The *algocracy* as a new ideal type for government organizations: Predictive policing in Berlin as an empirical case

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Abstract. Motivated by the classic work of Max Weber, this study develops an ideal type to study the transformation of government bureaucracy in the 'age of algorithms'. We present the new ideal type – *the algocracy* – and position this vis-à-vis three other ideal types (machine bureaucracy, professional bureaucracy, infocracy). We show that while the infocracy uses technology to improve the machine bureaucracy, the algocracy automates the professional bureaucracy. By reducing and quantifying the uncertainty of decision-making processes in organizations the algocracy rationalizes the exercise of rational-legal authority in the professional bureaucracy. To test the value of the ideal type, we use it to analyze the introduction of a predictive policing system in the Berlin police. Our empirical analysis confirms the value of the algocracy as a lens to study empirical practices: the study highlights how the KrimPro system conditions professional assessments and centralizes control over complex police processes. This research therefore positions the algocracy in the heart of discussions about the future of the public sector and presents an agenda for further research.

Keywords: AI, algorithms, algocracy, government organizations, public sector, predictive policing

Key points for practitioners:
- The use of algorithms in a government bureaucracy entails much more than the use of an instrument: it transforms the organization;
- Where previous technologies transformed the routine tasks in government bureaucracies, algorithms transform professionals' tasks;
- The central coordinating mechanism in an algocracy is not the standardization of work or skills but the artificial advice based on data analysis.

1. Introduction

With algorithmic systems[1] a new type of technology has been introduced to public organizations (Peeters & Schuilenburg, 2018). At the center of these systems is machine learning as a technique for

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[1]The term algorithmic system is used here to denote technologies in demarcation from 'information systems'. In contrast to the latter which can include static, manually programmed, thus rule-based algorithms, algorithmic systems are based on dynamic, 'learning', data-analysis based algorithms (Yeung, 2018; Veale & Brass, 2019). Thus, algorithmic systems are qualitatively different because they draw on the automated analysis of, often unstructured, data by making use of methods such as machine-learning to detect patterns and correlations which enables them to computationally generate knowledge (Yeung, 2018; Lodge & Mennicken, 2019).

producing new insights (Kitchin, 2014). Artificial Intelligence Applications need large datasets to infer relationships that are often concealed or at least not self-evident by applying statistical techniques. For their potential to provide important new insights, these algorithmic systems are seen as powerful tools for government organizations (Veale & Brass, 2019; Griffiths, 2019; Lodge & Mennicken, 2019).

The logic of algorithmic analysis is fundamentally different from the logic of the bureaucracy as conceptualized by Weber (2006). A bureaucracy relies on information about a single case to come to a rule-based decision. The introduction of algorithmic systems, however, enables government organizations to quantify the uncertainty inherent in decision-making processes on the basis of data analysis by expressing it as probability and to thereby further rationalize this process: even though there is no full certainty about a situation, a more rational choice can be made based on probabilities. A food inspector, for example, may not know for certain whether a certain restaurant breaks rules for hygiene but, on the basis of a risk assessment model based on large amounts of data, the inspector can make a rational choice about inspecting this restaurant even though there is no hard information that they are breaking the rules. This means that the implementation of algorithmic systems into bureaucracy results in fundamental changes in the way government organizations function.

Motivated by the classic work of Max Weber, this study will make use of ideal types to study the transformation of government bureaucracy in the 'age of algorithms' (Abiteboul & Dowek, 2019, p. 2). An ideal type is a thought construct that entails the main, symptomatic characteristics of an empirical phenomenon (Weber, 2006; Zuurmond, 1994) and therefore it can be used to understand and explain cultural developments. This paper will use the ideal type as a lens to show how the use of algorithms transforms the organization of the Berlin police and we regard this organization as an example of bureaucratic but also knowledge intensive organizations. The paper stresses that earlier waves of new technologies in the public sector mainly automated routinized organizations whereas the current wave of algorithms transforms knowledge intensive public organizations.

