (Mintzberg, 1980). In contrast, hierarchy, centralization, and control is limited as standardization and formalization is low (Mintzberg, 1980). This type of bureaucratic organizations can be found in "school systems, social work agencies" (Mintzberg, 1980, p.333), and hospitals.

3.4 Infocracy

In this chapter, Zuurmond's infocracy will be presented. It is the third ideal type which is to be considered in the construction process of the new ideal type. As mentioned above, ideal types are only meaningful when they are compared with others. Hence, the infocracy is presented vis a vis the machine and the professional bureaucracy. It will be shown that the infocracy, like the bureaucracy, is a configuration that enables the exercise of rational-legal authority. Moreover, differences between the infocracy and the bureaucracy will be pointed out. For this, a closer look will be taken especially at the developments in information and communication technology.

> "The mechanisms of domination change, not domination itself (the process of modernization and rationalisation continues to unfold)." (Zuurmond, 1998, p.267)

As shown above, bureaucracy describes an ideal typical organizational configuration that promotes the exercise of rational-legal authority. From Weber's perspective at the turn of the 19th to the 20th century, the bureaucratic administration was the most effective configuration to reach this goal (Weber, 2006, p.222). Bureaucracy's particular organizational structures, its use of 'Dienstwissen' and 'Fachwissen', and its personnel – the civil servants – made it so successful that many of these characteristics can still be recognized in organizations these days. However, public organizations show also changes in their structural elements and attributes that cannot be understood and explain by Weber's bureaucracy (Zuurmond, 1998). "With that ideal type we cannot explain why bureaucracies become less mechanistically structured, flatter and more horizontally oriented, while gaining more and more control over more and more complex situations." (Zuurmond, 1998, p.267). Organizations are exposed to a process called informatization which denotes the proliferation of information and communication technology (ICT) in general and the personal computer in particular (Zuurmond, 1994). Zuurmond (1994; 1998) showed that informatization shapes organizational structures and he argued that this produces an organizational configuration that administers the exercise of rational-legal authority differently – and probably more effectively – than the bureaucracy. To understand and explain these new mechanisms and the resulting type of organization, a new ideal type was introduced (Zuurmond, 1994; 1998). Following Weber, Zuurmond (1994) called it infocracy a combination of the word information and the suffix 'cracy'.

Information and communication technology

"The principal idea is (…) that ICTs are the core technologies of public administration, and that fundamental changes in these core technologies will have a revolutionizing influence on the structure and functioning of the public service." (Snellen, 2000, p.208). To investigate this idea, it is necessary to clarify what ICTs actually are. Snellen (2000) presents five groups of information and communication technologies:

a) Database: This group mainly stores and organizes information. It is used in a range of different technologies.
b) Decision support: This technology helps humans in their decision-making "by applying specific rules to individually, or collectively, entered data" (p.209). Decision support technologies vary in their sophistication.
c) Networking: This technology connects computers with other computers and ultimately with humans. It thereby facilitates communication.

d) Personal identification, tracking, tracing, and monitoring: This group includes a broad range of technologies that help to identify people and follow them virtually: identification numbers (social security or student number), “smart cards” (p.210), and camera surveillance (CCTV).
e) Office and multi-media: This technology is used “for the generation, handling, rearrangement, and provision of information in a retrievable form” (p.210).

In sum, ICTs are a range of technologies that store and organize information in a digital form which are used in systems that support the processing of information or the decision-making process directly. Moreover, ICTs include technologies that promote networked connections and thereby communication and that allow to link information to individuals. This overview gives an idea of how diverse ICTs are and how difficult it is to define such an inclusive concept. Therefore, it might be more useful to have a look at how ICTs are used in administrative organizations and which functions of the bureaucracy are supported or substituted.

Zuurmond (1998) contrasted the work process of bureaucratic organizations with that of infocratic organizations which make use of databases, networks to exchange information, and identification numbers. A number of differences between the two organizational configurations were revealed (Zuurmond, 1998). The “computerized network-process” (Zuurmond, 1998, p.263) showed the following characteristics (Zuurmond, 1998):

1) Tasks are performed simultaneously instead of one after the other.
2) Information is not exclusively retrieved from the citizen anymore, but also from the network consisting of a number of organizations. This changes the street-level bureaucrat’s position “to monopolize the ability to create an image of the client” (p.264).
3) The work process is managed differently. Instead of small units overseen by a manager with coordinating, allocating, controlling and communicating tasks, a management system performs these routine tasks automatically which allows more complex work processes in larger organizational units.
4) As the vertical part of the routine work process, i.e., coordinating and controlling, is performed by the computer, the horizontal part is emphasized. The reliance on networked information additionally promotes this development. “The orientation is now towards a network of organizations.” (Zuurmond, 1998, p.264).

In terms of Weber’s bureaucracy, this means that ‘Dienstwissen’, the retrieved factual information, is not stored on paper files anymore, but it is stored on networked databases that are filled in and used by a range of organizations. Moreover, the ‘Fachwissen’ is also affected by the informatization. The rules that guide the routine working processes are not left to be enforced by incumbents and their

organizational mechanisms of coordination and control, but they are now inscribed into the information architecture that automatically performs routine coordinating and controlling tasks.

The case of the Dutch collection agency

In their article 'From Street-Level to System-Level Bureaucracies', Bovens and Zouridis (2002) present the case of the Dutch collection agency. By making use of information technology the collection of fines has been automated (Bovens & Zouridis, 2002):

In the Netherlands, traffic offenses, likes speeding violations, are automatically processed by an elaborate information system. In a first step, cameras capture violations and license plates to identify the traffic offender. This information is fed into a computer network via which the information is accessed by the Central Judicial Collection Agency which is tasked with the collection of all sorts of fines in the Netherlands. In an automated process, the information is analyzed, and fines are sent to the offenders. As a rule, no human intervention is required.

In the terms of Bovens and Zouridis (2002) who emphasize the effects on the roles of public servants, the street-level bureaucracy is thereby turned into a screen-level bureaucracy which in turn evolves into a system-level bureaucracy when the computer network spreads out to further integrate more and more organizations into a unified system. However, using Zuurmond's ideal type approach focusing on organizational structures one would describe the above-described process as a shift from machine bureaucracy to infocracy: Routine tasked that were performed by unskilled workers on a massive scale become automated by making use of information systems.

Zuurmond (1994) finds that this infocratic way of organizing control might be more effective than that of the bureaucracy. The machine, made up of people, does not behave entirely, as the master wishes" (Zuurmond, 1994, p.69). Because the bureaucracy is only a means to an end, i.e. organizing the exercise of rational-legal authority, it might be weakened and eventually replaced by a system that coordinates social action more effective with regard to the values of rational-legal bureaucracy (Zuurmond, 1994). Then, the management of the organization ensures obedience through the mechanisms of informatization, and no longer through those of bureaucratization (Zuurmond, 1994, p.69). Consequently, also the structural elements of organizations change that promote rational-legal authority by infocratic instead of by bureaucratic means (Zuurmond, 1994; 1998):

1. Standardization of work has increased: The degree to which civil servants are in charge of how they perform their work has shrunk. The system forces them to work in even more standardized ways.

2. Hierarchy has declined in the infocracy. For example, the middle line management has shrunk.

3. Centralization has declined. “Team members are empowered: they have more rights to make final decisions, less and less draft proposals have to be sent to the top of the organisation” (Zuurmond, 1998, p.264).

4. Formalization has declined. Civil servants have to provide less written documentation and their work is regulated by less written rules. However, these are substituted by rules inscribed into the information systems.

5. Specialization has changed in two ways: For the operating core, more tasks fall in the category of unskilled labor. The range of tasks has broadened. The major workload can be performed by civil servants with low vocational training as the standardization of work processes has increased. In the technostructure, however, highly skilled professionals are required that hold expert knowledge about information technology.

In sum, the structural elements of organizations are less in line with Weber’s bureaucracy. From the perspective of the bureaucracy, it would mean that this configuration is less capable of promoting rational-legal authority (Zuurmond, 1998). Instead, Zuurmond (1994; 1998) found increasing control and obedience as well as “a broadening of rational-legal authority” (Zuurmond, 1994, p.280) which can be explained by the informatization, but not by the bureaucratization. The infocracy has the potential for the management of organizations and their (political) masters to “achieve more effective control, obedience and transparency than they could have achieved with the structural means of rationally legal bureaucracy alone” (Zuurmond, 1994, p.283). This means that not structural elements of organizations ensure the exercise of rational-legal authority, but that information (technology) does. That demarcates the infocracy from the machine as well as from professional bureaucracy.

3.5 Towards a new ideal type

In this chapter, an ideal type that helps to understand and explain how organizations are shaped by algorithmic systems will be developed. This algorithmization produces a new organizational form which enables the exercise of rational-legal bureaucracy. In the tradition of Weber, this ideal type will be called algocracy. For the construction of the new ideal type, scientific literature on algorithmic systems and their role in organizations will be reviewed and discussed. Moreover, insights drawn

from the expert interviews (marked with an 'EI') will be added to validate theory-based characteristics and complement the construction of the algocracy.

It has been shown above that despite of the same source of the authority's legitimacy configurations can make use of different mechanisms to exercise the authority. More specifically, it has become clear that technological progress can lead to such distinctly different socio-technical configurations that existing ideal types lose their heuristic value, i.e., the ability to understand and explain them. This means that attention should be paid to the proliferation of new technologies in organizations and their potential effects on structural elements. A technology that has spread in public as well as private organizations in recent years is algorithmic systems, i.e., the algorithm-based analysis of huge amounts of data. Scholars have compared this technology to mechanisms that are associated with the exercise of rational-legal authority through bureaucratic organizations (Danaher, 2016; Peeters & Schuilenburg, 2018). "Algorithms are bureaucratic in that sense that they structure human behaviour and decision-making in similar ways as bureaucratic organizations do – or perhaps even more so, given the reduction of judgement on individual cases to classification." (Peeters & Schuilenburg, 2018, p.277). This means that the prevalence of this algorithmic technology produces an organizational configuration that administers the exercise of rational-legal authority differently – and probably more effectively – than the bureaucracy (Wirtz et al., 2018). To understand and explain these new mechanisms and the resulting type of organization, the algocracy will be developed. To do this, algorithmic system will be examined more closely as a first step in the following part.

3.5.1 Algorithmic systems

> "We are living in an algorithmic age where mathematics and computer science are coming together in powerful ways to influence, shape and guide our behaviour and the governance of our societies." (Danaher et al., 2017, p.1).

Algorithmic age, algorithmic governance, algorithmic bureaucracy, algorithmic government, algocracy (Aneesh, 2006; 2009; Williamson, 2014; Danaher, 2016; Coletta & Kitchin, 2017; Danaher et al., 2017; Engin & Treleaven, 2019; Vogl et al., 2019) – all these terms are used to describe the prevalence of systems "in which algorithms are used to collect, collate and organize the data upon which decisions are typically made and to assist in how that data is processed and communicated through the relevant governance system" (Danaher, 2016, p.247). Thus, these algorithmic systems structure the organization of social life and social action (Danaher, 2016). But what are the characteristics of algorithmic systems?

To answer this question, it is helpful to take a closer look at algorithms. A broad definition of an algorithm is a series of steps to perform a task (Cormen, 2013). This definition does not limit the

existence of algorithms to the world of computer (Cormen, 2013). In fact, this broad definition would also apply to a recipe that is followed by a chef who prepares a meal. However, for computers a recipe would have to be much more precise than for a human (Cormen, 2013). That is why computer run on code and not on natural language (Cormen, 2013). “So, a computer algorithm is a set of steps to accomplish a task that is described precisely enough that a computer can run it.” (Cormen, 2013, p.1). The tasks that are performed by a computer algorithm are computational (Cormen, 2013). An algorithm is expected to perform these tasks correctly and by using as little resources as possible (Cormen, 2013). These two expectations are often in competition with one another (Cormen, 2013). An algorithm that always produces a correct result might need more time than considered practical for a particular task. For example, the perfect algorithm for a car navigation system would not be an algorithm that never makes any errors in finding the fastest route from a to b, but that needs 3 hours to calculate the route. The perfect algorithm in this case would probably be an algorithm that calculates the route within 15 seconds, but that makes an error once in every 10,000 times by choosing a route that is at most five per cent longer than the optimal route. This means that algorithms usually perform a task correctly not with 100 per cent probability, but with a probability that is acceptable in the given context and by making use of computational resources as efficiently as possible (Cormen, 2013).

Algorithms are extremely widely used. They can be found in search engines like Google as well as in cars (Cormen, 2013). In the search engine, algorithms scan the internet according to the query and decide which results are presented to the user (Cormen, 2013). Hence, they are the basis for more complex systems that deploy algorithms to perform elaborate tasks. These algorithmic systems are developed around the fields of computational methods, automation, and artificial intelligence (Kitchen, 2014). “A branch of artificial intelligence” (Kitchen, 2014, p.103) is called machine learning. The idea is that, instead of human analysts, automated processes are developed to make decisions on how algorithms are to perform data analysis (Kitchen, 2014). “Machine learning seeks to iteratively evolve an understanding of a dataset; to automatically learn to recognise complex patterns and construct models that explain and predict such patterns and optimize outcomes.” (Kitchen, 2014, p.103). This is very different from the functioning of information systems. Human programmers add coded decision-rules to the information system that contain instructions how the system is supposed to react to a particular set of information. Information systems, however, do neither recognize patterns or relationships themselves nor are they able to build models.

In general, two forms of machine learning can be distinguished: supervised and unsupervised learning (Kitchen, 2014). In supervised learning, a dataset is used to train a model by finding relationships between input data and data that is defined as the output (Kitchen, 2014). This

approach assumes that a dataset contains data that allows to model its relationships with a known variable (Kitchen, 2014). In unsupervised learning, the model is left to find any relationships and patterns in the data without defining input or output (Kitchen, 2014). “In both cases, the model is created through a learning process shaped by learning rules and weightings that direct how the model is built in relation to the data.” (Kitchen, 2014, p.103). These learning techniques allow the creation of systems that are way more powerful than systems that have to be programmed by human coders. The abilities of self-learning systems cause again and again surprise in the (interested) public and headlines in the media; much as, for example, a demonstration of the virtual Google assistant’s ability to call a hair salon to make an appoint on behalf of the user. However, creating suitable machine learning models is not a trivial process, but it requires “domain expertise and thoughtful reflection” (Kitchen, 2014, p.103). Machine learning is used in a broad range of analytical techniques, inter alia in the fields of data mining and pattern recognition as well as in predictive analytics which will be introduced next (Kitchen, 2014).

As it is not readily apparent which data in huge dataset are of value, useful data and patterns have to be identified. This identification process is called data mining (Kitchen, 2014). As explained above, machine learning can be used to detect relationships in datasets (‘pattern recognition’). For data mining and pattern recognition approaches many “different techniques including natural language processing, neural networks, decision trees, and statistical methods” (Kitchen, 2014, p.104-105) can be employed. The choice of the most suitable technique greatly depends on the data and on the purpose of the analysis (Kitchen, 2014).

Another way of gaining valuable insights from data is prediction (Kitchen, 2014). It used to determine the probability of events under alternative circumstances (Kitchen, 2014). Again, many different techniques can be applied to come to a prediction (Kitchen, 2014). “In all cases, models are built utilising existing knowledge about how a system works, which process data to estimate a potential outcome under different scenarios.” (Kitchen, 2014, p.110).

In sum, advancements in the fields of data and computational science have resulted in a sophistication of analytical techniques that “improved our ability to understand this data and use it” (Vogl et al., 2019, p.1). Data must therefore be understood as the most important input for algorithmic systems or as the basis on which they operate (Danaher et al., 2017). A definition of big data that has become a classic is Laney’s (2001) “‘three Vs’ framework” (Danaher et al., 2017, p.3) that stands for volume, velocity, and variety (Danaher et al., 2017). Kitchin (2014) added four more characteristics (see table 4) to the three Vs by bringing together the findings of what can be considered the most influential literature on big data (e.g. boyd & Crawford, 2012; Cukier & Mayer-

Schönberger, 2013). Using these attributes, Kitchin (2014) compares small data with big data (see table 4; see Kitchin, 2014 for detailed information).

Table 4

Characteristics of small and big data

	Small data	Big data
Volume	Limited to large	Very large
Exhaustivity	Samples	Entire populations
Resolution & indexicality	Coarse and weak to tight and strong	Tight and strong
Relationality	Weak to strong	Strong
Velocity	Slow, freeze-framed/bundled	Fast, continuous
Variety	Limited to wide	Wide
Flexibility & scalability	Low to middling	High

Notes: own depiction after Kitchin (2014, p.28)

Besides these characteristics of which volume is probably most prominently discussed in the scientific literature (Cukier & Mayer-Schönberger, 2013), big data's multilayered complexity (Kitchin, 2014) has to be mentioned. To grasp this complexity, Kitchin (2014) introduced the concept of data assemblages. Data assemblages illustrate the various conditions under which and different actors that are involved in the production of data. Thus, the concept of data assemblages also helps to raise awareness for how misleading the notion of 'raw data' is which wrongly presents data as neutral and uninfluenced by their gathering process (Van Dijck & Poell, 2013; Iliadis & Russo, 2016). On the contrary, data are always shaped by the affordances of their production systems (Van Dijck & Poell, 2013).

In the bureaucracy and infocracy small data are gathered because particular information is needed. More specifically, the information is required for the decision-making by administrate rules or law which motivates the collection of small data by the bureaucratic or infocratic organizations (EI3). For example, to calculate a person's pension payments, data are gathered that represent that person's income and duration of employment as the pension law says that these are the determinants of the amount of the pension payments. This means the small data is collected bearing its specific purpose in mind. In contrast, "much of big data is generated with no specific question in mind or is a by-product of another activity" (Kitchen, 2014, p.100). This also means that the small data gathering process is usually carried out by the user himself or herself, whereas big data is usually collected by other actors in automated ways. Therefore, there are not only simpler conditions and less actors

involved in the gathering of small data, but the user usually also knows about these conditions and actors. Users of big data are often unfamiliar with the conditions and the involved actors. Big data must therefore be handled with care, require due to their undirected gathering process different analytical approaches, but big data also enable these. This has resulted in a proliferation of algorithmic systems which has been further promoted by innovations in the field of their implementation (Vogl et al., 2019). Especially open-source software and programming languages as R and Python have become more powerful and sophisticated (Vogl et al., 2019). The free access to these tools lowered the costs for the implementation of machine learning and other analytical techniques that are the drivers of algorithmic systems (Vogl et al., 2019). This has made algorithmic systems widely available not only for high tech corporations that run search engines and build cars, but also for public organizations.

3.5.2 Algorithmic systems in public organizations

After considering the technological developments that seem to be the main drivers behind the increasing prevalence of algorithmic systems, this section turns to the consequences of this process for organizations and their functioning. This section will draw especially on the previously discussed and some additional literature, but the author will also develop own thoughts. As a new ideal type ought to be developed connections between theory-based aspects are made that rely on the logic of the author's reasoning. This theory building part is, therefore, more speculative than the preceding sections. Hence, expert interviews have been conducted which are an additional step to ensure the validity of this theory building process.