This paper presents a new ideal type: the algocracy. The term is composed of the word 'algorithm' and the Greek suffix '-kratia' which indicates the exercise of power through something. So, whereas the bureaucracy denotes the exercise of power through the office (Weber, 2006), the algocracy shows that power is exercised through algorithms and reveals how the organizational characteristics of government organizations that rely on algorithmic systems differ from the traditional bureaucracy. The following research question is formulated to guide our research: what are the key characteristics of the algocracy and how can this ideal type help to understand the reshaping of organizational patterns through algorithmic systems? To answer this research question, this paper will draw on theoretical and empirical explorations. In a first step, literature on bureaucratic organizations, IT in public organizations, and algorithmic systems is discussed to assess the existing ideal types and build the algocracy as a new ideal type. In a second step, the algocracy is used as a theoretical lens to analyze the empirical case of predictive policing at the Berlin police in Germany. 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 conclusion on the value of the algocracy as a lens for studying how algorithmic systems shape public organizations.

2. What is an ideal type?

In building the ideal type of the algocracy, we followed a broad tradition in the social sciences based on Weber (2006). An ideal type is defined as a thought construct that contains 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: the thought construct and the logical composition of the main characteristics.

Firstly, an ideal type is a concept, thus an abstraction of reality (Bonazzi, 2014). Ideal types do not actually exist – no organization is a bureaucracy in the full sense – but the abstraction helps us to qualify certain types of organizations and to organize the complex reality of actually existing organizations. We qualify a local government organization as a bureaucracy and thus understand the key role of procedures and formal positions in the organization even though we do not know the exact rules or the details of the organizational structure.

Secondly, even though an ideal type suggests a normative attribute, it is not an optimal or best version of a phenomenon. Weber (2006) stresses that an ideal type 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). This logically coherent version of a phenomenon is formed by the one-sided accentuation of a concrete individual phenomenon to arrange it into a unified thought construct (Weber, 2011). This accentuation is done by so-called stylization, which entails the purposive overstressing of typical elements, making them over-explicit for demonstrative purposes (Eliaeson, 1990). Where to start with the stylization is determined by the question and aim of the research and 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). The ideal type requires logically consistency and it will be judged by its usefulness with regard to understanding empirical phenomena.

3. Key characteristics of the algocracy

To evaluate an ideal type's usefulness for understanding and explaining an empirical phenomenon, it must be compared to other ideal types of the same phenomenon. Therefore, the key characteristics of the two classic ideal types of government organization – the machine bureaucracy and the professional bureaucracy (Mintzberg, 1980; Lunenburg, 2012) – and an earlier ideal type of the informatized government organization – the infocracy (Zuurmond, 1994) – are compared with the new ideal type of the algocracy in Table 1. We are aware that new models of bureaucratic organization have been developed more recently such as the neo-weberian bureaucracy (Denhardt & Denhardt, 2000; Pollitt & Bouckaert, 2011; the post-bureaucratic organization (Hekscher, 1994; Alvesson & Thompson, 2005) and the late-bureaucratic organization (Meijer, 2008). For our line of argument, however, we selected two classic models (machine and professional bureaucracy) and two modern technology-facilitated models (infocracy and algocracy) to highlight key similarities and differences between the earlier waves of informatization in the public sector which resulted in the ideal type of the infocracy and current waves of informatization which result in the algocracy.

We will briefly introduce the four ideal types. 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 work processes are highly structured and rule-based as, for example, in a tax department. On

Table 1
Comparative analysis of key characteristics of the four ideal types

	Machine bureaucracy	Professional bureaucracy	Infocracy	Algocracy
Authority exercised through …	Impersonal social order	Professional positions	Information infrastructure	Algorithmic systems
Information from …	Organizational files	Organizational files	Digitalized organizational files	Digitalized organizational files and external data sources
Processed by …	Civil servants/ unskilled labor	Public professionals/ skilled labor	Information systems	Algorithmic systems
On the basis of …	Laws and rules	Professional expertise	Coded laws and rules	Automated data analysis
To deal with …	Routine tasks	Non-routine tasks	Routine tasks	Non-routine tasks
Prime coordinating mechanism	Standardization of work	Training, experience	Programmed information system	Artificial advice based on data analysis

the contrary, the professional bureaucracy is an organization that mostly performs non-routine, expertise-based tasks and relies on the standardization of skills (Mintzberg, 1980). Because medical diagnoses and care cannot be standardized, physicians are needed who only belong to this profession because they are highly-trained and have taken a state-approved exam. Like the machine bureaucracy, the infocracy is an organization that performs routine tasks. However, instead of counting on civil servant's internalization of rules that standardize the work routines, the standardization of work is coded into the information technology used in the organization (Zuurmond, 1994). In a tax department, the information system could require that digitalized tax forms can only be submitted when they are fully filled in and logically coherent. Finally, the algocracy is an organization that performs non-routine tasks. However, instead of relying only on the expertise and experience, for example, of highly-trained physicians, medical diagnoses are performed by algorithmic systems that perform automated analyses of historical patient data. This replaces the organization's dependence on professionals expertise at least partly by analytical capacities of machine-learning algorithms (Aneesh, 2009; Yeung, 2017).

In general, all these four ideal types are systematic answers to the question how authority is exercised. Thus, we will compare the four ideal types on the basis of four elements that are central to the bureaucracy as conceptualized by Weber (2006): authority, information sources, processing and prime coordinating mechanism.

The four configurations vary in how the exercise of *authority* is organized. Authority refers to intra-organizational forms of legitimate power. The machine and professional bureaucracy exercise authority through the impersonal order of formal rules and regulations and the rule-based appointment or election of officeholders along with their formal competences, rights, and obligations (Weber, 2006; Mintzberg, 1980). In contrast, the infocracy exercises authority through information infrastructures which codify legal and organizational rules (Zuurmond, 1994). Coordinating responsibilities, such as 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 (Zuurmond, 1994). In the algocracy, authority is exercised through algorithmic systems which codify legal, organizational but also professionals rules (Peeters & Schuilenburg, 2018; Danaher et al., 2017; Coletta & Kitchin, 2017). 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 from files (Weber, 2006; Mintzberg, 1980). In addition to the rules and knowledge that needs to be internalized by the personnel, the storage of information in registries ensures the continuity of the bureaucracy. Due to their physical form, file access is limited and dispersed. In the infocracy, these files are digitalized and therefore information systems are used which allow quicker, location independent, and simultaneous access to information (Zuurmond, 1994). Moreover, information access can be managed easily which allows better control of information flows. Finally, the algocracy's information basis is not limited to internal files: it relies on internal as well as external data sources. Internally, data collection draws on files. 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) (Van Dijck & Poell, 2013; Schäfer & Van Es, 2017; Vogl et al., 2019). The analysis of these huge amounts of data can be predetermined and steered to a certain degree by the developers of machine-learning algorithms whose judgements, perceptions, and beliefs enter the system.

Processing the information to make decisions can be regarded as the key activity of all the types of government organization. In the machine bureaucracy, the information stored in files are processed by civil servants according to written laws and rules to perform routine tasks (Weber, 2006). Civil servants learn to work exactly according to written procedures. In the professional bureaucracy, organizations are tasked with non-routine work (Mintzberg, 1980). The decisions are made based on professional expertise by professionals who are selected on the basis of their formal training. Infocratic organizations again conduct routine tasks but the laws and rules that guide the work of the machine bureaucracy are enshrined in the information systems (Zuurmond, 1994; Lessig, 2006; Aneesh, 2009). In the algocracy, organizations apply advanced technologies to do non-routine work. Algorithmic systems draw on branches of artificial intelligence such as machine learning for the purpose of data mining, pattern recognition, and prediction (Cormen, 2013; Kitchin, 2014; Wirtz et al., 2018).