As indicated above, a configuration appears to have emerged that uses algorithmic mechanisms to enable the exercise of rational-legal bureaucracy. "Algorithms instead of rules are the source of the rationalisation of decision-making, the formalisation of the procedures for reaching decisions, and the standardisation of the treatment of each case" (Peeters & Schuilenburg, 2018, p.276). This means that, like bureaucracy and infocracy, the algocracy is form in which rational-legal authority can be exercised. Rational-legal authority is defined as a command and obedience relationship that is legitimized by laws and rules (Bonazzi, 2014). The algocracy is characterized by the exercise of that authority through a configuration shaped by algorithmic systems.

The algocracy draws on organizational and informational structures

Organizations that make use of algorithmic systems do this by drawing on existing organizational and informational structures (Danaher et al., 2017). In the bureaucracy, the 'Dienstwissen', information stored in files and registries, enable continuity of the organizational functioning and are the information basis of its impersonal decision-making. In this, the rationalization of the (machine and

professional) bureaucracy becomes apparent when compared to configurations exercising traditional or charismatic authority. Ensuring information sources for decision-making that potentially endure longer periods of time than the (working) life span of any individual in an organization is an invention of modernity. The handling of that information is governed by written rules that have to be internalized by public servants.

In the infocracy, the computerization of work processes results in the digitalization of 'Dienstwissen'. This further rationalizes the management of information as information can be processed faster by information systems than by human administrators. Moreover, digital information can be distributed more precisely (with more control) and more easily (quicker and simultaneously) than analog files. Additionally, the handling of the information is not (exclusively) governed by written rules, but by rules that are coded into the information system: code is law (Lessig, 2006). Software is similar to man-made architecture that forces everyone onto pre-defined paths (Lenk, 2018). This enables a rule-based automation of information processing and decision-making for the performance of routine tasks.

In algocracy, this informatization of organizational operations have created increasing amounts of data which are used by algorithmic systems to reach organizational goals. Moreover, the division of labor and the compiled expertise of the civil servants, which are manifested in the organizational structures of the bureaucracy and are partly transferred to the information systems of the infocracy, also inform the functioning of algorithmic systems. In sum, the algocracy draws on the achievements of the bureaucracy (organizational structures, files) and infocracy (information infrastructure, data)**.**

The algocracy makes use of data that has been collected outside of the organization

In addition to this data from within the organization, external big data sources have emerged, and their numbers have multiplied. Big data are used that have been collected, inter alia, from publicly accessible sources (e.g. statistical offices), from devices that are part of the Internet of things (IoT) (e.g. sensors), internet services (e.g. social media, online shopping), and mobile phones (e.g. communication, individual motion profiles) (Vogl et al., 2019). Neither these data sources nor big data are part of the machine and professional bureaucracy as well as infocracy. They handle information that is gathered on the basis of rules. For example, in order to decide whether a citizen is eligible for welfare benefits, the public employment agency is required to gather data that answer questions like: Who is that person? Where does he or she live? When did he or she lose his or her job? How long did he or she work in that job? Data that answer one of these descriptive questions is information (Ackoff, 1999). In contrast, big data, e.g. social media data, are not gathered to answer the question, who has a high risk of losing his or her job, that might be interesting to the public

employment agency. Data from social media platforms are a by-product[1] resulting from the use of these platforms. Data remain 'just' data until they are processed to answer descriptive questions. Only then data become information.

In sum, in the machine bureaucracy and infocracy, an organization collects particular information in (digitalized) files for the rule-based decision-making process. The algocracy draws additionally on a variety of data that has been produced and collected externally to the organization: i.e. publicly available data, data from IoT devices, internet services, and mobile phones. Therefore, it should be thought about where data come from, which data are not gathered or used, and what effect this has on the resulting information (EI1). In contrast to the bureaucracy and infocracy, not only information that is required for the decision-making process by law or administrative rule is collected and used, but additionally data that has been gathered independently of the organization is used as it is believed to be potentially beneficial (EI3). The availability of this additional information from externally produced data and its usage by public organizations shifts the demarcation line between the public and private spheres (EI4).

The algocracy uses dynamic algorithmic systems with machine-learning abilities

In order to gain valuable insights from these data, they must be sorted, processed, and analyzed which is increasingly done automatically (Danaher, 2016). The technologies that are applied to do this are diverse (as described above) and the scope of application is broad (Wirtz et al., 2018). Wirtz and colleagues (2018) who conducted a systematic literature review on artificial intelligence (AI) in the public sector differentiate between "10 AI application areas" (for details see Wirtz et al., 2018, p.1). The reason for this potentially universal usefulness of AI might be found in the self-learning ability and adaptive capacity of the algorithms that are seen as an essential factor for innovations in the field of artificial intelligence (Wirtz et al., 2018). However, due to the learning and adaptive abilities these algorithmic systems are very dynamic (EI4). This makes them considerably more complex than information systems that are static (EI4). This complexity raises, therefore, the level of expertise that is necessary to comprehend the algorithmic decision-making process. On the other hand, machine learning enables these systems to make sense of data without relying on human-made decisions about how the data should be analyzed. Instead structures and patterns in the data are drivers behind the statistical analysis. This means that neither rules written in legal code nor rules written in binary code ('code is law'; Lessig, 2006), but the recognition of patterns in data is key. This mode of operation is known from the professional bureaucracies that rely on the experience and expertise of their workers to perform non-routine tasks.

[1] from the users' perspective; from the platform's perspective data really are the product.

In sum, in the algocracy, this variety of data is processed by systems that develop dynamic, machine-learning and correlation based analytical models. The dynamic nature of the algorithmic system reduces the comprehensibility of the decision-making process for non-experts. However, the function of these algorithmic models resembles the role of expertise in the professional bureaucracy.

The algocracy spreads in the domain of professional bureaucracy and promotes prevention

The algorithmic systems' autonomy from laws and rules in the decision-making process enables them to perform non-routine tasks that have been performed by professionals before. Instead of highly standardized rule-based work processes dealing with routine tasks in machine bureaucracies, highly trained civil servants perform non-routine tasks relying on their expertise and experience in professional bureaucracies (EI2). The advances in pattern recognition and prediction manifested in algorithmic systems that automate non-routine decision-making processes "open up new paths for bureaucratisation of the public sector beyond the confines of public service provision" (Peeters & Schuilenburg, 2018 , p.277) and possibilities for future-oriented predictive practices (Peeters, 2015). The algorithmic systems' ability to predict human behavior and therefore, assess future risks by analyzing data further rationalizes formerly professional expertise-based domains. This increases the confidence in the value of predictive practices (Peeters, 2015). Moreover, it makes capacities available that formerly were occupied with performing non-routine tasks which can be allocated to predictive practices as well.

In sum, the algocracy's penetration into the domain of expertise-based decision-making expands its rationalization beyond the performance of routine-tasks in the field of machine bureaucracies; to non-routine tasks in the area of professional bureaucracies. Additionally, the algocracy's ability to anticipate future human action, to thereby determine the likelihood of possible future scenarios, and to identify those that are most likely, promotes preventive policies and the use of preventive practices which also explains its prevalence in the domain of professional bureaucracies.

The algocracy translates professional bureaucracy's uncertainty into probability

The machine bureaucracy's ambition is to erase the previously existing uncertainty by making decisions solely on the basis of laws and rules as well as on objective information given its availability and correctness. In machine bureaucracy, civil servants apply laws and rules in standardized ways to particular cases to make decisions. Ambiguity is introduced as laws are abstractly formulated so that their implementation leaves room for interpretation. In infocracy, these laws and rules are (partly) written into the information systems which support civil servant's decision-making which, therefore, does not have to be as standardized (Lessig, 2006; Aneesh, 2009). Normal cases are often handled automatically, but ambiguous decisions are left to human administrators.

In contrast, decision-making in professional bureaucracy relies on training, expertise, and professional experience as well as low standardization of work which leaves comparably large margins of uncertainty. The algocracy's ambition is to reduce these margins by supporting or performing decision-making, not by relying on laws and rules, but by making use of computational and statistical methods. These methods rely on probability to compute correlations, categorize cases based on patterns in the data, and predict events under alternative circumstances. In the algocracy, one is made aware of the uncertainty that is inherent but concealed in the expert-based decision-making of the professional bureaucracy. In the algocracy, uncertainty is quantified and thus expressed as probability. This is how the algocracy contributes to the further rationalization which has also been promoted by both machine and professional bureaucracy as well as infocracy.

In sum, in the machine bureaucracy and infocracy, uncertainty is radically reduced by making decisions based on laws and rules. This introduces, however, ambiguity which is, in turn, met with discretion. The uncertainty that is inherent in the decision-making of experts in the professional bureaucracy, is quantified and expressed as probability as well as reduced by the analytical techniques of algorithmic systems in the algocracy.

In conclusion: The algocracy further rationalizes the exercise of authority in the domain that has been dominated so far by the professional bureaucracy.

Similar to the rationalization trend furthered by the infocracy in the domain of the machine bureaucracy, the algocracy promotes rationalization in the domain of the professional bureaucracy. By quantifying and reducing uncertainty of decision-making, the algocracy offers new ways of promoting the exercise of legal-rational authority and new instruments of control which facilitate the obedience of the organization to its (political) master. Contrasted with machine and professional bureaucracy as well as infocracy, the algocracy shows a number of differences especially regarding the following characteristics:

1) Information is neither exclusively retrieved from citizens (as in the bureaucracy) nor from a network consisting of a number of organizations (as in the infocracy), but data is gathered from working processes within the organization and most importantly from sources outside of the organization (e.g. IoT, internet services, smart phones). Information is retrieved from this data by means of algorithmic analysis. This changes information gathering, processing, and decision-making processes, especially with regard to non-routine tasks performed by professional bureaucracies.
2) The management of work processes regarding the performance of non-routine tasks changes. Instead of large units with far-reaching competencies and autonomy as well as

limited managerial oversight as found in the professional bureaucracy, algorithmic systems limit the autonomy of the operating core by introducing standards and means of direct vertical control.

3) The automation and rationalization of non-routine task performance opens up capacities that are directed to future-oriented preventive practices. This is in contrast to bureaucratic and infocratic practices that are mostly reactive.

In terms of the Weberian bureaucracy, this means that the range of sources of 'Dienstwissen', the retrieved factual information stored in files in the bureaucracy, has broadened in the algocracy. Data is gathered outside of the organization and not with the purpose of informing organizational decisions. Moreover, the 'Fachwissen' regarding the performance of non-routine tasks is also affected by algorithmic systems. The prime coordinating mechanism for non-routine tasks is the standardization of skills in the professional bureaucracy (Mintzberg, 1980). In the algocracy, algorithmic systems with their pattern recognition and predictive abilities that resemble expertise of individual professionals on an aggregated level are the prime coordinating mechanism.

Structural elements of algocratic organizations

This algorithmic way of organizing the exercise of rational-legal authority seems to be more effective than that of the bureaucracy (Peeters & Schuilenburg, 2018). "These AI applications, for instance, may increase efficiency and lead to cost savings by automating processes, assisting resource allocation and reducing waiting time and administrative burdens." (Wirtz et al., 2018, p.6). Because the professional bureaucracy, like all configurations, is only a means to an end, i.e. organizing the exercise of rational-legal authority, it will be weakened and eventually replaced by a system that coordinates social action more effectively with regard to the values of rational-legal authority (Zuurmond, 1994). Then, values as effectiveness, efficiency, obedience, and continuity will be ensured through algorithmic mechanisms and no longer through those of the professional bureaucracy. Consequently, also the structural elements of organizations change that promote rational-legal authority by algorithmic instead of by bureaucratic means:

As in the professional bureaucracy, algocratic organizations are tasked with non-routine work. Professional bureaucracies use standardization of skills as the prime coordinating mechanism. Whereas, standardization of work is associated with machine bureaucracies. In the algocracy, both coordinating mechanisms are used. The degree to which civil servants are in charge of how they perform their work has shrunk (Wessels, 2018). The system forces them to work in more standardized ways especially with regard to data gathering and decision-making (Peeters & Schuilenburg, 2018; Vogl et al., 2019). This increased standardization of work ought to ensure data

quality which is necessary for the functioning of the algorithmic systems. Moreover, the automated advice that is given by the algorithmic system standardizes the work process as it determines the supposedly optimal decision or course of action.

Moreover, algorithmic systems also standardize skills. Instead of training professionals to internalize skills and knowledge before they begin to work and to continue training throughout their working life, their skills and knowledge are transferred to algorithmic systems. As show above, the analytical abilities of algorithmic systems resemble professional expertise. Thus, skills are standardized as they are coded into the algorithmic system. It is not left to the individual professionals to use their skills and apply their knowledge at their own discretion. In the algocracy, professional work is automated. The algorithmic system automatically provides advice, a recommendation for action, based on probability-based analysis. The standardization of skills that are used for making decisions are given by the algorithmic system. This makes it less important to standardize the skills of professionals before they enter the organization.

In contrast to the highly trained professionals that perform their tasks freely and autonomously in the operating core of the professional bureaucracy, in the algocracy the professionals are subjected to more control and perform their tasks less autonomously. The standardization of work and skills through the algorithmic systems increases hierarchy and centralization. The strategic apex gains an instrument of direct vertical control which emphasize the hierarchical relationship between management and operating core. Moreover, in this way the strategic apex has more influence on the decision-making at the level of the operating core. Moreover, better informed decisions can be made at the top level as more data on work processes within the organization are available (Vogl et al., 2019). All this increases the importance of the strategic apex within the algocratic organization and limits both vertical and horizontal decentralization.

In the algocracy, algorithmic systems support or even take on the execution of non-routine tasks which are the core of the professional bureaucracy. The automated advice of the algorithmic systems increases also the vertical control of the work which contradicts the notion of professional work. However, new non-routine tasks regarding the handling of data and probability emerge in the algocracy. As the algorithmic systems open up capacities, especially in the operating core, they can be used to scrutinize decision-making processes which requires analytical and reflective skills (Knobloch, 2018). Therefore, professional labor entails the handling of technology at all levels of the organization; not only in the technostructure where expert knowledge on algorithmic systems is especially needed. Moreover, more time might be spent on enacting algorithmically created advice with a focus on future-oriented preventive practices (Peeters, 2015). Once algorithmic systems are set up, they can be used with only little effort to provide predictions on a daily basis. Implementing

predictive advice, however, requires expert knowledge and skills. In the algocracy, work, therefore, remains professional labor.

In the professional bureaucracy, the performance of non-routine tasks goes hand in hand with a low level of formalization. In the algocracy, there are also rather few written rules and instructions governing the work. However, there are dynamic rules that govern the non-routine work. The automated advice that is based on algorithmic data analysis determines a course of action that is considered to be the result of an objective analysis of data. This standard formalizes the supposedly ideal way. Therefore, any deviation from this standard likely attracts attention, potentially requires additional justification, and entails a potential risk. Moreover, data gathering which is facilitated by datafication and automation is of utmost importance. Therefore, formalization might also increase there where data are not collected automatically, but where rules govern the data collection executed by civil servants.

In sum, the structural elements of organizations are less in line with all of the existing ideal types of rational-legal authority. They would not be capable of understanding and explaining how this configuration performs non-routine tasks and would probably assume an incapability of promoting rational-legal authority. Instead, Peeters and Schuilenburg (2018) as well as Wirtz and colleagues (2019) found a more effective exercise of rational-legal authority which can be explained by the algorithmization, but not by bureaucratization or informatization. The algocracy has the potential for the management of organizations and their (political) masters to gain more control and to increase efficiency and effectiveness further than the professional bureaucracy would have allowed it.

3.6 The algocracy: theory-based characteristics

This part will summarize the results of the preceding sections of chapter 3 to come to a conclusion and to answer the first research sub-question: *What are the characteristics of the algorithmic ideal type that can be inferred from scientific literature?* As discussed above, an ideal type must always be examined in relation to other ideal types. Therefore, the key characteristics of the four above-presented ideal types will be compared in the following section (see table 5). The second part is in particular concerned with a comparative analysis of the structural elements of the four ideal types. In this way, the subsequent empirical analysis of the predictive policing case will be prepared which will draw on the findings of this literature-based study.

Table 5

Comparative analysis of characteristics of the four ideal types

Configuration of rational-legal authority	Machine bureaucracy	Professional bureaucracy	Infocracy	Algocracy
exercised through…	the impersonal order and its formal functions		information infrastructure	algorithmic systems
Information from…	own files		digital files	additionally: external data sources like IoT
processed by…	civil servants		information systems	algorithmic systems
on the basis of…	laws and rules	professional expertise	coded laws and rules	AI, data mining & pattern analysis, machine learning
to deal with…	routine tasks	non-routine tasks	routine tasks	non-routine tasks
Uncertainty is…	erased by decision-making based on applying laws and rules	reduced by decision-making based on experts' interpretation of information	erased by (partly) automated decision-making based on programmed laws and rules	reduced and quantified by decision-making based on algorithmic data analysis
Prime coordinating mechanism	standardization of work	training, experience	programmed information system	automated advice based on probability

Notes: own depiction

Machine and professional bureaucracy as well as infocracy and algocracy are ideal types of organizational configurations exercising authority that is legitimized by its legality. This type is, therefore, called rational-legal authority. The four configurations vary with regard to how the exercise of this authority is organized. The machine and professional bureaucracy exercise authority through the impersonal order characterized by the rule-based appointment or election of officeholders along with their formal competences, rights, and obligations. In contrast, the infocracy exercises the authority through information infrastructure which allows, for example, lower hierarchization than in the machine bureaucracy. Coordinating responsibilities, e.g. the distribution

of tasks and necessary information sources, that are carried out by middle management in the machine bureaucracy, are performed through the information infrastructure. Consequently, the need for middle managers is lower in the infocracy. In the algocracy, authority is exercised through algorithmic systems. This allows, for example, higher centralization because work that is expertise-based in the professional bureaucracy is automated in the algocracy. This means that the organizational leadership can intervene in and steer subordinates' decision-making processes more directly. Consequently, control can be exercised more immediately than in the professional bureaucracy that makes use of standardization of skills to coordinate social action.

All four configurations rely on information for their decision-making. Both the machine as well as the professional bureaucracy retrieve information usually from citizens to store it as their so-called 'Dienstwissen' in files. What information is needed for making a particular decision is governed by rules and laws. The storage of information in registries ensures the continuity of the bureaucracy. The organization is not dependent on individuals that hold particular information. Civil servants look up information in the files that is needed for performing their tasks and might add information. Due to the division of labor, the files in their physical form are usually sent from one function to another within the organization. In the infocracy, these files are digitalized, and all newly retrieved information is stored digitally as well. Consequently, files do not have be sent in their physical form from one function to another, but information can be shared electronically. For this, information systems are used which allow quicker, location independent, and simultaneous access to information. Moreover, information access can be managed more easily which allows better control of information flows. In contrast, the algocracy relies on data analysis to retrieve information. Data are gathered from organization internal as well as external sources. Internally, data collection draws on files and work processes. Externally, a plethora of data sources can be accessed, especially devices that are connected to the internet (e.g. mobile phones) as well as data that is made available on the internet by other organizations (e.g. social media corporations or statistical offices). To makes sense of these data, they are fed into and analyzed by algorithmic systems. Algorithmic systems can quickly process and analyze huge amounts of data that cannot be processed manually (in reasonable time). Moreover, the way of analysis can be predetermined and steered.

In the machine bureaucracy, the information stored in files are processed by civil servants according to written laws and rules. This is done to perform routine tasks. For example, the German authority for student loans decides about students' eligibility to receive financial support. The criteria that regulate whether a student is eligible are determined by law (BAföG). Rules require applicants to provide information that is regarded necessary to determine whether eligibility criteria are satisfied, e.g. information on the income of an applicant's parents. Civil servants who have to internalize the

rules then compare the provided information with the law-based criteria to determine an applicant's eligibility. This rule-governed process erases uncertainty from the decision-making that is inherent to processes under traditional or charismatic authority. A high standardization of work is used as the prime coordinating mechanism in organizations of the machine bureaucracy which is made possible by the strictly rule-based and routine work.

The same type of work is performed by infocratic organizations. They also conduct routine tasks. The laws and rules that guide the work of the machine bureaucracy are, however, enshrined in the information systems of the infocracy which reduces the need for internalizing the laws and rules ('code is law'). Coming back to the example from above, in the infocracy the student loan applicant's information would be processed by an information system that support the civil servant's decision-making or even automatically produce a decision about whether the applicant satisfies the eligibility criteria. This additionally limits the influence of human bias and errors on decision-making. Uncertainty is erased by the (partly) automation of decision-making based on programmed laws and rules. Consequently, the programmed information systems are used as the prime coordinating mechanism in the infocracy.

In the professional bureaucracy, organizations are tasked with non-routine work. As in the machine bureaucracy, information is drawn from files; however, work is less formalized which means that it is less documented in written form. Civil servants assess the information by making use of their professional expertise which is gained by the civil servants usually before they begin to work. This training and the experiences they gain on the job are, therefore, the prime coordinating mechanisms of the professional bureaucracy. For example, a hospital employs physicians that have been trained at universities for several years. After they have finished their academic education, they start to assist more experienced physicians in the hospital to gain practical experience. Only thereafter, they are allowed to practice on their own. This lengthy process is necessary to develop the professional expertise that allows them to perform non-routine tasks like medical care. The decisions are not law- or rule-based as they are in machine bureaucracy and infocracy, but they are made based on professional expertise, e.g. identifying the illness of a patient. Therefore, uncertainty cannot be erased from this decision-making, but it can be reduced by training experts to interpret information.

In the algocracy, organizations are also tasked with non-routine work, but new ways have been found to reduce uncertainty from expertise-based decision-making processes. Algorithmic systems that process and analyze huge amounts of data do not rely on expertise to interpret information, but they make use of machine learning and artificial intelligence for the purpose of data mining, pattern recognition, and prediction. For example, to identify the disease of a patient in a hospital the measurement data from medical devices are not interpreted by a physician, but they are fed into an

algorithmic system that recognizes patterns in the data and is therefore able to link the patient's data to cases with a similar data structure for which the corresponding illness is known. Thus, the algorithmic system automatically provides advice to the physician. The advice might include the identified disease and the probability of correct identification. Moreover, it might also encompass a recommended course of action; how the patient's probable disease should ideally be treated. This automated advice is the prime coordinating mechanism in the algocracy. The uncertainty that is inherent but concealed in the physician's expertise-based decision-making is reduced and quantified as probability by the data analysis of the algorithmic system.

Structural elements of the ideal typical organizations

These differences in tasks and how they are achieved between machine and professional bureaucracy, infocracy, as well as algocracy come along with different organizational structures which are depicted in table 6.

The machine bureaucracy is shaped by a high standardization of work processes. Rules and laws govern all work which is, therefore, executed in narrowly defined ways. A fine-grained division of labor and high vertical control of tasks characterize the specialization of work of the machine bureaucracy. Centralization, the accumulation of decision-making competence at the top of the organization, is high as well as hierarchization and formalization. The key part of the organization is the technostructure which owes the high degree of standardization its special role as the technostructure is responsible for the implementation of the standards.

In the infocracy, the standardization of work is also very pronounced. However, it is not the prime coordination mechanism as this standardization is promoted by rules and laws that are programmed into information systems. In this way, the key position of the technostructure within the organization gets even more strengthened. The information systems guide the work which are characterized by a fine-grained division of labor as well as a high vertical control. However, they allow less centralization so that decisions can also be made at lower organizational levels. Moreover, hierarchization and formalization are also reduced compared to the machine bureaucracy.

The professional bureaucracy makes use of a high standardization of skills as its prime coordinating mechanism. This means that professionals gain high levels of expertise through training and practical experience which coordinates, thus standardizes, their social action. The work is characterized also by a high division of labor, but it is subjected to little vertical control as it is expertise-based. Therefore, it is very challenging to standardize the work processes. This makes also a high level of centralization unfeasible. Decision-making competence is thus dispersed on all levels of the organization. Hierarchization and formalization are low to give the professionals free space to

perform their tasks. Consequently, the operating core is empowered and forms the key part of the organization.

The algocracy, combines the standardization of work and skills using its prime coordinating mechanism, i.e., automated advice based on probability, to raise the leadership's control of the organization. The algorithmic system requires and enables the standardization of work. On the one hand, as algorithmic systems need high-quality data work processes are standardized to ensure their availability. On the other hand, the automation of decision-making advice by the algorithmic systems sets a standard for decisions and actions which also increases formalization. Moreover, standardization of skills is achieved not by training and experience to gain professional expertise, but by the data analysis of the algorithmic system that resembles and also aggregates professionals' expertise. This makes it possible to standardize work even though it is professional. This means that highly skilled professionals are still very essential to the algocracy, but the standardization of skills is not the algocracy's main coordinating mechanism, in contrast to the professional bureaucracy. The algocracy is, therefore, characterized by a different form of professionalism than the professional bureaucracy. In the algocracy, a high division of labor is found, but the vertical control of the work has increased due to the algorithmic systems. This does not make it unskilled labor as seen in the machine bureaucracy as the tasks performed in algocratic organizations are still very complex and control of them can only be exercised via the data analysis of the algorithmic systems. In contrast to the machine bureaucracy and the infocracy where control of work is unidirectionally exercised through the organizational and the information infrastructure respectively, the algorithmic systems are to be used bidirectionally. Professionals are required to use their reflective and analytical skills to question and improve the functioning of the algorithmic systems as they ultimately are also tools for the professionals to perform their work more effectively and efficiently. In the algocracy, the algorithmic systems also come along with higher levels of centralization. Decisions that have been taken at the level of the operating core in the professional bureaucracy, can be steered from superior levels, especially from the strategic apex. Moreover, hierarchization and formalization are higher. The automated advice provides a dynamic but standard course of action which allows it to take note of and sanction divergent social action. This promotes obedience and gives more ways of control to the strategic apex which is the key part of the algocratic organization.

Table 6

Comparative analysis of the structural elements between machine bureaucracy and infocracy as well as professional bureaucracy and algocracy

Rational-legal authority	Machine bureaucracy	Professional bureaucracy	Infocracy	Algocracy
Standardization	of work	of skills	of work	of work (& skills)
Specialization	unskilled	professional	unskilled	professional
Centralization	high; limited horizontal decentralization	low; horizontal and vertical decentralization	lower; horizontal decentralization	higher; vertical centralization
Hierarchization	high	low	lower	higher
Formalization	high	low	lower	higher
Key part	technostructure	operating core	technostructure	strategic apex

Notes: own depiction

In this final section of chapter 3, the characteristics of the four ideal types, machine and professional bureaucracy, infocracy as well as algocracy, have been summarized so that their differences become clear. It has been shown that the machine bureaucracy and the infocracy as well as the professional bureaucracy and the algocracy resemble one another in many regards. However, the infocracy and the algocracy are to be seen as manifestations of a continued development that comes along with technological advancements which result in more rationalized forms in which rational-legal authority are exercised.

It has been shown that the infocracy reduces hierarchization, formalization, centralization, and specialization compared to machine bureaucracy. Nevertheless, control and obedience rise in the infocratic organization which cannot be explained by the machine-bureaucratic mechanisms.

In contrast, it has been found that the algocracy promotes standardization, centralization, and hierarchization compared to the professional bureaucracy. Rising levels of control and obedience are, therefore, logically consistent from a bureaucratic perspective. However, neither the (machine and professional) bureaucracy nor the infocracy can explain how these high degrees of standardization, centralization, and hierarchization can be achieved in organizations that are tasked with non-routine work. This can only be understood and explained when the functioning of the algorithmic systems and their automated advice based on probability are taken into account. This is the contribution of

the algocracy in the tradition of ideal types that further the understanding of the exercise of rational-legal authority.

This completes the literature-based construction of the algocracy. This has been the first step of the ideal type's development. In the following chapter, the ideal type will be used to analyze the case of predictive policing at the Berlin police. This will show which characteristics of the algocracy will be demonstrated by the case. This is done for the purpose of accentuation which means the purposive overstressing of the most prevailing characteristics of the ideal type.

4. Empirical exploration: Predictive policing

In this chapter, the predictive policing case will be presented to illustrate the theoretically based characteristics of the ideal type with the aim of stylization ('Steigerung'), i.e. the over-stressing of typical elements, making them over-explicit for demonstrative purposes. This means that the case is not a test of a finished ideal type, but it is rather another step of its construction process. This chapter will therefore focus on producing demonstrative and lively descriptions of the ideal typical characteristics based on the empirical data. The guiding research question asks: *Which characteristics of the algorithmic ideal type are demonstrated by the case of predictive policing at the Berlin police?* In the first section of this chapter, the predictive policing literature will be briefly presented to establish the context for the following empirical description. In the second section, the status quo of predictive policing in Germany will be described. The following section is concerned with predictive policing at the Berlin police and is sub-divided into parts about the Berlin police organization and the evolvement of predictive policing at the Berlin police as well as about KrimPro's, the predictive policing system, technology and usage. In the fourth section, it will be demonstrated in detail how KrimPro shapes the Berlin police. Finally, a conclusion will be drawn on how this case illustrates the characteristics of the algocracy.

4.1 Predictive policing literature

In this section, a brief overview of scientific literature on predictive policing will be given. This will be done to theoretically contextualize the following exploration of the predictive policing system of the Berlin police. The phenomenon called predictive policing is not consistently defined in the scientific literature. However, Meijer and Wessels (2019) made the effort to conduct a systematic literature review which resulted, inter alia, in a comprehensive definition comprising the aspects of predictive policing considered as consensual:

> "Predictive policing is the collection and analysis of data about previous crimes for identification and statistical prediction of individuals or geospatial areas with an increased probability of criminal activity to help developing policing intervention and prevention strategies and tactics." (Meijer & Wessels, 2019, p.3)

Thus, predictive policing consists at least of two parts. First, it draws on data and their analysis. Data, often in an unstructured form, come from a wide range of sources and are analyzed using data mining techniques to get insights into crime developments (Meijer & Wessels, 2019). "This indicates that all data is relevant, whereas the traditional policing methods only rely on criminal data." (Meijer & Wessels, 2019, p.3). This means that predictive policing models, like risk terrain analysis or more advanced hot spot identification models, include a variety of data without self-evident value for the estimation of criminal activity (Meijer & Wessels, 2019). However, these data are potentially relevant as they might lead to more accurate models (Meijer & Wessels, 2019). Therefore, not only data that have been selected with theoretical motivation are used, but predictive policing models are also data driven (Meijer & Wessels, 2019). The authors (Meijer & Wessels, 2019) report, for example, that besides crime data selected due to near repeat theory, i.e. the assumption "that future crimes are more likely to take place near to the time and place of current crimes" (Meijer & Wessels, 2019, p.3), data indicating weather conditions are used for the spatiotemporal prediction of crime.

Second, this data analysis informs police strategy and tactics and is linked especially to the usage of preemptive measures (Meijer & Wessels, 2019). This means that the estimation of future risks of criminal behavior enabled by predictive policing systems put emphasis on the prevention of said predicted crime (Peeters, 2015). Predictive policing is regarded to support police forces "to deploy their resources more efficiently and effectively" (Meijer & Wessels, 2019, p.3). Besides this general benefit, Meijer and Wessels (2019) identified two more specific advantages of predictive policing which are claimed in the scientific field's literature. They are related to the two levels on which predictive policing systems can operate. Firstly, "resources can be deployed more accurately in place and time" (Meijer & Wessels, 2019, p.3). As most predictive policing systems conduct data analysis to identify areas with a high risk of crime in a certain period of time, they have to be seen as a (additional and) potentially more precise information source for the planning and execution of police operations (Meijer & Wessels, 2019). However, some more advanced predictive policing systems estimate risks of criminal activity for individuals either as an offender or as a victim (Meijer & Wessels, 2019). Therefore, predictive policing systems are, secondly, regarded "to identify individuals that potentially will be involved in an act of crime" (Meijer & Wessels, 2019, p.4).

On the other hand, the scientific literature reviewed by Meijer and Wessels (2019) also warns against potential downsides of predictive policing. First and foremost, predictive policing models draw on

advanced and complex technology (i.e., algorithmic analysis of data) that might not be entirely understood by law enforcement professionals and might further the opacity of decision-making processes (Meijer & Wessels, 2019). These issues regarding comprehension and transparency, might lead to a lack of accountability (Meijer & Wessels, 2019). Thus, the division of responsibilities for decisions made by predictive policing systems might be uncertain (Meijer & Wessels, 2019). Moreover, discriminatory practices, e.g., the stigmatization of groups and individuals, that result from biases in the data and in the (trained) algorithmic models might not be uncovered due to the lack of transparency (Meijer & Wessels, 2019). Also, it might be difficult to take action against discrimination due to the lack of accountability. Furthermore, predictive policing can potentially lead to other unintended consequences as well as raises "more fundamental concerns regarding privacy and ethics" (Meijer & Wessels, 2019, p.6).

In sum, those practices are characterized with the term predictive policing that include the algorithmic analysis of data to predict the likelihood of criminal activities either on a spatiotemporal or on an individual level. This is done to support decision-making on police strategies and tactics. Hence, predictive policing systems seems to meet many characteristics of the algocracy as developed in chapter 3.

4.2 Predictive policing in Germany

In this section, a brief overview of the emergence and proliferation of predictive policing in Germany will be given to provide additional information on the broader context of the following case of predictive policing at the Berlin police.

Predictive policing emerged in the United States of America at the end of the previous decade (Egbert, 2018). The topic gained popularity due to the austerity policy following the financial crisis as well as due to the allegations of racism with which the police was confronted (Egbert, 2018). Nowadays, law enforcement agencies in the US use relatively advanced predictive policing systems, but predictive policing has also arrived in continental Europe, for example, in Germany (Egbert, 2018). According to Egbert's (2018) comprehensive assessment of predictive policing in Germany, all German states have addressed the question whether to test or implement a predictive policing system. For example, all state-level criminal police offices took part in a workshop on predictive policing lead by the federal criminal police office (Egbert, 2018). The main driver behind the proliferation of predictive policing in Germany was the rapidly increasing number of burglaries ten years ago and in the following, the growing political and medial pressure to find adequate measures to reverse or at least stop this trend (Egbert, 2018). This has led to the emergence of a main type of

applied predictive policing in Germany (Egbert, 2018): The usage of a separate forecasting system for the statistically based and algorithmically processed prediction of spatiotemporal parameters of domestic burglaries. Despite this common ground established by the apparent relevance of the topic for German law enforcement, there are big differences between the German states with regard to the advancement of their respective predictive policing efforts (Egbert, 2018). This is caused by Germany's federal structure. As most policing tasks lie within the responsibility of the states, not the federal government, but the states decide about the implementation predictive policing systems.

Bavaria has taken a pioneering role with regard to the use of a predictive system in everyday policing practices in Germany (Egbert, 2018; Knobloch, 2018). The Bavarian police has introduced the predictive policing system 'PRECOBS' in 2014 (Egbert, 2018). 'PRECOBS' has been developed by a private research institute in Germany (Egbert, 2018). It resembles the 'PredPol' system which is widely used in the US both of which rely on the near repeat method (Knobloch, 2018). However, 'PRECOBS' targets only domestic burglaries. The system is also used in other countries (e.g. Switzerland) and in a pilot run in the German state of Baden-Wuerttemberg (Egbert, 2018; Knobloch, 2018).

The German states Hesse (KLB-operativ), Lower Saxony (PreMAP), and North Rhine-Westphalia (SKALA) have developed their own predictive policing programs on the basis of existing software components (Egbert, 2018; Knobloch, 2018). The predictive policing system 'SKALA' takes a special role among the systems in Germany. According to Egbert (2018), it is the only one that can be attributed to Risk Terrain Analysis method. 'SKALA' is more advanced than the other 'near repeat' systems as it is draws on more criminological theories and is based on a wider range of data sources; some of them are external to the police organization (socio-economic, demographic, and infrastructural data) (Egbert, 2018; Knobloch, 2018). Moreover, 'SKALA' is currently the only system that is used to predict offences beyond domestic burglaries, namely burglaries in buildings used for commercial purposes and car thefts (Knobloch, 2018).

Predictive policing seems to be attractive for police forces also in Germany. All German states have looked into the topic; at least six of them are using predictive policing software in some form. Also, the police in the German capital has developed its own predictive policing system which is called 'KrimPro'. It has been introduced in 2016 and has been tested and gradually integrated in the every-day work of the Berlin police since then. A detailed description of the Berlin police and KrimPro will be given in the following section to accentuate the characteristics of the algocracy.

4.3 Predictive policing in Berlin

In this part, the case of predictive policing at the Berlin police will be described in detail. For this, it will be made use of the findings from police documents (marked with a 'R') and interviews (marked with an 'I') with the staff of the Berlin police as well as the author's own observations. First, a literature-based description of the Berlin police organization will be given including its departments, responsibilities, and legal framework. Then, the development of the predictive policing system will be retraced. The third part will take a closer look at the technology of the KrimPro system. Finally, the usage of the predictive policing system at the Berlin police will be discussed. These steps are taken to develop a comprehensive understanding of the Berlin police and the KrimPro system before it is investigated which characteristics of the algocracy are demonstrated by this case. This case has been chosen because a self-developed predictive policing system enables the Berlin police to share insights into the system's technology, for example, with researchers. Moreover, predictive policing at the Berlin police seems to be a fitting case as the organization shows characteristics of the professional bureaucracy.