As for the *coordinating mechanism*, 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 (Weber, 2006). This mechanism does not work for the professional bureaucracy due to the non-routine nature of the work and therefore the standardization of skills is used as the prime coordinating mechanism (Mintzberg, 1980). As for the infocracy, the programmed information systems are used as the prime coordinating mechanism: he who controls the information systems, controls the organization (Zuurmond, 1994). Finally, the automated advice is the prime coordinating mechanism in the algocracy. The uncertainty that is inherent but concealed in the professionals' expertise-based decision-making is reduced and quantified as probability by the data analysis of the algorithmic system (Aneesh, 2009; Peeters & Schuilenburg, 2018; Mohabbat-Kar et al., 2018).

4. Structural elements of the algocracy

The aim of this article is to explore how the algocracy as an ideal type can help to understand the reshaping of organizational patterns. To realize this aim, we will now proceed to compare the structural elements of the four ideal types. These differences in tasks and how they are achieved come along with different organizational structures. The various structural elements are derived from the conceptualizations of the bureaucracy and infocracy by Weber (2006) and Zuurmond (1994; 1998), respectively. They are presented in Table 2 and discussed below.

The *machine bureaucracy* is shaped by a high standardization of work processes. Rules and laws

Table 2
Comparative analysis of structural elements of the four ideal-types

	Machine bureaucracy	Professional bureaucracy	Infocracy	Algocracy
Standardization	Procedures	Knowledge	Procedures	Knowledge
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

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 (Weber, 1901; Mintzberg, 1980).

The *professional bureaucracy* makes use of a high standardization of skills as its prime coordinating mechanism (Mintzberg, 1980). 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 space to perform their tasks. Consequently, the operating core is empowered and forms the key part of the organization.

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 (Zuurmond, 1994; Lessig, 2006; Aneesh, 2009). In this way, the key position of the technostructure within the organization gets even more strengthened. The information systems guide the work which is characterized by a fine-grained division of labor as well as high vertical control. However, the information systems 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.

In the *algocracy*, advanced technologies enable further expansion of technologies into domains of human decision-making through the standardization of skills rather than the standardization of work. Standardization of skills is achieved by the data analysis of the algorithmic system (Kitchin, 2014; Danaher et al., 2017). 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 (i.e. the most senior management level in the organization). 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.

In sum, the characteristics of the four ideal types 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. 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. While the infocracy reduces hierarchization, formalization, centralization, and specialization compared to machine bureaucracy, the algocracy promotes standardization, centralization, and hierarchization compared to the professional bureaucracy. This is the contribution of the algocracy in the tradition of ideal types that further advanced our understanding of the exercise of rational-legal authority in modern government organizations.

5. Research design: Algocracy as a lens to study the Berlin police

To explore the value of the algocracy for understanding the changing nature of government organizations we used it as a lens for analyzing KrimPro, a predictive policing system at the Berlin police. 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 that carries out tasks that are central to a state's functioning, i.e., maintaining and safeguarding public safety and order (Kugelmann, 2012). In addition, the police is an example of a knowledge intensive public organization: police professionals (re)combine various sorts of information on the basis of extensive training and expertise.

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 (Egbert, 2018; Knobloch, 2018). The interest of the Berlin police in the topic of predictive policing originated from efforts to move from yearly retrospective analyses of crime developments to analyses on a daily basis. In the middle of the year 2015, this led to the preliminary conceptualization of the development of a predictive policing system, which was approved by the police leadership and which was to be called KrimPro. The development phase started at the beginning of 2016 and an extended nine-month test run of KrimPro in all six locally competent police departments started in October 2016. 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 (R4;[2] PL1[3]). In its current form, predicted areas are displayed on a map providing an overview of the geographical distribution of the probable high-risk areas in the Berlin region. These maps are used for decisions about allocating resources to specific areas and specific tasks.