4.3.1 The Berlin police

As part of the executive authority of the German state of Berlin, the Berlin police, officially named 'Der Polizeipräsident in Berlin' (literally: The police commissioner in Berlin), is responsible for averting threats to public safety or order in the state territory (ASOG Bln, 2006). Within this responsibility, the Berlin police must prevent crime as well as prosecute criminal offences also by taking preventive action (ASOG Bln, 2006). The authority, responsibilities, and tasks of the Berlin police are regulated by federal law ('Strafprozßordnung') and by state law ('Allgemeines Gesetz zum Schutz der öffentlichen Sicherheit und Ordnung in Berlin'). Most importantly, they must be in

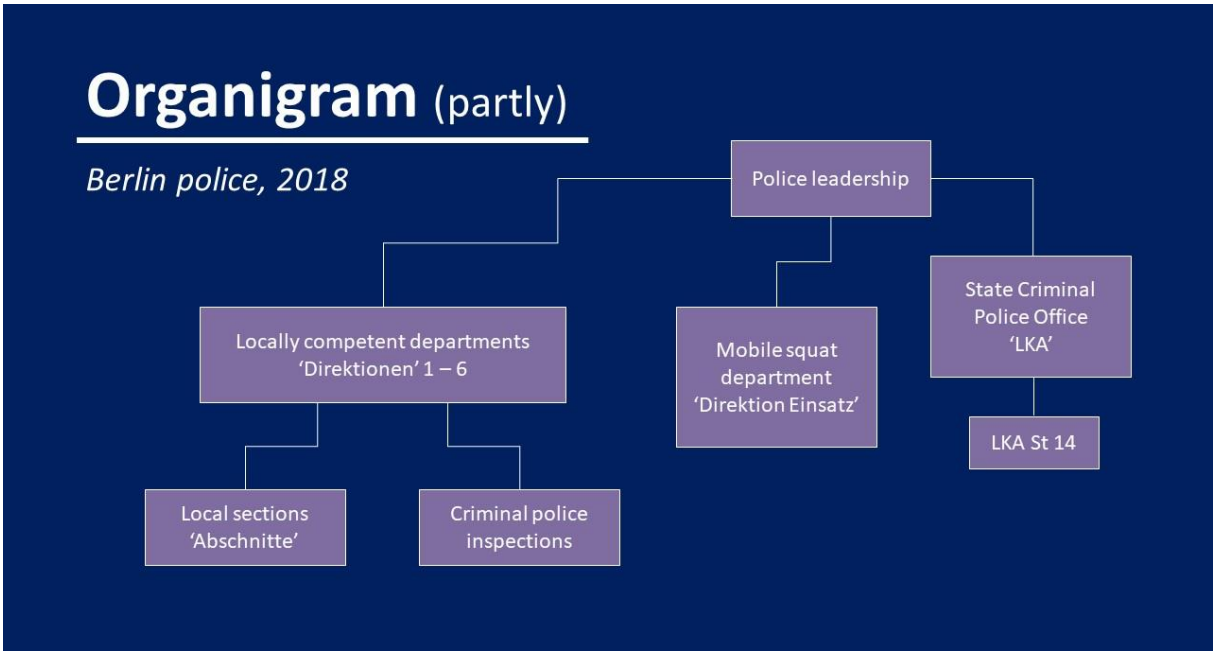

Figure 2: organigram of relevant departments of the Berlin police; own depiction based on Polizei Berlin (2018)

accordance with the fundamental rights laid down in the German constitution, the 'Grundgesetz' (Kugelmann, 2012). The constitution also establishes the federal order with the distribution of competences between the federal government and the states (Kugelmann, 2012). Accordingly, most policing tasks lie within the responsibility of the states (Egbert, 2018). The Berlin Senate Administration for Internal Affairs and Sports is the political supervisory authority of the Berlin police.

Whereas the tasks and responsibilities of the state police forces are rather similar across the German states, their organizational form and capacities differ widely which reflects the existing differences between the German states themselves (Kugelmann, 2012). In the city state Berlin, the police force is subdivided into six locally competent departments, called 'Direktionen' (Polizei Berlin, 2018). For example, Direktion 2 is responsible for the city districts Spandau and Charlottenburg-Wilmersdorf (Polizei Berlin, 2018). Each of these departments is again divided into criminal investigation departments for particular offenses (e.g. burglaries) and into 6 (except Direktion 4: 7) sections (Polizei Berlin, 2018). The sections harbor the constabulary police and manage the emergency response for subparts of the department's city district (Polizei Berlin, 2018).

The seventh department, 'Direktion Einsatz', has the largest number of police officers at their disposal which are organized as mobile squats that are deployed mainly to deal with large-scale events like demonstrations, public celebrations, and soccer matches (Polizei Berlin, 2018).

Besides the police academy as well as the police leadership around the commissioner and the vice commissioner, the Berlin police has another important department: the State Criminal Police Office ('Landeskriminalamt'; LKA) (Polizei Berlin, 2018). It is responsible for very serious offences like organized, white-collar, and drug-related crime (Polizei Berlin, 2018). The LKA cooperates closely with the six departments regarding these and other serious offences (Polizei Berlin, 2018). It is also active in the field of prevention and advises police leadership (Polizei Berlin, 2018).

4.3.2 Emergence of predictive policing

The interest of the Berlin police in the topic of predictive policing originated from long-existing efforts to move from yearly retrospective analyses of crime developments to analyses on a daily basis. This led to the implementation of a data-warehouse in 2005. The data-warehouse is a database in which data from all departments of the organizations are brought together and that guarantees a uniform and consistent standard regarding its availability and quality. Around 2012, the Berlin police came more directly in contact with predictive policing. Staff from a department in the LKA responsible for the crime statistics and analyses (LKA St 14) that inform the strategic orientation of the Berlin police were confronted with the topic on expert conferences. A German software

company, the 'Institut für musterbasierte Prognosetechnik' (IfmPt), developed the commercial predictive policing software PRECOBS. The IfmPt introduced their system to the professional public, including the Berlin police, trying to find a police force as a pioneer for predictive policing in Germany. The Berlin police was interested, but not convinced also due to the high acquisition costs. However, the Bavarian police bought PRECOBS in 2014. In the following time, staff from the above-mentioned Berlin LKA department were in contact with and visited the police in Munich to learn from the Bavarian police's experience with PRECOBS. This made the Berlin police think more deeply about the requirements necessary for the implementation of predictive policing in Berlin.

We reached the point that we said, we have all the information. We get them on a daily basis. So, we do not need additional ways of collecting information; we do not have to burden anyone. (…) We just have to make better use of the treasure that we already have. (I1, 1)

Thus, the data that has been collected on a daily basis for years in the data-warehouse proved to be a key factor in the development of the predictive policing system. In the middle of the year 2015, this led to the preliminary conceptualization of the police-internal development of a predictive policing system which was approved by the police leadership. After a first working group had made little progress, a smaller team of about four staff members proceeded their work in part time and under the radar. Two staff members of the LKA ST 14 contributed criminological expertise, whereas two police-internal programmer that were also responsible for the data-warehouse provided the technological know-how. Additional programming expertise was added by external consultants from

Figure 3: timeline of the emergence of predictive policing at the Berlin police; own depiction

Microsoft with which an advisory relationship has already existed as well as from the Microsoft-associated company Oraylis. Moreover, meetings and workshops were organized with staff members from the locally competent Berlin police departments; in particular with information analysts and criminal police commissars responsible for fighting domestic burglaries.

This development phase started at the beginning of 2016. In this time, also the political interest in the topic increased. The Senate Administration for Internal Affairs and Sports who is responsible for police matters in Berlin asked for progress with regard to predictive policing. This interplay of growing attention for the predictive policing efforts from politics and police leadership and close cooperation between professionals of the LKA as well as police-internal and external programmers resulted in a quickly progressing and goal-oriented development of a predictive policing system. This initial programming was finished in June 2016 and the predictive policing systems was called 'Kriminalitätsprognose Wohnraumeinbruch' (KrimPro). Subsequently, KrimPro was subjected to a first two-week test run under real working conditions in two of the six locally competent police departments. This phase ended with a report on the quality of the predictions and the programs practical applicability. The police leadership decided to continue the development of the predictive policing system with an extended test run. Finally, the Senator for Internal Affairs and Sports presented KrimPro to the media and the general public.

After further programming, an extended nine-month test run of KrimPro in all six locally competent police departments started in October 2016. This test run was used to closely monitor the quality of predictions and the numbers of burglaries per month. Moreover, the LKA St 14 attempted to resolve issues regarding applicability of the program and acceptance by program users who are to put the predictions into practice. Again, the test run ended with a more elaborate report on KrimPro. The predictive policing system was left in place in all six locally competent departments which marks the de-facto implementation of KrimPro in the Berlin police, even though it is not officially implemented and still runs as a test. Nevertheless, first efforts are undertaken to extend KrimPro to be used to predict the risks of other offences like car (parts) theft.

4.3.3 KrimPro: technology

KrimPro is an algorithmic system that is based on data mining, pattern recognition and prediction and that makes use of machine learning technology. For this, it requires large amounts of data. The data that contain information on registered offences by the police are made available via the data-warehouse. These data are kept up to date via an information system that processes information on police operations. Information on domestic burglaries that are entered into the information system until midnight are made available until about 6 a.m. on the following day via the data-warehouse. These data are immediately fed into the KrimPro system. Moreover, KrimPro can access data from

2010 onwards. They contain information, inter alia, on the location and (period of) time of the crime, modus operandi, and stolen goods.

Furthermore, police-external data are also fed into KrimPro. The data stem from a geo database system of the state authority for statistics of Berlin-Brandenburg and contain the following information:

- Geographical coordinates
- The location of train stations
- The location of motorway junctions
- The quality of residential areas (simple, mediocre, good)
- The level of noise pollution in an area
- The amount of damage caused by domestic burglaries in an area
- The age structure in an area (in age groups)

All these data are made publicly available by the authority for statistics. For KrimPro, the geographical coordinates which are the official representation of the regional geographical structure are used to divide the Berlin territory into sections of the size of 400 by 400 meters. About 5,000 of these quadrants cover the territory that is of interest; excluding areas beyond state borders and without buildings (like parks and lakes). The quadrants are the geographical units for which KrimPro estimates risk scores.

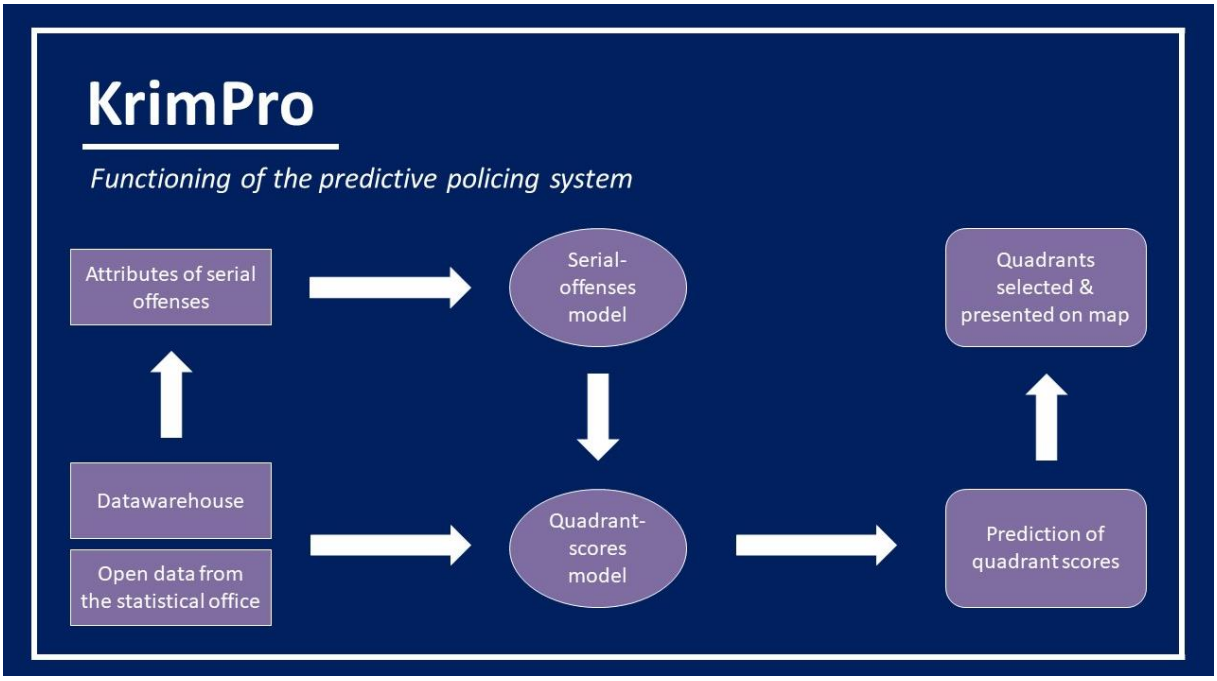

Figure 4: schematic representation of KrimPro; own depiction

Quadrant-scores model

So, first and foremost one thinks about what could possibly have an influence on a prediction of burglaries. And that is basically what is already included in the near repeat approach. (I6.2, 2)

The theory "that future crimes are more likely to take place near to the time and place of current crimes" (Meijer & Wessels, 2019, p.3) is called near repeat. This assumption that originated from the prediction of earthquakes was transferred to burglars, especially those that are professionally organized in groups (Knobloch, 2018). Based on a rational-choice calculation, professional burglars are expected to show this pattern to maximize their profit while minimizing their efforts (Knobloch, 2018). Once they have made the effort to find and spy out a neighborhood as well as (successfully) burgled a house, they are likely to use their gained knowledge again and burgle another house in close proximity. Based on this theory, various figures are calculated that represent information on the occurrence of domestic burglaries for KrimPro. For example:

- all quadrants with domestic burglaries within the past three days
- all quadrants without domestic burglaries within the past three days
- all quadrants with neighboring quadrants with domestic burglaries within the past three days
- all quadrants with domestic burglaries and a following burglary within three days

Whereas the calculation of these figures is motivated by the near repeat theory, their usage in the predictive model is left to the program. Machine learning allows that structures and patterns are automatically recognized in the data and used to establish relationships between data points. More specifically, as the desired output of the system is known, namely the probable risks of domestic burglaries, supervised learning is applied to automatically identify and weight variables from which the output can be estimated best.

Next to these data that contain information on registered domestic burglaries, the publicly available demographic and infrastructural data are analyzed by the algorithmic system. This is in line with data mining approaches for which basically all data are valuable as the chance that relevant structures in the data are uncovered increases with growing amounts of data. Therefore, the analysis of data often is not theoretically motivated, but it is data driven. With KrimPro, this is also the case: *Sometimes we have a clear thesis and we think 'ok, that certainly is important' (…), but at other times we said, 'no idea, whether it is of relevance', but we can just try it out. And then we will see. And maybe it will provide us with a new insight.* (I1, 3)

In principle, it is not harmful to make data available to the system or to broaden the range of data. If they are not relevant, if they are not recognized as valuable by the program, then they will just be

there, but they do bother anyone. So, when I add Hertha's (Berlin's football club) football results from the weekend to the system and I say: 'Ok, in a week in which Hertha has won maybe more or less crime will occur or not'. If it does not correlate or form any patterns, then the information is not harmful, the information just is not helpful. (I6.1, 4)

Thus, both data sources are used to train a model by applying supervised learning techniques. This model a set of decision rules, also called an algorithm, can then be used to analyze other data in order to make predictions about the risk of burglaries at a certain time in a certain place. *Of course, it recognizes patterns. That is the secret of all of these data mining procedures, right?! So, principally one provides the system with test data. It (the system) knows, what is supposed to be the output. It has a variable of which it knows the output values. And it tries to find structures in the test data with which it is able to predict the results and with them it builds a set of rules. And this set of rules can be used afterwards to transfer it to unknown data and to make a prediction. So, actually the question that is asked all the time is: Can I divide the data in 'burglary' and 'non-burglary' by means of this attribute. In principle, a decision tree is put together by means of its branching, the yes-and-no-questions, it can be reliably predicted whether there is a burglary or not.* (I6.2, 5)

For KrimPro, this decision-tree is not only calculated once, but many times with randomly chosen subsets of the available data. This method is called 'random forest'. The forest, consisting of many decision trees, is finally combined into a single tree. This approach increases the quality of the model. This model is used in KrimPro to predict the risk scores for domestic burglaries in the quadrants making up the Berlin territory. However, this quadrant-scores model is influenced by another model with an additional decision tree which will be described in the following.

Serial-offences model

Besides the above-described process, there is another model which is supposed to uncover which burglaries are (potential) serial offenses. *Serial offenses mean that there are two cases in spatiotemporal proximity. And if these cases show a concurring modus operandi, then they will get extra points. Depending on the modus operandi, more or less extra points. (…) So, if both burglars came over the roof, then both cases will get 300 extra points. If both cases show a modus operandi that… something which does not significantly indicate professional burglars, then both get minus points.* (I6.2, 6)

Thus, this scoring model compares concurring attributes of cases regarding stolen goods, modus operandi, and access to the crime scene. The weighting of the particular characteristics takes into account whether they indicate professionally committed serial offenses. Stolen goods like cash and debit cards indicate serial offenses, whereas stolen goods like clothing and food rather point to

occasional perpetrators or drug-related crime. The weighting of the attributes was defined in workshops with information analysts and criminal police commissars responsible for fighting domestic burglaries from the locally competent departments.

Table 7

Illustration of the weighting applied in the scoring model

Attribute	Weighting
Stolen good: debit card	+++
Stolen good: clothing	-
Modus operandi: pulling the latch of the door	++++
Modus operandi: unlocking the door	+
Access: over the roof	++++++
Access: door	++

Notes: own depiction based on Polizei Berlin (2018)

Also, for this model a decision tree is produced from a set of rules regarding the attributes that are believed to help identify serial offenses. If a certain threshold is exceeded, then the corresponding case is marked as a presumed serial offense. This assessment is considered by the quadrant-scores model described above.

Prediction of risk scores

Whereas the scoring model for serial offenses does not change automatically, the quadrant-score model is newly calculated every month so that it is responsive to potential changes. So, the daily predictions of the risk scores is made with the same model for a month. However, every day new data can be added to the data base (data-warehouse) that is used for the prediction.

The prediction is queried automatically in the morning of each working day. A risk score for each of the 4,473 quadrants is estimated. However, to improve the usefulness of the prediction for the police officers the number of quadrants with a displayed risks score is reduced. Each day only up to three areas consisting of several quadrants are provided by KrimPro for the entire state territory. Single quadrants are not handed out as this is considered unfitting for police work regarding domestic burglaries. This means that areas for which a high risk of domestic burglaries is estimated are always larger than 400 by 400 meters which is the size of a single quadrant. The prediction is valid for three days. However, each (working) day a new prediction is added which can lead to an overlap between predicted areas.

The predicted areas are displayed on a map providing an overview of the geographical distribution of the probable high-risk areas in the Berlin region. Additionally, map sections for a more detailed display of the predicted areas are given out by KrimPro. Each quadrant in the predicted areas shows its attributed risk score and a color which depends on the level of the estimated risk.

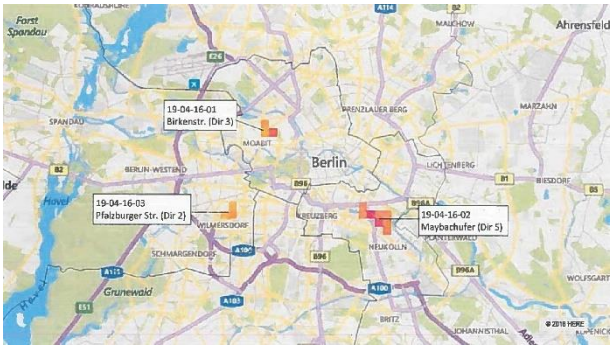

Figure 5: overview map; source: Polizei Berlin

Figure 6: detailed map section; source: Polizei Berlin

In sum, KrimPro shows many of the characteristics of algorithmic systems as conceptualized in chapter 3. KrimPro has been developed by the Berlin police. It makes spatiotemporal predictions of risks of domestic burglaries. The system applies machine learning techniques for data mining and pattern recognition to analyze data from police-internal and external sources. Areas for which a high risk of domestic burglaries was estimated are displayed on maps to inform police operations. How the predictions produced by KrimPro are subsequently used in the police organization will be discussed in the following.

4.3.4 KrimPro: usage

Staff from the LKA department for crime statistics and analyses (LKA St 14) operate KrimPro on a daily basis. Usually between 6 and 8 a.m., they briefly check the prediction that is queried automatically for potential technical issues. Then the maps are produced that illustrate the predicted areas with probable high risks for domestic burglaries. The maps are distributed in pdf format as email attachments. The staff from LKA St 14 adds some additional information: where the predicted areas are, for which period of time the prediction is valid, and characteristics of burglaries that are potentially linked to the prediction. Moreover, a list with burglaries and their characteristics that have been reported in the previous days is attached. This email is sent to the locally competent departments (‘Direktionen 1 – 6’) as well as to the department that coordinates the mobile squats (‘Direktion Einsatz’) and an LKA department that coordinates police operations.

The locally competent departments

In the locally competent departments, the information analysts and criminal police commissars in the police inspections that are responsible for fighting domestic burglaries receive the KrimPro report. Staff in both positions are responsible for the specialist assessment of the predictions as they are supposed to be an additional source of information for the planning of local police operations. *This management process does not work automatically: The prediction does not have to be followed. But prediction means a human decides 'do I accept that' or 'no, do not send officers there, send them somewhere else'. And that of course has an effect that can lead to – and I do believe it – that the predictions that might be a bit better are selected and supplemented by this human assessment when actually an experienced person says: 'So, this prediction, sorry, howsoever you came up with this, I do not believe it. But this one, yes, this makes sense.' So, he decides that police officers will be deployed for this predicted area, but not for the other one.* (I1, 7)

A unit of information analysts (about 3 employees) is placed at the level of the local departments; with the exception of department 2 where an information analyst is directly placed in the criminal police inspection for domestic burglaries. The information analysts are liaison officers between the LKA and the locally competent departments. They are responsible for assessing information for the operational police work regarding not only domestic burglaries but many different offenses. The information the analysts assess especially regards reported offenses in a particular field of crime and descriptions of potential suspects. *When we hand out the predictions to our colleagues, we always ask them: 'Take a look at them. Consider your own insights. And when you think that you should not follow the prediction, you do not have to. If you have diverging insights, then do not follow the prediction. It is not obligatory.* (I6.1, 8)

So, if they receive a KrimPro report that shows areas with a predicted high risk of domestic burglaries in a city district of their competence, the information analysts check a database in which all criminal activities regarding domestic burglaries that are known to the police are listed. The database, an excel document, contains information on the domestic burglaries, e.g. on the site and time of the crime. The information analysts typically add the information on known domestic burglaries that have happened recently in the area with a predicted high risk to the report received from the LKA St 14. Moreover, they assess the KrimPro report based on that information regarding recent crime developments in their department's districts. For example, if a burglar who is believed to be responsible for a series of offenses has been detained by the police on the previous day, the prediction of high risk for the area in which that burglar has supposedly committed crimes has likely become groundless. The information analysts, however, do not make any decisions; they just

forward the enriched KrimPro report to the department's criminal police inspections that are tasked with the crime control regarding a particular type of offense (e.g. burglaries).

Each of the six local departments has an inspection for domestic burglaries. The head of the inspection plans and decides about police operations regarding the respective offense in the department's districts. He or she receives the KrimPro report directly as well as a version assessed by an information analyst. The head of the inspection has a limited number of criminal police officers at his or her disposal, inter alia, a so-called operational component which is a group of five to eight civilian policemen and women. These can be deployed to observe potential suspects and investigate burglaries. Uniformed police officers perform preventive work as increasing visibility, establishing contact to persons with a high risk of committing offenses, and informing residents about how the risk of burglaries can be reduced by distributing leaflets or talking to them (e.g. about fully closing their windows when leaving the house). The (enriched) KrimPro reports are only one source of information for the head of the inspection to make a decision on operations. They receive information from various officers on the ground, e.g. from units covertly observing, investigating, and overtly demonstrating police presence. It is the head of the inspection's core competence to know the structures of criminal activities in his or her district to make well-informed decisions on the deployment of units.

Moreover, the sub-sections of the locally competent departments that harbor the constabulary police and manage the emergency response for subparts of the department's city district receive the KrimPro reports. The police units that respond to emergencies are instructed to take a look at the predictions and to patrol areas with high risks more intensively if they have spare time. However, it seems to differ between departments and sub-sections how much effort is made to implement this. Furthermore, some sub-sections plan and carry out their own preventive practices for which KrimPro reports are used as a source of information.

Additional police officers: 'Direktion Einsatz'

In the past, we have always asked what to do with these human resources. How do we deploy them meaningfully? (I1, 9)

KrimPro reports are also received by the department ('Direktion Einsatz') that coordinates mobile squats operations, mostly at large-scale events like demonstrations. If there are no such events, mobile squats can be deployed for other operations. *The 'Direktion Einsatz' actually is the human resources pool which is especially targeted by KrimPro. Because it is clear, as it is with these forces, that they have to hold reserves for large-scale operations. So, because they have these reserves, the*

question is: What do they do with their time when they do not have operations? And that of course is exactly where this program wonderfully fits in. (I1, 10)

The heads of the mobile squat units are advised to take the KrimPro reports into consideration and to execute operations in the predicted areas. This is a chance for the locally competent departments to get more human resources for fighting domestic burglaries in their city districts. *Then contact is established. Sometimes, even directly by the 'Direktion Einsatz' (…). They call the locally competent department. And they respond – I hope, usually – that they are happy to get some more police presence in the area.* (I1, 16)

This coordination with the locally competent departments and inspections for domestic burglaries in particular is necessary because they have the overview of past and ongoing operations in their area. For example, it can happen that the presence of uniformed police officers from the 'Direktion Einsatz' would counteract covert police operations performed by the locally competent department.

Gathering information on conducted operations

Besides information on criminal activities, information on police operations are also gathered. All police units are required to report information on their operations, e.g. location, duration, number of involved police officers, and purpose. The information is stored and processed in an information system. All operations that have taken place in areas with predicted high risk of domestic burglaries by KrimPro are marked with a particular code. It does not matter whether or not the operations are linked in any way to domestic burglaries. For example, traffic checks in KrimPro areas are also marked with that code because the police argue that any police presence might affect the risk of burglaries. The operations are marked with the KrimPro code to evaluate the quality of KrimPro predictions in relation to conducted operations.

In conclusion, the Berlin police that is responsible for averting threats to public safety or order in the state territory has developed a predictive policing system as a tool for the future-oriented analysis of crime trends that builds on technological advances in the field of algorithmic data analysis. KrimPro is an algorithmic system that deploys machine learning technology for data mining, pattern recognition, and predictions. It calculates the probability of domestic burglaries on a spatiotemporal level for the state territory of Berlin by making use of internally and externally collected data. In this way, KrimPro informs decision-making processes on police operations that are supposed to prevent domestic burglaries. This means that based on algorithmic data analysis KrimPro provides automated advice and suggest a particular course of action based on the probability of criminal activity. Thereby, KrimPro performs non-routine work that is carried out by police professionals with high levels of expertise. These professionals are asked to assess the advice of the algorithmic system; however,

they can be rewarded with additional police units when they accept the predictions of KrimPro. Hence, the algorithmic system is believed to quantify and reduce the uncertainty that is inherent in the non-routine work of analyzing crime trends and it is used to coordinate the performance of tasks in the police organization. In the following section, it will be examined which consequences this use of KrimPro has for the organization of the Berlin police. In particular, the five structural elements of organizations; centralization, hierarchization, standardization, specialization, and formalization; will be discussed.

4.4 How KrimPro shapes the Berlin police

In this part, it will be explored which characteristics of the algorithmic ideal type are demonstrated by the case of predictive policing at the Berlin police. To do this the interviews with the staff of the Berlin police, the police documents, and the author's observations have been analyzed by making use of the characteristics of the algocracy for the coding. In the following, the findings of this analysis will be presented. Many direct quotes will be used to convey a vivid image that shows how KrimPro shapes the Berlin police organization as precisely and authentically as possible. The findings that will be presented in this chapter ought to give an answer to the sub-question: *Which characteristics of the algorithmic ideal type are demonstrated by the case of predictive policing at the Berlin police?* This question will then be answered in the following section.

As described in the preceding sections, KrimPro has been developed and implemented and is now operated by staff from the state criminal office department of the Berlin police (LKA St 14) that is responsible for strategic analytics and statistics. Thus, KrimPro adds a new layer to the assessment procedure of criminal activities at the top of the police organization. The LKA St 14 had not been tasked with the analysis of crime trends for police tactics and everyday operations before KrimPro was introduced. *A layer of observation that did not exist in the decentralized structure has been introduced centrally (…). It was never the plan that we here (at the LKA St 14) would have anything to do with running KrimPro. (…) It does not belong here. We are not a deployment-controlling department.* (I1, 12) Nevertheless, KrimPro is operated from this central organizational position now. Thus, the LKA ST 14 intervenes in the decision-making on the deployment of police units to fight domestic burglaries. The KrimPro predictions have a direct effect on the decisions made by the head of the correspondingly tasked inspections. Before the implementation of the KrimPro system, the LKA St 14 did not have any leverage over these decision-making processes. Staff from the locally competent departments clearly identify this shift of decision-making competence that is caused by KrimPro: *That (KrimPro) is something from the LKA. It has been imposed on us here.* (I2, 13). *It would be desirable to have it (the operation of KrimPro) placed not so far away from the practical work.*

(I5.5, 14) This practical work of the police professionals entails non-routine tasks as assessing information in order to identify serial offenses for which counteractions can be planned.

But what makes it possible that decision-making competence is added at a central position in an organization in which professionals conduct non-routine work at the level of the operating core?

With KrimPro the performance of these non-routine tasks of the police professionals are automated by relying on algorithmic data analysis. *In this way, the comparative work of an information analyst, who (ideally) also observes offenses that show spatially and temporally proximity and their criteria and who tries to establish links between these offenses, is automatically performed by the program.* (R1, 15)

Besides the information analysts, these tasks are also performed by the heads of the inspections that are responsible for fighting domestic burglaries. *That had basically been our work also before KrimPro that we of course recognize that we have an accumulation in an area, an accumulation of a particular modus operandi. (…) And then I also had to react to that and had to send operational units (…).* (I4.1, 16)

Even though the heads of the inspections as well as the information analysts are experts in this domain, it also seems difficult for them to identify the characteristics that are effective for the detection of serial offenses in the field of domestic burglaries. The identification of serial offenses and patterns in criminal activities is, therefore, non-routine and time-consuming work. The professionals that are tasked with accomplishing this work have to be highly trained and experienced. *Yes, what are these serial characteristics? What could be put into the matrix, so to speak? (…) That are just various characteristics that then also create something special in their interplay… Prying open a door is pretty general on its own. If that is, however, combined with a particular stolen good or a time of day, then, in turn, it will be distinctive.* (I5.5, 17) This means that only particular combinations of characteristics might be indicative for serial offenses. In a workshop with the professionals, the LKA staff that developed KrimPro tried to collect these characteristics. Especially, the heads of the inspections responsible for domestic burglaries were targeted by these workshops as they have a lot of knowledge on domestic burglaries and the characteristics of (potential) serial offenses that can be used for their detection. Their skills and knowledge were used to develop a scoring model for the identification of serial offenses (see section 4.3.3). This model makes it possible that KrimPro performs analyses and automatically gives advice that resemble the non-routine tasks that are conducted by the police professionals.

What does it mean for the Berlin police organization that KrimPro performs analyses that resemble the non-routine work of the professionals?

Even though KrimPro's functioning resembles the interpretations undertaken by the information analysts and the head of the inspections tasked with fighting domestic burglaries, the algorithmic systems' *approach, a probability-based prognosis, is in fact clearly different from the detective approach used for the case processing by the criminal police* (R2, 18). KrimPro relies on algorithmic data analysis to automatically give advice and set standards for decisions and actions. Thereby, KrimPro initiates a chain of events that begins with the KrimPro reports that are sent from LKA St 14 to the other departments. *The principle is: We forward all predictions. (…) That is a principle that we continue to apply very thoroughly (…). It would be dishonest if we suppressed predictions that just look weird.* (I1, 19). *The handling of the reports is institutionalized to a great extent. That works… who gets to know what and how (…).* (I6.1, 20) So, there are standardized ways of distributing KrimPro reports within the police organization which also implies that the workflows of the staff that operates KrimPro at LKA St 14 are coordinated with those of the staff of the local departments that subsequently process the information that is provided in the KrimPro reports. However, this is not the only coordination process that is necessary. Especially between the mobile squats department ('Direktion Einsatz') and the locally competent departments in the field of domestic burglaries mutual adjustments is required. This has led to an intensification of internal communication for which (informal) rules have emerged. *I count then on a call from the mobile squats department. This KrimPro report that I get via email also goes to other departments, inter alia, to LKA 12 and the 'Direktion Einsatz' that directs then the mobile squats.* (I4.1, 21)

They call me and tell me that they have some time. 'What are we supposed to do?' And I make a proposal usually. And then they drop by here and get information materials from us. (I5.1, 22)

A KrimPro report that indicates a high risk of domestic burglaries for a particular neighborhood is followed by a call from the mobile squats department ('Direktion Einsatz') to the department responsible for the corresponding region. The 'Direktion Einsatz' offers to send units to support operational measures. In areas for which a high risk of domestic burglaries is often predicted this can lead to an oversupply of mobile squats. *It is relatively easy to get… Sometimes, the mobile squats are even almost forced on one when the 'Direktion E' calls (…).* (I1, 23). Sometimes, *we get more units than necessary, for example, 10 groups of patrolmen, or whatever, offered due to KrimPro.* (I5.1, 24) This means that KrimPro is followed by highly standardized actions that might be ineffective at times. The oversupply of additional units can, however, be stopped by the heads of the inspections who are granted the freedom to make a decision against the standard procedure. *The prediction does not*

have to be followed. But prediction means a human decides 'do I accept that' or 'no, do not send officers there, send them somewhere else'. (I1, 25)

To be able to make a useful assessment of the predictions produced by KrimPro, however, an understanding of the system's mode of operation as well as analytical and reflective skills are required; for example, to think about the sources of the data and which data have not been used as well as resulting effects. As the system is self-developed by the police, there are no legal restrictions preventing the police to be organization-internally transparent about KrimPro's mode of operation. In contrast to a purchased proprietary predictive policing software like PRECOBS, KrimPro enables the Berlin police to provide actual insights into the system to the staff. However, this possibility has only been used to a very limited extent and seems also to be regarded as dispensable by several respondents: *I have no inkling of KrimPro.* (I3, 26). *(…) a training is not necessary for us. (I5.1, 27)*

But training courses, to my knowledge, were also not necessary because the program itself is just operated by the LKA St 14 department. That is already something almost scientific, technical. It is not possible to teach that to anyone. (I2, 28)

This perception of the staff from the locally competent departments seems to conflict with calls for a critical engagement with the predictions from supervisory departments, especially the LKA St 14. They hope that the predictions are complemented with additional information at the local departments. *If KrimPro becomes increasingly integrated into the everyday working area of the information analysts, then they have to deal with it more intensively of course. And if they intensify that and for my part, also gladly with a critical impulse like: 'Ehm, this prediction seems to be stupid. How did it come to this? I'll take a look at it.' Then, they will look into the data, in the information. And then it can happen that they say: 'No, this still is bullshit.' Or they say: 'Now I have an idea.'* (I1, 29)

However, KrimPro makes use of a complex algorithmic analysis. *Well, basically it is a complicated program, complicated computations that are behind that. It is not possible to go into detail, but that is why there is the group at the LKA headquarters that take care of that (…). (I5.1, 30)* So, how KrimPro produces the advice seems to escape the understanding of the respondent or at least he does not regard it as his task to acquire a deep understanding of KrimPro's functioning. This is in contrast to the idea that the police professionals who are responsible for fighting domestic burglaries should decide which KrimPro advice should be followed and which not. If they do not understand why the algorithmic systems gives the advice, a rational decision on whether the advice is plausible seems to be impossible. Additionally, the police professionals can be biased towards compliance as non-compliance might entail greater risk. If they reject the prediction and therewith additional units

and a crime is committed that might have been prevented by these units, they put themselves in a bad light. On the other hand, the heads of the inspections do not risk anything when they just comply with the assessment provided by the KrimPro report and deploy additional units even if these extra efforts appear to be ineffective. Respondent I1 describes it like this: *I get additional units here now. I can accept them. I do not risk anything because even if I find it stupid and nothing happens there or even if something happens, it will not be my responsibility. I have not done anything wrong. But maybe I say in a discussion with my colleagues and other professionals: This is total nonsense. Units are being wasted. – I deliberately exaggerate this. But it is important to ask exactly these questions.* (I1, 31)

Consequently, it seems unlikely that the KrimPro prediction is discarded which makes it de-facto a standard that can only be overcome with additional effort and potential risks for the deviator. In addition, hierarchical mechanisms seem to push for compliance as higher-level function-holders are associated with more approval than lower-level professionals. *As I have told you already, the heads of the locally competent departments are on average; that was my impression of the matter; rather open to that. If a head of a department notices 'huh, it does not work out in my department', the police commissioner is maybe also a bit skeptical already and is like: 'What is up? Why does this department not participate anymore?' Then, I cannot rule out (…) that internal processes are executed that exert some pressure. And therefore: Yes! Yes! Yes! That is not an easy position for anyone who actually really rejects this system because there is always some kind of pressure, even if it is not clearly legally formulated: 'You have to do this.' But of course, there is de-facto pressure.* (I1, 32)

This means that KrimPro's automated advice works as a coordinating mechanism within the police organization. KrimPro does that most importantly by setting new standards regarding the decision-making on where to deploy units to fight domestic burglaries. In its weakest understanding, KrimPro offers a guideline for decision-making that can be followed, but that can also be easily rejected by the professionals. However, it has been shown that professionals experience pressures that limit their free choice. Therefore, attributing greater importance to KrimPro means that a standard course of action is determined by the algorithmic system's automation of advice that can only be overcome against all odds and only with additional justification. Asking a respondent under which circumstances he would reject a KrimPro report; especially whether he would reject it because he does not trust the report; he answered: *Yes… well now. Only because I do not trust the report? No!* (I3.1, 33) The respondent thinks twice about the answer and concludes that he has to have a valid reason for rejecting the report and the offered units from the mobile squat department. He explains, that a valid reason for doing so would be *that I am conducting other operations (…) and they would*

be torpedoed (I3.1, 34) by the mobile squat units. This means that the heads of the inspections must justify their decisions which are documented as data on all operational measures taken by the police are collected and stored in a database. *That is documented in a patrol-monitoring sheet. On this sheet, I have to document everything: When did I take over the patrol car? Was it fully equipped? When did I start? Where did I go? Did I register an offense? And in case I drive through the KrimPro-area, then I have to document that as well. Then, the supervising group leader receives the sheet.*

After that, the information is transferred from the sheet to a database. This is a database that has been set up for the 'Direktion Einsatz', the mobile squats department, and in which all numbers, data, and facts are gathered, when, by whom, how, where, and what was done. And then, this is added: (…) We have done KrimPro basically means we have just driven through the street and yes.