This case of the use of KrimPro by the Berlin police has been selected as it is regarded as a typical case of algorithmic systems in public organizations according to the main characteristics of the algocracy that we presented in Table 1: authority is exercised through an algorithmic system (KrimPro), with information from digitalized organizational files and external data sources (such as police files and data from other sources such as housing registers), which is processed by an algorithmic system (KrimPro) to plan police activities on the basis of data analysis and, in the end, algorithmic analysis as a prime coordinating

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[2]Internal police reports are referenced by an R and consecutively numbered.
[3]Interviewees are referred to by PL for police leadership, PS for police staff, and PO for police officers, as well as a personal identifier (number).

mechanism for allocating resources. The first step in the empirical research entailed validating the characteristics of the algocracy for the case of the use of KrimPro by the Berlin police by exploring each one of them in depth. The second step in our empirical analysis of the KrimPro-system was to study the structural elements of the algocracy (see Table 2). The characteristics that have been identified from the literature review and discussed with the experts were used as codes (e.g. Organizational structure: Centralization, Hierarchization, Formalization, Specialization, Standardization; KrimPro: Data-driven technology, Classifications, Prerequisites; Rationalization; and Counterstrategies) and the coding was performed by means of the software Nvivo. For example, if the literature review suggested an increasing centralization of organizations that make use of algorithmic systems, 'increasing centralization' was 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 was empirically substantiated and detailed and the prevalence of particular characteristics was assessed. Please note that our objective was to understand structural changes to bureaucratic organizations through the use of algorithmic systems and not to evaluate the predictive policing system or assess the efficiency and possible negative side effects (see: Meijer & Wessels, 2019).

In order to validate the key features of the algocracy and to analyze its structural elements, 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. The questions concerned the everyday practices of respondents and how the use of the system impacts the police work and organization: How do police officers use KrimPro in their everyday work? How does their everyday work change due to the use of the system? How does the use of KrimPro change the organization of work and work processes? Does the use of KrimPro have unexpected or undesirable results? How do you deal with them? Six interviews have been held with a total of 12 respondents from different levels of the police organization: 3 respondents from the department's leadership, 2 respondents from the middle management, 2 respondents from the analytical department, and 5 respondents from the operational department. All interviewees gave their informed consent. A protocol has been handed out to all respondents to inform them about the research, data protection measures, and their rights before the interview was conducted. Documents, in particular reports, internal evaluations, presentations, and communications were provided in various interviews and used for the analysis of the case.

6. Berlin police from the lens of an algocracy

6.1. KrimPro and the characteristics of the algocracy

The first step in our empirical analysis was the validation of the four key characteristics of an algocracy for the case of the use of KrimPro by the Berlin police (see Table 1). The objective of this step was to show that these four characteristics are not only a theoretical construct but can actually be identified in empirical practices.

6.1.1. Authority exercised through algorithmic systems
KrimPro makes use of a complex algorithmic analysis that cannot be fully grasped but offers advice that needs to be followed by the local units. "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 (. . .).” (PS4) 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. 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. 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 (PS3).

6.1.2. Information from digitalized organizational files and external data sources

For data mining, pattern recognition and prediction, KrimPro requires large amounts of data. “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.” (PO1) 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. 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 information on geographical coordinates, location of train stations, location of motorway junctions, quality of residential areas (simple, mediocre, good), level of noise pollution in an area, amount of damage caused by domestic burglaries in an area and the age structure in an area (in age groups) (R7).

6.1.3. Processed by algorithmic systems

Fighting burglaries is a complex process but KrimPro provides an advice for local units on the basis of extensive data analysis and machine learning. 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, with the intention to improve the usefulness of the prediction for the police officers the number of quadrants with a displayed risks score is reduced. 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 (R5; PL1). Thus, the algorithmic systems process all the information and present maps to be used in operational practices.

6.1.4. Artificial advice based on data analysis as the prime coordinating mechanism

KrimPro has become the central mechanism for coordinating police efforts around fighting burglaries and it has greatly influenced the professional based decision-making processes about allocating resources at the local units. The role of the algorithm as a coordinating mechanism does not only entail daily operations but also obtaining extra police resources for a specific task. 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.” (PS3).

Table 3 summarizes these four characteristics and shows that the emerging practices in the Berlin police are in line with the main characteristics of the algocracy.

This empirical analysis confirms that the use of KrimPro by the Berlin police can indeed be understood

Table 3
Comparing the use of KrimPro by the Berlin police to the main characteristics of the algocracy

	Algocracy	KrimPro in Berlin police
Authority exercised through …	Algorithmic systems	KrimPro
Information from …	Digital files and external data sources	Police records and geo database system of the state authority for statistics of Berlin-Brandenburg
Processed by …	Algorithmic systems	KrimPro
On the basis of …	Pattern analysis, machine learning	Machine learning technology for data mining, pattern recognition, and predictions
To deal with …	Non-routine tasks	Fighting domestic burglaries
Prime coordinating mechanism	Artificial advice based on probability	Advice from KrimPro to police professionals at competent departments

as an algocracy since the emerging practice is in line with the ideal-typical characteristics that we identified (see Table 1). The next step in our empirical analysis was to analyze the implications of the algocracy for the structural elements of the organization of the Berlin police.[4]

6.2. KrimPro and the structural elements of the algocracy

For the second step in our empirical study, the analysis of the structural elements of the algocracy, we systematically analyzed the use of KrimPro by the Berlin police in terms of the six structural elements of the ideal-type of the algocracy (standardization, specialization, centralization, hierarchization, formalization and key part of the organization).

6.2.1. Standardization
KrimPro relies on algorithmic data analysis to automatically give advice and set standards for decisions and actions. "The handling of the reports is institutionalized to a great extent." (PL2) The standardized ways of distributing KrimPro reports within the police organization imply that the workflows of the staff that operates KrimPro at the state criminal office department (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 local departments in the field of domestic burglaries mutual adjustment 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." (PS3).

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[4]This overview highlight how the algocracy can be used as a lens to understand the use of KrimPro by the Berlin police. This analysis does not show to what extent this approach is effective as several factors impede a useful assessment of KrimPro's advices. 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. This brief analysis highlights that further research is needed into the effectiveness of this organizational model.

6.2.2. Specialization

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." (PO2) This means that only particular combinations of characteristics might be an indicator 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 (PL1). 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.

6.2.3. Centralization

The introduction of KrimPro in the Berlin police resulted in a centralization of decision-making around domestic burglaries. 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. KrimPro adds a new layer to the assessment procedure of criminal activities at the top of the police organization and thus, the LKA ST 14 intervenes in the decision-making on the deployment of police units to fight domestic burglaries in the local police units. "[KrimPro] is something from the LKA. It has been imposed on us here." (PS1).

6.2.4. Hierarchization

If the police professionals who are responsible for fighting domestic burglaries 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 PL1 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." 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 no. Only because I do not trust the report? No!" (PS2) 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.

6.2.5. Formalization

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) 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 (. . .)." (PS3) 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 (PO2).

6.2.6. Key part of the organizational structure

KrimPro's automated advice works as a coordinating mechanism within the police organization. This coordinating mechanism is steered by the state criminal office department of the Berlin police (LKA ST 14). 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" (PL2). KrimPro controls organizational activities 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. 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.

In conclusion, the case of predictive policing confirms the expected structural elements of the algocracy. The transformations in the organization of work can be understood as a coherent new perspective on the structure of government organization.

7. Conclusions

To answer the research question that asked what are the characteristics of an ideal type that helps to understand how algorithmic systems shape the structure of public organizations, the algocracy has been developed in this article.

The main theoretical contribution of this paper to the academic literature is the introduction of a new ideal type: the algocracy. Let us summarize the main features of this ideal type. The algocracy is shaped by algorithmic systems that computationally produce advice based on the automated analysis of data. 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 algorithm- and data-driven 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.

We positioned the algocracy vis-à-vis other ideal types to highlight its specific characteristics. First, we positioned the algocracy as 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). Second, we positioned the algocracy as an advanced version of the infocracy. We showed that the machine-learning

capabilities of artificial intelligence applications enable the algocracy not only to process routine tasks, as the infocracy, but also non-routine tasks. This new position as a high-tech professional bureaucracy in which advice based on data analysis plays a key role characterizes this new ideal type of a government organization.

The empirical contribution of this study is the systematic description of the organizational transformation of a government organization through the use of an algorithmic system. The case of predictive policing at the Berlin police was used to accentuate the theory-based ideal type. The Berlin police shows characteristics that can be attributed to the professional bureaucracy and others that are indicative of the machine bureaucracy. 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. In the case of the Berlin police, 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. 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 through the use of (rational) algorithms rather than relying on (irrational) human beings.