There are also guidelines that require us to write that down in the database in a sense so that it is transparent how often, where, and when there has been a patrol. (I4.2, 35). This makes it possible to analyze in which predicted high-risk areas which and how many operational measures were implemented. *And the operational measures; at the beginning they have been a little bit the quality issue: at first they were recorded manually and therefore poorly analyzable; bad quality. It has gotten better. By now it is also widely forced. A forced input into a database in which we record all operational measures with the deployed personnel and the time spent. And we also can then automatically match the operational measures with the corresponding predictions.* (I1, 36)

Thus, the Berlin police has standardized the ways of data collection by enforcing the use of information systems to record the key features of performed operations. This standardization was justified by KrimPro's need for high-quality data. Additionally, workshops have been organized to call the staff's attention to this issue. This means first and foremost that information, for example, on stolen goods, must be directly and immediately transferred from criminal complaints to the database. Besides the need for high-quality data that is used for KrimPro predictions and the assessment of their quality, the data on operational measures can also be used as a hierarchical mechanism of control. This data in combination with the advice provided by KrimPro not only limits the professionals' choices by setting a standard, but it also allows that deviations from the KrimPro advice are documented. Besides the traceability of deviations, the hierarchical structure enables also the sanctioning of dissenters, especially so as higher-level function holders seem to be more positive about KrimPro than lower-level staff.

Managers can mostly even be convinced of such an approach more easily than those that have conducted the information analysis in accordance with the conventional method so far, so to speak, and that have familiarized themselves with the topic. And they have a bit of a problem with that a

department that has actually nothing to do with the analysis for operative purposes has developed this approach and tells them now how it is actually done best or differently. (I1, 37) Thus, existing hierarchical structures are used to implement KrimPro in the organization. As described above, subordinate units are instructed to assess KrimPro predictions. This does, however, not mean that they can choose freely whether or not they want to use the system. If a department stops using KrimPro predictions, supervisory function holders might intervene. This emphasizes the hierarchical organizational structure without introducing new or enlarging existing levels of management. Instead the centralization shows subordinates the limits of their competences, especially with regard to the availability and deployment of additional units. *Our competence is being questioned here. When we say: 'No, something is going on in front of the building and to the right.' And the program says: 'to the left'. And I do not get units for an operation on the right, but I only get units for an operation on the left. (…) One gets units more easily when one says: 'Attention, we have a prediction here, and I think that is really great.'* (I1, 38)

Even though KrimPro produces advice far away from its implementation, it is often perceived as binding because KrimPro makes use of hierarchical structures in which every function has to answer to a higher level. KrimPro can, therefore, also empower certain functions. For example, KrimPro makes it possible for heads of inspections that are responsible for fighting domestic burglaries to get more personnel. *It is easier. Now, it is an automatism of course. Before (KrimPro) a head of a locally competent inspection for domestic burglary did not get additional police forces. It was unthinkable in the past that one can steer the mobile squats like that. And now it happens very often. That the mobile squats are not available because they are at demonstrations or other events and that they, thus, cannot do our operation, that may well be. But in most cases – without that I could prove it statistically – our operations take place. And we get some kind of feedback. And it might be that the leaflets that are distributed sometimes are demanded from us and distributed in high numbers. So, operations are taking place and I am happy about that of course…* (I4.1, 39)

And respondent I5.3 reports that he uses KrimPro to justify particular decisions: *In that way, I have also the possibility (…) to say: 'Come on, people. We have to do some prevention here.' I can just justify it better. I can just supposedly… pretend to have some kind of reason, simply give another reason that I say: 'Go outside, do some preventive work. We have a predicted area.' And therefore, it has accomplished something for us. So, for the management of units in itself. And it works exactly like this (…).* (I5.3, 40)

Besides this interference of the central unit into decisions that had been made fully decentralized before KrimPro was introduced, the process of making decisions that had already been made fully centralized is enhanced by KrimPro. The system's predictions and the analysis of their quality in

relation to conducted police operations provides the LKA St 14 with more information that might help them to make well-informed decisions. After all, the department that pushed the development of the predictive policing system is responsible for *conducting statistical assessments and creating the crime statistics and furthermore having the tasks of keeping an eye on the crime development in Berlin citywide, recognizing trends, but rather from a strategic point of view* (I6.1, 41). Moreover, the LKA St 14 department also answers inquiries from the Berlin house of representatives and press inquiries which are two of the most important external supervisory actors of police work. The direct supervisory body, however, is the Berlin Senate Administration for Internal Affairs and Sports that might also gain more control over the police organization due to the use of KrimPro: *The quality of the predictions was about 80% in past November. That slowly became scary. Because I also do not want this. If we produce prediction qualities that come close to 100%, then the question will eventually be raised: 'Yes and why did you not order a policeman to stand on the doorstep of each house in each high-risk area?' That is also not what we want. Because then we will not be able to use the system as flexible anymore as we would like to do it. (I1, 42)*

Thus, as the presumed spatiotemporal risks of domestic burglaries become calculable and therefore known, the police can be held accountable more easily for each non-prevented, conducted domestic burglary in one of the high-risk areas. Hence, the control and obedience relationship that is inherent in rational-legal authority is emphasized and promoted by the use of KrimPro at the Berlin police. This even exceeds organizational boundaries.

4.5 The algocracy: empirical illustrations

In the preceding sections of this chapter, the predictive policing literature has been briefly discussed to set the scene for the following discussion of the case of predictive policing at the Berlin police which includes: a description of the Berlin police, the development of predictive policing in the organization, the technological characteristics of the predictive policing software KrimPro, and the use of KrimPro by the Berlin police. Finally, it has been demonstrated how KrimPro shapes the Berlin police organization. The findings from this preceding part, will be summarized in the following to answer the sub-question: *Which characteristics of the algorithmic ideal type are demonstrated by the case of predictive policing at the Berlin police?*

It has been shown that the Berlin police's inspections that are responsible for fighting domestic burglaries are tasked with non-routine expertise-based work. This especially regards the identification of crimes committed by serial offenders which is one of the main strategies pursued by the Berlin police to reduce the number of domestic burglaries. KrimPro is used to automate this

work. This is done by relying on a scoring-model that aggregates insights of the professionals into their identification strategies of serial offenses and by performing algorithmic data analysis. Based on this, KrimPro automatically gives advice to the heads of the responsible inspections, i.e., identifying the areas for which the probability of domestic crime is especially high. In this way, KrimPro sets a standard course of action that can either be followed or rejected by the heads of the inspections. They and the information analysts are asked by the LKA St 14 to critically assess and if deemed implausible to reject the advice given by KrimPro. However, several factors impede a useful assessment. First, even though KrimPro is not a proprietary system, the heads of the inspections and the information analysts have limited knowledge of its functioning. This leads to low levels of confidence in the capacities of KrimPro and reduces the staff's ability of a rational assessment. Second, high confidence in KrimPro at the top of the organizational hierarchy pushes for the KrimPro predictions to be used at the level of the operating core. Third, the acceptance of KrimPro's advice is easier, less risky, and is potentially rewarded with additional units. The rejection of KrimPro advice entails considerably greater risks than accepting it, especially as the availability of additional police units for fighting domestic burglaries depends on the acceptance of the KrimPro predictions. The rejection of a prediction and of the mobile squat units that come along with it requires significant additional justification. If a head of an inspection cannot or is not willing to make an extra effort to justify the rejection of the KrimPro report, the mobile squats units might be deployed at times more due to the standardization caused by KrimPro than because it is regarded an efficient use of police forces.

With KrimPro a new organizational layer has emerged that is involved in the analysis and control of crime developments in the field of domestic burglaries. It has been introduced at a central and superordinate position compared to the locally competent departments. Without KrimPro the standardization and formalization of the police professionals' work were virtually impossible as individuals' decision-making could not be linked to increasing or decreasing numbers of domestic burglaries which is typical for expertise-based work. KrimPro's standardization of the professionals' work allows higher levels of control of decision-making processes from this central position. Deviations from the standard, i.e., the advice provided by KrimPro, are easily traceable as all police operations are recorded and fed into a database by default. This standardization of data collection is justified with the aim of higher data quality, but it serves also as a hierarchical mechanism of control. Besides the traceability of deviations which resembles the function of formalization, the hierarchical structure allows also the sanctioning of dissenters, especially so as higher-level function holders seem to be more positive about KrimPro than lower-level staff. Moreover, the higher levels of control that are made possible by KrimPro's automated advice also exceed organizational

boundaries. Political function holders like the Senator for Internal Affairs and Sports of Berlin might be able to exercise control much more fine-grained if predictions become increasingly reliable.

In conclusion, the case of predictive policing successfully demonstrates characteristics of the algocracy. KrimPro is operated on a central organizational level. The predictions standardize and formalize the work of the professionals who are tasked with the decision-making on operative measures. The use of the automated advice is promoted by rewards and hierarchical mechanisms. The control of the performance of non-routine work increases and even exceeds organizational boundaries.

5. Conclusion

In this final chapter, the results of the construction process of the algocracy are presented. The algocracy is an ideal type that has been developed by means of theoretical and empirical explorations. In a first step, scientific literature on related ideal types, i.e., machine and professional bureaucracy as well as infocracy, and on algorithmic systems has been discussed from which the characteristics of the ideal type were derived. Moreover, expert interviews were conducted to test the validity of the theory-based characteristics. In a second step, the case of predictive policing at the Berlin police has been discussed in detail. The literature-based characteristics of the ideal type has been used to analyze the empirical phenomenon. Thereby, it has been explored which ideal typical characteristics are demonstrated by the case. Based on these two steps, a conclusion will be drawn to answer the main research question in the first section of this chapter. Afterwards, the results are discussed to work out the significance of some of the algocracy's most important facets. Then, the theoretical and practical implications of this research are discussed. This thesis ends with a discussion of this study's limitations and avenues for future research.

5.1 The algocracy

In this section, the findings from the theoretical-based construction of the ideal type will be brought together with the results from the case of predictive policing at the Berlin police to present the accentuated version of the algocracy and to answer the main research question: *What are the characteristics of an ideal type that helps to understand and explain how algorithmic systems shape public organizations?*

In this thesis, the algocracy has been developed. Like the machine and professional bureaucracy as well as the infocracy, the algocracy is an ideal type of an organizational form in which rational-legal

authority is exercised. In contrast to these other ideal types, the algocracy helps to understand and explain how organizations are shaped by algorithmic systems. Algorithmic systems are based on the processing of huge amounts of data and make use of machine learning and artificial intelligence to conduct probability-based analyses like data mining, pattern recognition, and predictions. This enables the automation of non-routine work and the reduction of uncertainty associated with expertise-based decision-making processes that come along with the performance of non-routine tasks. This means that the algocratic organizations is a further rationalized configuration of the professional bureaucracy as the infocracy is a further rationalized configuration of the machine bureaucracy.

The standardization of skills that is achieved by training and gaining experience in the professional bureaucracy is used for the development of the algorithmic systems in the algocracy. For example, the Berlin police developed a scoring model for the identification of serial offenses in the domain of domestic burglaries from the skills and knowledge obtained in a workshop with their professionals from the responsible departments. The skills are aggregated and formalized by putting them into the form of an algorithm. Based on the formalization of the professionals' expertise and the algorithmic data analysis, the production of advice is automated. This allows a reduction and quantification of the uncertainty that is inherent in expertise-based decision-making processes. For example, KrimPro, the predictive policing system of the Berlin police, automatically calculates in consideration of potential serial offenses the probability of domestic burglaries on a spatiotemporal level for the state territory of Berlin on a daily basis. In contrast, identifying serial offenses in order to reduce the risk of domestic burglaries is a difficult and time-consuming task with inherent uncertainty for police professionals. The automation of this non-routine work enables the management of decision-making process at the level of the operating core from a centralized organizational position.

Thus, in the algocracy, decision-making competences are centralized that are necessarily decentralized in the professional bureaucracy. For this, the algocracy falls back on mechanisms that are also known from the machine bureaucracy and the infocracy. First and foremost, standardization of work processes enables this centralization. In contrast to the machine bureaucracy and the infocracy, standardization of work is, however, not reached through laws and rules. That is only possible if an organization performs routine-work. Instead standardization of work is realized by the algocracy's prime coordinating mechanism: the automated advice that is based on probability. With it, the algorithmic system sets a standard for decisions and actions; hence, by giving recommendations it predetermines a particular course of action. In contrast to the rules that govern the machine bureaucracy and the infocracy, these standards are not static and generally valid, but they are dynamic and tailor-made. The standards based on the algorithmic system's advice perform,

thereby, the same task as the standardization of skills in the professional bureaucracy. They can be applied to professionals' non-routine work. However, instead of relying on individuals' professional but still uncertain and subjective judgement, the algocracy's standardization is based on the supposedly objective algorithmic analysis of data. For this, high-quality data are needed which come from inside and outside of the organization. Internal processes are subjected to standardization to ensure the required quality of the data. This goes hand in hand with an increase of formalization which typically is low in the professional bureaucracy. The standardization of work that results from the algorithmic systems' automation of advice enables the formalization of non-routine work in the algocracy. Instead of written rules that determine social action and written reports that give an account of the proper social action, the algocracy formulizes by means of advising social action based on algorithmic data analysis and by collecting data on social action that in turn is analyzed. Deviations from the standard set by the algorithmic system's advice are, therefore, traceable and sanctionable by means provided by the organization's hierarchical order. Hence, in the algocracy, control and obedience are strengthened compared to the professional bureaucracy.

This challenges the foundation of professional labor which is characterized by a high division of work and little vertical control in the professional bureaucracy. In contrast to the machine bureaucracy and the infocracy where control is exercised through organizational and informational infrastructure respectively, the algocracy's mechanism of control is the automated advice that is based on probability. Besides its controlling function, the advice requires professional scrutiny and implementation as well as enables professionals to conduct their work potentially more effectively and efficiently. For this, the professional bureaucracy's skill set is not sufficient anymore. In the algocracy, professional labor requires analytical and reflective skills and the proficient use of probability-based advice.

To answer the research question that asked *what are the characteristics of an ideal type that helps to understand and explain how algorithmic systems shape public organizations*, the algocracy has been developed in this thesis. In conclusion, the algocracy shows the following characteristics:

- The algocracy is shaped by algorithmic systems that automatically produce advice that is based on probability.
- The automated advice is used as the algocracy's prime coordinating mechanism. This means social action within an algocratic organization is steered by this advice.
- Due to its probability-based algorithmic data analysis, the automated advice quantifies the uncertainty that is inherent in professionals' expertise-based work.

- The automated advice reduces uncertainty by standardizing and formalizing non-routine professional labor.
- Thereby, decision-making competences are centralized, and the organization's hierarchical order is strengthened. The strategic apex gains in importance.
- Professional labor is, therefore, subjected to greater control which makes the algocratic organization more obedient towards its leadership and political master.
- Consequently, by reducing and quantifying the uncertainty of decision-making processes in organizations that perform non-routine tasks the algocracy further rationalizes the exercise of rational-legal authority in comparison with the professional bureaucracy.

5.2 Discussion

As discussed above, the algocracy is a further rationalized version of the organizational configuration known as the professional bureaucracy. This has been shown by means of similarities regarding the kind of work that is performed (i.e., professional non-routine tasks) contrasted with the differences in mechanism that are used to structure the organization (e.g. standardization of skills vs. standardization of work). Moreover, the case of predictive policing at the Berlin police has been used to accentuate the theory-based ideal type. In chapter 2.2, the selection of this case has been justified by its typicality with regard to its form of organization. In particular, it has been argued that the police can be regarded as a typical bureaucratic organization. However, to be most suitable for the illustration of the algocracy the Berlin police should specifically resemble the characteristics of the professional, not of the machine bureaucracy. In this way, it would be possible to show that the characteristics of an organization that are understood and explained best by the ideal type of the professional bureaucracy can be better understood and explained by the algocracy if this organization makes use of an algorithmic system.

The Berlin police is a rather complex organization with competences and responsibilities divided between many different departments. Especially, in the rather large operating core big differences between departments can be observed. The constabulary police that is organized in the earlier-mentioned police sections ('Abschnitte') is responsible for the emergency response and general measures that promote the visibility of the police. This work is rather standardized and formalized by rules, but it also requires training and experience. In the police inspections each of which is responsible for the crime control of a particular type of crime (e.g. burglaries), the work is even less standardized and formalized and requires higher levels of expertise, thus, more training and experience. Hence, it closely resembles the professional bureaucracy. Moreover, as it is typical for

the professional bureaucracy police staff in the middle line and even in the strategic apex often have a professional background and have often even began their careers in the organization's operating core. What is rather uncommon for the professional bureaucracy is the strong hierarchical order in the Berlin police. This can probably be traced back to the police's unique role as the organization that exclusively exercises the state's monopoly on the use of force in Germany. This monopoly which is, for example, manifested by the police's right to carry guns and use them under specific circumstances requires an organization with a strictly hierarchical structure so that responsibilities are clearly distributed, and function holders can be held accountable for their actions.

Thus, the Berlin police shows characteristics that can be attributed to the professional bureaucracy and others that are indicative of the machine bureaucracy. As explained above, ideal types are by definition so pure that no organization can show all ideal typical characteristics as conceptualized by the ideal type. However, it is possible to assign an organization to an ideal type that has the highest explanatory power. Arguably, this is the professional bureaucracy for the Berlin police; especially so when it is considered which aspects of the police organization are shaped by KrimPro. These namely concern in particular the functioning of the inspections that are tasked with crime control in the field of domestic burglaries. The heads of these inspections as well as the information analysts who conduct non-routine work, i.e. the identification of serial offenses, clearly perform professional labor. This means that the case of predictive policing at the Berlin police can indeed be regarded a fitting case for the purpose of this thesis, e.g. to accentuate the ideal type of the algocracy. The case, but especially the fact that the algorithmic system shapes the part of the Berlin police organization most profoundly that is tasked with non-routine expertise-based work, corroborates the notion that the algocracy is a further rationalized organizational configuration of the professional bureaucracy.

This rationalization is manifested in the values that are promoted by a specific organizational configuration. The values of Weber's bureaucracy are obedience, continuity, effectivity, efficiency, and calculability (Zuurmond, 1994). In comparison with the professional bureaucracy, the algocracy promotes these values more successfully. It has been shown, for example, that the automated advice quantifies uncertainties, thus ensures more calculability. Moreover, human resources can be deployed more efficiently. Besides the values of the bureaucracy, additional values are promoted in the infocracy: integrality, virtuality, massiveness, controlled complexity, and high velocity (Zuurmond, 1994). Some of them also seem to be relevant for the algocracy. For example, the algocracy seems to be able to deal with greater complexity than the professional bureaucracy. In the case of predictive policing at the Berlin police, it has been shown that even the police professionals have a hard time identifying serial offenses in the field of domestic burglaries because patterns are difficult to recognize in the wealth of information. Moreover, this complexity is even growing due to

a claimed professionalization of internationally operating gangs of burglars that make use of the freedom of movement within the Schengen area. The algocracy seems to be better prepared to deal with this growing complexity (of a late-modern world) by making use of algorithmic data analysis that allows, for example, the automation of pattern recognition. This might help algocratic organizations to better promote values like effectiveness and efficiency. For example, predictive policing has emerged as a crime control strategy in the field of domestic burglary in Germany also because the state seemed to be overstrained with the tasks of effectively fighting this type of crime. This ineffectiveness was not enough to call the legality of the statutory order and the authority of the police in Germany into question. However, the ineffectiveness led to a considerable increase of political and media pressure so that in several German states predictive policing systems were implemented to fight domestic burglary, even though this crime is virtually irrelevant from an economic perspective. Rather the impending failure of the German police to effectively exercise its rational-legal authority appears to be the reason for the implementation of algorithmic systems. Thus, when it is said that the algocracy is a further rationalized version of the professional bureaucracy, then this means that the algocracy is an organizational configuration that promotes these values more successfully. In turn, the successful promotion of these values through an organizational configuration ensures the fruitful exercise of rational-legal authority so that the legality of the statutory order is recognized and obeyed.

As discussed above, the algocracy is characterized by the automation of advice based on probability which is its prime coordinating mechanism. Thereby, uncertainty that is inherent in professionals' expertise-based decision-making is reduced and quantified as the advice is based on the algorithmic analysis of data. This is the potential of algorithmic systems; to erase human bias from non-routine decision-making processes that cannot fully be governed by rules. In the algocracy, algorithmic systems' advice can rationalize these processes more than it could be done by the standardization of skills in the professional bureaucracy. However, some scholars argue that the rationalization by automated advice is in fact pseudo-rationalization:

> "While operating under a cloak of rationality, algorithm-driven risk assessments present a specific threat because the outcomes do not 'argue' (they do not present an argument or a reasoning, which includes revealing sources and assumptions, but present a 'truth') and because they are increasingly generated automatically (not through human analysis, but through algorithms)." (Peeters & Schuilenburg, 2018, p.276)

So, two points are to be considered here. First, the automated production of advice is based on the algorithmic analysis of data. Machine learning techniques enable the analysis of huge amounts of data which proofs to be advantageous over the limited capacity of human analytical abilities.

Therefore, a proliferation of algorithmic systems has been seen in the past years. Second, due to their technological complexity, algorithmic systems raise questions regarding their comprehensibility and accountability. These have also come up in the case of predictive policing at the Berlin police. For example, an information analyst compared KrimPro with a crystal ball. Even though he was tasked with assessing the reports of the predictive policing system, he reported that he does not understand how KrimPro works. This incomprehensibility that is linked to algorithmic systems can have different reasons. For one, promoting the understanding of these systems might have been neglected in an organization. Second, the ability to understand the functioning of these systems has been furthered, but other constraints limit their comprehensibility. Third, the used technology rules out its comprehensibility. An example that has come up in one of the interviews with academic experts of the field might clarify this (EI4): Imagine the streets are full of completely autonomously driven cars which are interconnected with all other autonomous vehicles. All of them collect, share, and analyze data in real time by means of algorithmic systems. These systems are also adapting in real time to new data that are used to optimize their machine learning models. Now imagine, one of these autonomously driving cars hits a cyclist. Who is to blame for this accident? It might be very costly or even impossible to reconstruct the potentially faulty decision made by the algorithmic system in the car that has led to this accident. The dynamism of the system might prevent the ex-post reconstruction of decisions if the algorithmic system has already changed. If the reconstruction is not technologically impossible, it will at least require proper expertise and it will probably be very time consuming. This rules out that the decision-making process of each case, e.g. an accident of an autonomous car with a cyclist, can be reconstructed; especially, given the restraints resulting from output management, e.g., time pressures.

So, even though it has been shown that algorithmic systems seem to further rationalize the exercise of rational-legal authority, it appears that they can also jeopardize precisely this statutory order. Their potential incomprehensibility conflicts with values that are linked to rational-legal authority. From this perspective, it is expected that function holders can be held accountable for their actions. For this, it must be possible to comprehend decision-making processes; for example, to empower citizens to notice unjust decisions and to enable them to proceed against them. If this is not given, the use of algorithmic systems might endanger modern achievements as the rule of law and might undermine the very order, the rational-legal authority, and its exercise that they are believed to further rationalize.

Moreover, if this incomprehensibility and lack of accountability was paired with an emphasis on preventive practices by the state, this would have profound and alarming consequences. The prediction of high-risk on the level of individuals by means of algorithmic analysis and their targeting

by state authorities would lead to unprecedented levels of control and monitoring that would potentially endanger the liberal democratic basic order of modern societies. Scholars (EI4) have, therefore, warned against the use of preventive practices by the state that negatively impact individuals, e.g. curtailing rights of individuals with a predicted high risk, and demanded the use of preventive practices by the state exclusively for offering support and help to potentially at-risk individuals. What it means to be targeted by the state power because of algorithmically predicted risk scores has impressively been demonstrated by Virginia Eubanks (2018) in her book 'automating inequality' as well as by Cathy O'Neil (2016) in her book 'weapons of math destruction' that has already become a classic.

5.3 Contributions

In this section, the theoretical and societal implications of this study will be discussed. In this thesis, an ideal type has been developed that helps to understand and explain how algorithmic systems shape public organizations. This work, thereby, builds on a long existing strand of scientific literature. First and foremost, this field of expertise has been shaped by Max Weber. By developing the three ideal types of authority, Weber made not only a methodological contribution to the social sciences, but he significantly and permanently shaped the scientific community's understanding of (public) organizations. Especially with the bureaucracy, Weber inspired the research of many scholars, inter alia, Henry Mintzberg who specified Weber's ideal type.

In the 1990s, this strand of literature focused on the growing use of information technology in public organizations. A notable contribution to this was made by Arre Zuurmond who developed the ideal type of the infocracy that helps to understand and explain how information systems shape machine-bureaucratic organizations.

In the past 25 years, many technological advances have been made. Not all of them and their use in public organizations can be subjected to the infocracy, let alone the bureaucracy. This thesis takes a look at the latest wave of technology, by investigating the use of algorithmic systems in public organizations. An emphasis has been put on how this new technology shapes organizations which allows conclusions on their attainment of objectives and prioritization of values. In doing so, a contribution is made to this strand of literature that understands organizations as socio-technical systems.

Through public organizations the conditions of our societal coexistence are governed; thus, they determine how we live together. It is, therefore, a societal responsibility to hold a debate on what kind of public institutions we want to have. The scientific community can help to enable a good

debate by providing well-founded knowledge on the existing public organizations. This thesis does that, specifically by investigating how algorithmic systems shape public organizations. This allows to draw conclusions on which societal values are promoted by a particular organizational configuration and how this influences our societal order, e.g. how authority is exercised in our society. The ideal type approach that has been chosen for this study allows a broad assessment of the use of algorithmic systems in public organizations without focusing solely on the technology. Thereby, societal questions are emphasized and many starting points for debates as well as future research are pointed out.

5.4 Limitations and avenues for future research

In this final section, it will be discussed what the limitations of this research are and in what ways this thesis can inform future research. It has been the aim of this thesis to develop an ideal type that helps to understand and explain how organizations are shaped by algorithmic systems. With the construction of an ideal type, it necessarily comes along that starting points for future research are developed. The so constructed ideal type is always a demarcating concept that is justified by its ability to give research conceptual orientation (Bonazzi, 2014, p.179). Ideal types in the Weberian understanding are thus not concepts that represent an empirical phenomenon with all its details, but that emphasize the typical characteristics that help to distinguish one phenomenon from another. Hence, ideal types are supposed to stimulate the formulation of assumptions and derivation of hypotheses; thus, inspire new research. It is, therefore, the hope of the author that the reader has already found impulses for future research throughout the reading of this thesis. Additionally, some potential starting points for further research will briefly be mentioned here.

First, this research has focused on the influence of algorithmic systems on organizations especially with regard to their structural elements. However, what values are promoted by this organizational configuration has only been examined in the discussion. It might be very interesting to pursue this investigation in order to closely analyze the goals and values that can and are in fact attained by means of the algocracy. This seems to be especially relevant since questions regarding increased incomprehensibility, lack of accountability, and high levels of control are associated with the use of algorithmic systems in public organizations.

Second, the construction of the algocracy in this thesis is mainly based on scientific literature. The case of predictive policing at the Berlin police is used to accentuate the ideal type. However, the ideal type has not really been empirically tested yet. To assess the algocracy's heuristic value, future research should, therefore, use the ideal type in empirical studies. For example, in the context of his

doctoral thesis, Zuurmond (1994) operationalized the infocracy so that its characteristics could be systematically tested by means of empirical data. This has not been done here due to the limitations in terms of time and other resources that come along with a master thesis.

Third, one of the most interesting organizational characteristics of the algocracy seems to be its specialization, especially when it is compared to the professional bureaucracy. Therefore, a promising question to be researched would be how professional labor looks like in the algocracy. This could not be fully answered in this study as it has been focused on the organizational level. However, it has been shown that the work in the algocracy lies in a field of tension between increased vertical control and high requirements regarding analytical and reflective skills. The effects of the interplay between these factors and professional labor might be a fascinating research puzzle.

Fourth, it has been shown that algorithmic systems shape organizations in ways that make the algocracy a further rationalized version of the professional bureaucracy. The same dynamic has been demonstrated for the machine bureaucracy which is further rationalized by information systems and turns into the infocracy. Besides machine and professional bureaucracy, Mintzberg (1980) came up with three more organizational configurations. This raises the question what role technology, in particular algorithmic systems, plays in these organizations and whether they are shaped into forms that resemble the algocracy or the infocracy. Therefore, future research should be conducted in organizations that are regarded as simple structure, divisionalized form, or adhocracy. Especially the adhocracy appears to be an interesting case as it shows many similarities to the professional bureaucracy (e.g. professional labor).

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I. Appendix A

This appendix contains the a more detailed account of the refinement of the theory-based ideal type by means of the expert interviews.

In this chapter, the characteristics of the ideal type will be refined by means of the expert interviews. For this, statements about the main characteristics of the algocracy were formulated. After the first three expert interviews, the statements were adjusted with respect to the comments made by the interviewees. These changed statements were presented to the fourth expert and the peer group for review. In this section, each characteristic of the ideal type will be presented, discussed, and if deemed necessary, adjusted.

a) Initial version: Like bureaucracy and infocracy, the algocracy is an ideal type of authority which is defined as the legitimate power that one person or group holds and exercises over another. The algocracy is characterized by the exercise of authority through algorithmic systems.

   Proposed changes: The interviewees acknowledged the algocracy as an ideal type of rational-legal authority. In the second interview, the respondent discussed whether authority is actually exercised *through* algorithmic systems and proposed the formulation *the exercise of authority supported by algorithmic systems*. This formulation was introduced in the second round of interviews. However, the peer group criticized this formulation as too softened for the ideal typical description. In line with the above-described characteristics of algorithmic systems as mechanisms that shape the exercise of rational-legal authority and a specifically Weberian definition of rational-legal authority, the following formulation was chosen.

   Final version: Like bureaucracy and infocracy, the algocracy is an ideal type of the exercise of rational-legal authority which is defined as a command and obedience relationship legitimized through laws and rules. The algocracy is characterized by the exercise of that authority through a configuration shaped by algorithmic systems.

b) Initial version: The algocracy draws on the achievements of the bureaucracy (organizational structures, files) and infocracy (information infrastructure, data) and in turn shapes their functioning.

   Proposed changes: This statement was the last one presented to the interviewees, but it was suggested to put it in second place. It sparked discussion on the organizational layers that are affected by the introduction of algorithmic systems, especially the technostructure. In the second and third interview, it was proposed to change *shapes their functioning* into *becomes a part/layer of the exercise of rational-legal authority*. This was again criticized in the following interviews as more of an empirical observation than an ideal typical characteristic. Therefore, this part was removed from the characteristic:

   Final version: The algocracy draws on the achievements of the bureaucracy (organizational structures, files) and infocracy (information infrastructure, data).

c) Initial version: In contrast to the bureaucracy and infocracy, the algocracy draws on information sources beyond the control of the organization: i.e. publicly available data (e.g. infrastructural, demographic), data from IoT devices (e.g. sensors), internet services (e.g. social media, online shopping), and mobile phones (e.g. communication, individual motion profiles).

   Proposed changes: This statement and especially its consequences were heavily debated in the expert interviews. Bovens and Van Eck criticized the term *control* and suggested to replace it with *information sources outside of or external to the organization*. Moreover, van Eck

considered another aspect that was missing in the statement. She proposed to add that in bureaucracy and infocracy information is gathered because it is required for the decision-making by administrate rules or law. This formulation was introduced to being reviewed by the following interviewees who criticized that algocratic organizations could also be required to gather and use data from sources external to the organization. Therefore, the formulation was specified. However, the respondents also highlighted potential dangers. Zouridis warned against a reordering of the public and private spheres introduced by the increasing availability of data. Wessels reminded to think about where data come from, which data are not gathered or used and what effect this has on the resulting information.

Final version: In the bureaucracy and infocracy, an organization collects particular information in (digitalized) files for the rule-based decision-making process. The algocracy draws additionally on a variety of data that has been produced and collected externally to the organization: i.e. publicly available data (e.g. infrastructural, demographic), data from IoT devices (e.g. sensors), internet services (e.g. social media, online shopping), and mobile phones (e.g. communication, individual motion profiles).
In contrast to the bureaucracy and infocracy, not only information that is required for the decision-making process by law or administrative rule is collected and used, but additionally data that has been gathered independently of the organization is used as it is believed to be potentially beneficial.
The availability of this additional information from externally produced data and its usage by public organizations shifts the demarcation line between the public and private spheres.

d) Initial version: In the algocracy, this variety of data is processed by systems that develop dynamic and partly self-learning analytical models. The function of these models resembles the role of professional expertise in the bureaucracy and infocracy.

Proposed changes: This statement was mainly debated by the experts with regard to its potential consequences. They were especially related to the dynamic nature of algorithmic models. Zouridis remarked that decisions made by a changing system cannot be reconstructed ex-post because the system has already changed at the time of reconstruction. This leads to incomprehensible decision-making which is at odds with societal principles as the rule of law. As Van Eck noted, in more static models that do not change automatically or do so only in longer periods of time, reconstruction of decision-making might be hypothetically possible, but it is often practically not feasible due to restraints resulting from output management, e.g., time pressures. Moreover, minor changes were made in favor of a more precise terminology regarding technology.

Final version: In the algocracy, this variety of data is processed by systems that develop dynamic, machine-learning and correlation based analytical models. This makes decision-making either inherently or practically virtually incomprehensible. The function of these models resembles the role of professional expertise in the bureaucracy and infocracy.

e) Initial version: Instead of unambiguous decisions based on laws and rules as they are made in the bureaucracy and infocracy, in the algocracy decision-making is ambiguous as it is based on probability.

Proposed changes: This statement again was heavily debated. The experts brought up that bureaucratic decision-making is in fact ambiguous which is the reason for the field of tension between standardization of work and discretion on the street level. However, Zouridis noted that the algocracy does not deal with ambiguity but with uncertainty. Moreover, Bovens remarked that the uncertainty is not caused by decision-making as in bureaucracy, but uncertainty is

caused by data analysis which is probability based. This resulted in an accordingly adjusted statement which was again scrutinized by the peer group that asked whether *instead* or *additionally to* would be the correct formulation as decisions also have to implemented in algocracy. Zouridis as well as the peer group came to the conclusion that ambiguity can be reduced by automation (in infocracy as well as in algocracy). Therefore, uncertainty remains the main issue in algocracy.

Final version: In the bureaucracy and infocracy, ambiguity is caused by the implementation of laws and rules as they have to interpreted. In the algocracy, the dynamic probability-based analysis of data causes uncertainty.

f) Initial version: The algocracy's penetration into expertise- and probability-based decision-making expands its rationalization to areas beyond the confines of public service provision known from the bureaucracy and infocracy.

Proposed changes: Bovens criticized this statement for its unclear formulation *beyond the confines of public service provision*.

Final version: The algocracy's penetration into expertise- and probability-based decision-making expands its rationalization beyond the performance of routine-tasks in the field of machine bureaucracies; to non-routine tasks in the area of professional bureaucracies.

g) The growing ability to anticipate future human action and thereby reduce the unlimited number of possible futures to a few highly probable scenarios further promotes the use of preventive practices.

Proposed changes: This statement was also criticized by Bovens for an unclear formulation: *reduce the unlimited number of possible futures to a few highly probable scenarios*. Moreover, the peer group remarked that the statement was formulated as an ongoing development, but it should be static. Moreover, Zouridis emphasized the difference between prevention and precaution.

Final version: The algocracy's ability to anticipate future human action, thereby determine the likelihood of possible future scenarios, ad identifying those that are most likely promotes preventive policies and the use of preventive practices which also explains its prevalence in the domain of professional bureaucracies.

h) Additional statement: The algocracy further promotes the exercise of authority in a legal-rational way and offers new instruments of control which facilitate the obedience of the organization to its (political) master.

This statement was introduced after the expert interviews as the aspects of control and obedience came up multiple times, but they were not reflected enough in the statements above.

II. Appendix B

This appendix contains the protocol (in German) that has been used to receive informed consent from all interview participants at the Berlin police.

Informationen zum Forschungsprojekt ‚Predictive Policing' und Einwilligungserklärung für die Erhebung und Verwendung persönlicher Daten

Zuerst möchten wir uns bei Ihnen für Ihre Zeit und Bereitschaft bedanken, an diesem Interview teilzunehmen und damit zu dieser wissenschaftlichen Studie beizutragen.

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Forschungsinteresse

Dieses Forschungsprojekt besteht aus zwei Teilen.

1) Zum einen soll die Einführung und Verwendung von ‚KrimPro', des Systems für die vorhersagebasierte Polizeiarbeit der Polizei Berlin, sowie die sich daraus ergebenden Auswirkungen auf die alltägliche Arbeit von Polizisten und Polizistinnen und die Polizeiorganisation untersucht werden. Gewonnene Erkenntnisse sollen dann mit den Ergebnissen der bereits durchgeführten Studie zur Verwendung des niederländischen Predictive Policing Systems ‚CAS' durch die Polizei Amsterdam verglichen werden.