The theoretical and empirical of the algocracy in this paper can also form the basis for further theoretical and empirical research into the use of algorithms in the public sector. We would like to stress the need for a systematic research agenda which addresses the following four topics.

Firstly, strong research into the effectiveness of the algocracy is lacking (Meijer & Wessels, 2019) and this casts some doubts on the promise of rationalization of public organizations. The increased standardization of work caused by the automated advice, which basically cannot be rejected has a perverted effect at the Berlin police: namely, it does not leave any room for bringing in the local knowledge that is needed for a rational deployment. For this reason, the centralized rationality could be argued to even result in a more irrational deployment of police units instead of an increased rationalization as ascribed to the algocracy. These argument is in line with fundamental critiques on centralized forms of decision-making. Further research into the promise of rationalization and its contribution to the effectiveness of the public sector is needed.

Secondly, there are doubts about the legitimacy of the ideal type of the algocracy since the limited transparency and accountability of these organizations, especially the one that rely on machine-learning algorithms, has been criticized (Meijer & Grimmelikhuijsen, 2021). Decision-making is based on complex algorithmic rules that often cannot be reconstructed due to a lack of algorithmic transparency. The basic idea of a bureaucratic organization is that there is a clear hierarchical line of responsibilities – the chain of command – which ensures political control over de implementation of public policies. This clear line of responsibilities and accountabilities may no longer hold if algorithms influence bureaucratic decision-making in non-transparent manner. For this reason, we call for further research into the implications of the algocracy for questions of accountability and public control over public organizations.

Thirdly, this research indicates that the use algorithmic systems can also jeopardize precisely the statutory order. The use of algorithmic systems that support centralized modes of decision-making may endanger the rule of law: the prediction of high-risk on the level of individuals and their targeting by state authorities can lead to unprecedented levels of control and monitoring that endanger the liberal democratic basic order of modern societies. We have used the specific example of the police to show the empirical manifestation of the algocracy but the emerging literature on this topic suggests that similar patterns are

to be found in different sectors such as social security and urban governance (see Schuilenburg & Peeters, 2021). Several scholars 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. 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. There is a need for more systematic research into different ways of connecting the algocracy to legitimate forms of political order.

Fourthly, and finally, the ideal type of the algocracy may also have important negative implications for the people working in this type of organization. The autonomy of the civil servants in the alogocracy is limited and they are to act according to the instructions set by algorithms. Autonomy is one of the key elements in work satisfaction and a key element of worker empowerment and one can imagine that the iron cage – so vividly presented by Weber (2006) and developed further by Zuurmond (1994) – is only further strengthened for civil servants working in an algocracy. There is a need for more empirical research into the implications of the algocracy for civil servants autonomy and work satisfaction.

This study presented an interesting but also quite specific analysis of the empirical manifestations of an algocracy. The main empirical limitation of our research is that it is a single case study of a specific type of organization: the police. The police can be qualified as a highly formal and knowledge-intensive organization. These specific features were conducive to showing the value of the algocracy but also raise questions concerning the general applicability of this lens for studying the use of algorithms in the public sector. Similarly, the main practical limitation is that (advanced) algorithmic systems are not yet widely used in government organizations. The descriptions offered in this paper must, therefore, be regarded as observations of the use of a technology that is still in its infancy. It cannot be ruled out that the use of algorithms in organizations will play out differently once it has been widely adopted. The main theoretical limitation is that we have not systematically assessed the positive and negative outcomes of this ideal type. Further research into the empirical manifestations of this ideal type can help to understand to what extent the promise of a more rational public sector through the use of algorithmic systems is being realized in different government organizations but also to what extent this new type of organization endangers fundamental principles of the public sector. The lens that has been developed in this paper provides a basis for studying this transformation as an organizational process rather than a technological one. This research therefore positions the algocracy in the heart of discussions about the future of the public sector.

Acknowledgments

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