2) Zum anderen sollen die aus der Verwendung des Predictive Policing Systems ‚KrimPro' möglicherweise resultierenden Veränderungen der Organisation polizeilicher Arbeit untersucht und in den Kontext zunehmender Verbreitung algorithmischer Systeme in öffentlichen Organisationen eingeordnet werden.

Interviews und Verwendung persönlicher Daten

Um das oben genannte Forschungsinteresse zu verfolgen, sollen Interviews mit Beamten der Polizei Berlin geführt werden. Die Gespräche sollen aufgenommen werden, sodass deren Inhalte später aufgeschrieben und in der Forschungsarbeit verwendet werden können. Sind Sie damit einverstanden, dass das Interview aufgezeichnet wird?

Jegliche persönlichen Informationen, von denen ausgegangen werden kann, dass sie Sie identifizieren könnten, werden aus dem Transkript entfernt oder darin geändert. Nur diese Version des Transkripts, die eine Identifizierung nicht zulassen soll, soll anderen Wissenschaftlern zugänglich gemacht werden können, zum Beispiel zur Überprüfung der Forschungsergebnisse. Herr Schuppan und Herr Lorenz werden Verweise, die es zulassen, die codierten Transkripte den Studienteilnehmern zuzuordnen, für die Dauer des Forschungsprojekts sicher aufbewahren und nur Wissenschaftlern, die an diesem Forschungsprojekt beteiligt sind, zugänglich machen. Diese Verweise werden vertraulich behandelt. Nach Abschluss des Projekts – spätestens aber nach zwei Jahren – sollen diese Verweise gelöscht werden.

Selbsterklärung des Interviewteilnehmers/der Interviewteilnehmerin

Hiermit stimme ich zu, dass meine Daten, die für diese wissenschaftliche Untersuchung gesammelt werden, veröffentlicht oder zugänglich gemacht werden dürfen, vorausgesetzt, dass mein Name oder andere Informationen, die mich anzunehmender Weise identifizieren könnten, nicht verwendet werden. Mir ist bewusst, dass ich meine Teilnahme an dem Interview jederzeit ohne Angabe von Gründen beenden kann.

III. Appendix C

This appendix contains the direct quotes in their original German form from the interviews with staff from the Berlin police that have been translated into English by the author.

1. Wir kamen eigentlich dazu, dass wir gesagt haben, die Informationen haben wir. Die haben wir tagesaktuell. Da brauchen wir keine zusätzlichen Meldedienste; wir müssen niemanden belasten. (…) Wir müssen den Schatz eigentlich nur noch mehr nutzen, den wir ohnehin haben.

2. Also erstmal macht man sich natürlich normale Gedanken, was könnte überhaupt einen Einfluss haben auf so eine Einbruchsvorhersage. Und das ist eigentlich auch das, was in dem Near-Repeat Ansatz auch schon drinsteckt.

3. Manchmal haben wir eine klare These und denken, ok das ist bestimmt wichtig, weil damit kriegen wir mehr die Profis raus und bei anderen Sachen, da haben wir gesagt, keine Ahnung ob das irgendeine Relevanz hat, aber wir können es ja durchlaufen lassen. Und dann schauen wir. Und vielleicht ergibt sich ja doch irgendwie ein Hinweis darauf.

4. *Vom Grundsatz her ist das ja auch nicht schädlich, Daten dem System zur Verfügung zu stellen oder die Datenmenge zu verbreitern. Wenn sie keine Relevanz haben, wenn sie nicht vom Programm als hilfreich erkannt werden, dann sind sie einfach da, aber stören nicht. Also wenn ich die Fußballergebnisse des Wochenendes von Hertha irgendwie dazu tue und sage: ‚Ok, in der Woche, wo Hertha gewonnen hat, da passiert vielleicht mehr oder weniger oder auch nicht.' Wenn es nicht korreliert oder nicht Muster-bildend ist, dann schadet die Information nicht, sie nützt halt auch nicht.*

5. Logisch erkennt das Muster. Das ist ja das Geheimnis von diesen ganzen Data-mining Verfahren, nä?! Also man gibt denen ja im Prinzip eine Testmenge rein. Die wissen, was soll rauskommen. Die kennen eine Variable, wo sie die Zielwerte kennen. Und sie versuchen im Prinzip Strukturen in diesen Testdaten zu finden, mit denen sie die Ergebnisse vorhersagen können und bilden sich damit ein Regelwerk. Und dieses Regelwerk kann man dann hinterher nutzen, um das auch auf unbekannte Daten aufzusetzen und dann im Prinzip eine Vorhersage zu treffen. Also eigentlich stellen sie ständig die Frage, kann ich anhand dieses Attributs die Daten unterscheiden in ‚Einbruch' oder ‚Nicht-Einbruch'. Die stellen sich im Prinzip so einen Entscheidungsbaum zusammen, anhand dessen Verzweigungen, den Ja-Nein-Fragen im Prinzip, sie zuverlässig vorhersagen können, ob es ein Einbruch oder kein Einbruch ist.

6. Serientaten heißt dann immer, ich habe zwei Taten, die räumlich-zeitlich in der Nähe sind und wenn die einen übereinstimmenden Modus Operandi haben, dann kriegen die Pluspunkte. Je nachdem welcher Modus Operandi ist, desto höher sind die Pluspunkte. (…) Also, wenn die jetzt beide übers Dach gegangen sind, dann kriegen die beiden plus 300 Punkte. Wenn jetzt beide einen Modus Operandi haben, die… irgendwas ist, was jetzt nicht so signifikant ist für Profi-Verbrecher, dann kriegen die beide was abgezogen.

7. Wir haben ja so ein Steuerungsprozess, der nicht automatisiert sagt: Prognose heißt jetzt muss bedient werden. Sondern Prognose jetzt entscheidet ein Mensch, ‚nehme ich das an' oder sag ich ‚ne, da braucht ihr jetzt keine hinschicken, schickt's woanders hin'. Und das ist natürlich ein Effekt. Der kann ja auch noch – und das glaube ich sogar – dafür sorgen, dass eben die Prognosen, die vielleicht auch noch so ein bisschen besser sind, ergänzt um dieses Menschliche, diese menschliche Einschätzung, wo wirklich ein erfahrener Mensch sagt: ‚Also diese Prognose, tut mir leid, wie auch immer ihr darauf gekommen seid, glaub ich nicht. Aber die, ja das passt!' So jetzt sagt der, die wird bedient mit Einsatzkräften und die andere nicht.

8. Dass, wenn wir die Prognosen herausgegeben an die Kollegen, wir immer darum bitten: ‚Guckt sie euch an. Bezieht eure eigenen Erkenntnisse mit ein. Und wenn ihr meint, ihr sollt die nicht bedienen, ihr müsst die nicht bedienen, weil ihr irgendwie andere Erkenntnisse habt, dann tut es nicht. Es gibt keine Verpflichtung.

9. Früher gab es schon immer die Frage, was tun wir eigentlich mit diesen Ressourcen. Wie setzen wir die sinnvoll ein?

10. Weil die Direktion Einsatz eigentlich der Personalpool ist, auf den wir insbesondere dabei zielen. Denn es ist klar, wie das bei solchen Kräften ist, die müssen Reserven vorhalten für größere Einsatzlagen. So, weil sie Reserven haben, heißt das, was machen die in der Zeit wo sie nicht eingesetzt sind. Und das ist natürlich genau etwas, wo dieses Programm wunderbar passt.

11. Dann wird Kontakt aufgenommen. Manchmal direkt sogar von der Direktion Einsatz (…). Dann rufen sie in der Direktion an. Die sagen – hoffe ich, in der Regel – wir freuen uns, wenn wir hier etwas mehr Präsenz haben.

12. Eine Betrachtungsebene, die es dezentral noch nicht gab, haben wir hier zentral mal eingeführt (…). Das war nie geplant, dass wir hier irgendwas mit dem Betrieb zu tun haben. (…) Das gehört hier nicht hin. Wir sind keine einsatzsteuernde Dienststelle.

13. Das ist was vom LKA. Das ist uns hier aufoktroyiert.

14. Es wäre halt wünschenswert, dass es nicht so fernab der Praxis ist.

15. Auf diese Art und Weise wird die vergleichende Tätigkeit eines Auswerters, der (im Idealfall) ebenfalls räumlich und zeitlich nah beieinander liegende Taten auf Übereinstimmung in diesen Kriterien betrachtet und damit versucht Tatzusammenhänge herzustellen, automatisiert durch das Programm übernommen.

16. Das ist ja auch grundsätzlich auch vorher schon unsere Arbeit gewesen, dass wir natürlich durchaus merken, dass wir eine Häufung in einem Bereich haben, eine Häufung in einem bestimmten Modus Operandi. (…) Und dann musste ich vorher auch darauf reagieren und hab dann Operativkräfte (…).

17. Ja, was sind denn Serienmerkmale? Was könnte denn sozusagen in der Matrix hinterlegt werden? (…) Das sind halt verschiedene Merkmale, die dann auch im Zusammenspiel was Besonderes… Aufhebeln ist jetzt erstmal ziemlich allgemein. Wenn das aber in Kombination mit einem bestimmten Diebesgut kommt oder einer Tageszeit, dann ist es ja wieder markant.

18. (…) Ansatz einer wahrscheinlichkeitsbasierten Pronose tatsächlich deutlich vom detektivischen Vorgehen kriminalpolizeilicher Sachbearbeitung unterscheidet.

19. Das Prinzip ist: Wir geben alle [Prognosen] raus. (…) Das ist ein Prinzip, das wir wirklich brutal durchhalten (...). Aber es wäre unredlich, wenn wir jetzt Sachen unterdrücken, die einfach blöd aussehen.

20. Der Umgang mit den Meldungen ist weitgehend institutionalisiert. Der läuft… wer was wie zu Kenntnis bekommt (…).

21. Ich rechne dann also mit einem Anruf von der Einsatzhundertschaft. Diese Meldung, die ich per Mail bekomme, geht ja cc also auch parallel an andere Dienststelle, unter anderem an LKA Stab 12 und die Direktion E bei uns, die die dann die Einsatzhundertschaften steuern.

22. Die melden sich bei mir und sagen wir hätten dann eben Zeit. Was sollen wir machen? Und ich schlage denen das in der Regel vor. Und dann kommen die hier vorbei, werden von uns bestückt mit Informationsmaterialien.

23. Man kriegt relativ leicht dafür… Es wird einem sogar fast aufgedrängt manchmal, wenn sich die Direktion E selber meldet (…).

24. Wenn uns Kräfte im Überschuss, sag ich mal, 10 Gruppenstreifen, was auch immer, angeboten werden aufgrund dieser KrimPro-Geschichte.

25. „Wir haben ja so ein Steuerungsprozess, der nicht automatisiert sagt: Prognose heißt jetzt muss bedient werden. Sondern Prognose jetzt entscheidet ein Mensch, ‚nehme ich das an' oder sag ich ‚ne, da braucht ihr jetzt keine hinschicken, schickt's woanders hin'.

26. Von KrimPro habe ich keine Ahnung.

27. (…) eine Schulung braucht es da für uns nicht zu geben.

28. Aber Schulungen, meines Wissens, waren auch nicht erforderlich, weil das Programm als solches wird ja eben von Interviewteilnehmer (2019_04_15_m1)'s Dienststelle bedient. Das ist ja schon was fast Wissenschaftliches, Technisches. Da kann man niemanden beschulen.

29. Wenn das mehr zum alltäglichen Arbeitsfeld der Auswerter wird, dann müssen sie sich selber natürlich damit noch mehr auseinandersetzen. Und wenn sie das vertiefen und von mir aus auch gerne mit einem kritischen Impuls nach dem Motto: ‚Äh, diese Prognose kommt mir blöd vor. Wie kann das denn dazu gekommen sein? Ich gucke mir das mal an.' Dann gehen sie natürlich in die Daten, in die Informationen. Und dann kann es dazu kommen, dass sie sagen ‚ne, ist immer noch Blödsinn' oder sie sagen ‚jetzt habe ich eine Idee'.

30. Naja, grundsätzlich ist es ja schon ein kompliziertes Programm, komplizierte Berechnungen, die dahinterstehen. Da kann man jetzt auch gar nicht so ins Detail gehen, aber dafür gibt es ja eben die Gruppe beim LKA Stab, die sich darum kümmern (…).

31. ‚(…) ich krieg hier jetzt Kräfte. Ich kann die annehmen. Ich riskiere nichts, weil selbst wenn ich es blöd finde und da passiert nichts oder da passiert trotzdem etwas, ist das nicht meine Verantwortung. Ich habe nichts falsch gemacht.' Ich sag aber vielleicht in der Diskussion mit meinen Kollegen und mit anderen Fachleuten auch: ‚Es ist totaler Mumpitz. Da werden Kräfte verbrannt.' – Ich überspitze es bewusst. Aber es ist wichtig, dass man sich genau diese Fragen auch mal stellt.

32. (…) ich habe ja gesagt, dass die Direktionsleiter im Schnitt, war mein Eindruck der Sache, eher aufgeschlossen dem gegenüberstehen. Wenn da ein Direktionsleiter dann merkt ‚ups, in meiner Direktion läuft das nicht', die Präsidentin guckt mich vielleicht auch ein bisschen skeptisch an: ‚Was ist denn los? Warum macht da eine Direktion nicht mehr mit?' Dann kann ich nicht ausschließen (…), dass dann auch solche internen Prozesse ablaufen, die dann doch auch ein wenig Druck erzeugen. Und deswegen: Ja! Ja! Ja! Das ist keine bequeme Situation für jemanden, der das System wirklich richtig ablehnt, weil es gibt immer einen gewissen Druck, auch wenn der jetzt nicht klar juristisch formuliert ist: ‚Ihr müsst das machen'. Aber natürlich de-facto Druck gibt es.

33. Ja… Naja, also. Nur weil ich der nicht traue? Nein…

34. (…) dass ich andere Einsätze gerade fahre (…) und das würde dann torpediert werden.

35. Das wird dann in einem Streifenbegleitungsbogen dokumentiert. In dem muss ich alles dokumentieren: Wann habe ich den Funkwagen übernommen? War der vollständig? Wann

bin ich losgefahren? Wo bin ich hingefahren? Hatte ich da eine Feststellung? Und wenn ich durch den KrimPro-Bereich fahre, dann muss ich das eben auch dokumentieren. Der Bogen geht dann wiederum zum Dienstgruppenleiter. Dann wird das übertragen von diesem Bogen in die POLMAN-Datenbank. Das ist eine Datenbank, die hat sich die Direktion Einsatz, also die Hundertschaften, mal basteln lassen, und da werden sämtliche Zahlen, Daten und Fakten erhoben, wann, wer, wie, wo, was gemacht hat. Und dann kommt das darein: (…) Wir haben KrimPro gemacht, heißt quasi wir sind mal durch die Straße gefahren und ja. Es gibt ja auch Vorgaben, dass wir das in gewisser Hinsicht halt über POLMAN notieren sollen, damit nachvollziehbar ist, wieviel, wo, wann gefahren worden ist."

36. Und die Maßnahmen – das ist am Anfang noch so ein bisschen das Qualitätsproblem gewesen: die waren am Anfang noch mit manuellen Melden und deshalb schlecht auswertbar, schlechte Qualität. Das ist besser geworden. Inzwischen ist es auch weitgehend erzwungen. Eine erzwungene Eingabe in eine Datei, wo wir die Einsatzmaßnahmen mit Einsatzkräftestunden haben. Und wir haben dann auch automatisch die Zuordnung der Maßnahmen zu den entsprechenden Prognosen.

37. Führungskräfte meist sogar leichter zu überzeugen sind von solch einem Ansatz als die, die bisher sozusagen nach konventioneller Methodik Auswertung betrieben haben und sich dem Thema genähert haben. Und die jetzt nun schon so ein bisschen ein Problem damit haben, dass irgendeine Dienststelle, die eigentlich mit der operativen Auswertung gar nichts zu tun hat, mit so einem Ansatz kommt und ihnen nun sagt, wie es eigentlich besser oder anders geht.

38. Unsere Kompetenz wird hier angezweifelt. Wenn wir sagen: ‚Ne, ausm Gebäude und rechtsrum passiert was.' Und das Programm sagt: ‚linksrum'. Und Kräfte krieg ich aber nicht für rechtsrum, sondern Kräfte krieg ich jetzt eigentlich nur für linksrum. (…) Man kriegt leichter Kräfte, wenn man sagt: ‚Achtung, wir haben hier die Prognose und find ich ganz prima.'

39. Es ist leichter. Es ist natürlich ein Automatismus jetzt. Vorher hätte man, aus Sicht eines örtlich zuständigen Kommissariats-Leiters Wohnraumeinbruch, keine Kräfte bekommen. Das wäre früher also undenkbar gewesen, dass man da Einsatzhundertschaften so bewegen kann. Und jetzt passiert es natürlich sehr häufig. Dass die Einsatzhundertschaften zu irgendwelchen Demos und verschiedenen Anlässen überhaupt nicht abkömmlich sind und das nicht bedienen können, das mag durchaus sein. Aber in den meisten Fällen – ohne dass ich das jetzt statistisch (…) belegen kann – finden diese Einsätze statt. Und da kriegen wir auch ein Rücklauf und sei es, dass die Flyer, die manchmal auch noch verteilt werden, bei uns abgefordert werden und in einer großen Zahl verteilt wurden. Aber da finden also Einsätze statt und das freut mich natürlich…

40. So habe ich auch die Möglichkeit (…) zu sagen, ‚so Leute komm, wir müssen hier mal etwas Prävention machen.'. Ich kann es einfach besser Begründen. Ich kann da halt vermeintlich etwas… vorschieben bisschen auch als Grund, einfach einen weiteren Grund aufliefern, dass ich sage: ‚Geht raus, macht mal ein bisschen Prävention. Wir haben da einen Prognose-Raum.' Und deswegen hat es ja für uns was geleistet. Also für die Kräfte-Steuerung an sich. Und genauso funktioniert es auch…

41. statistische Auswertungen, polizeiliche Kriminalstatistik wird erstellt und darüber hinaus als Aufgabe, die Kriminalitätsentwicklung in Berlin stadtweit im Auge zu haben, Entwicklungen zu erkennen, aber eher aus strategischer Sicht.

42. Wir waren im letzten November bei 80%. Das wurde mir schon langsam unheimlich. Weil das will ich auch nicht. Wenn wir Prognosegüten erzeugen würden, die sich Richtung 100%

bewegen, dann kommt natürlich irgendwann die Frage: ‚Ja, und warum habt ihr dann nicht in jedem Prognoseraum vor jeder Haustür einen Schutzmann gestellt?‘ Das ist ja auch nicht das, was man will. Denn dann wird das System natürlich auch nicht mehr so flexibel handhabbar wie man sich das eigentlich wünscht.