Artificial Intelligence (AI) and Automation in Administrative Procedures: Potentials, Limitations, and Framework Conditions

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Abstract

Integrating artificial intelligence (AI) systems into administrative procedures can revolutionize the way processes are conducted and fundamentally change established forms of action and organization in administrative law. However, implementing AI in administrative procedures requires a comprehensive evaluation of the capabilities and limitations of different systems, including considerations of transparency and data availability. Data are a crucial factor in the operation of AI systems and the validity of their predictions. It is essential to ensure that the data used to train AI algorithms are extensive, representative, and free of bias. Transparency is also an important aspect establishing trust and reliability in AI systems, particularly regarding the potential for transparent representation in rule-based and machine-learning AI systems. This paper examines the potential and challenges that arise from integrating AI into administrative procedures. In addition, the paper offers a nuanced perspective on current developments in artificial intelligence and provides a conceptual framework for its potential applications in administrative procedures. Beyond this, the paper highlights essential framework conditions that require continuous monitoring to ensure optimal results in practice.

Keywords Artificial intelligence · AI · Law · Automation · Digital law · Transparency · Bias · Digital Government · E-Government · Legal Tech

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Introduction

The digital age has brought numerous advances and technological improvements, transforming how we live, work, and interact with each other, so the importance of E-Government has also become increasingly apparent in recent years (De Vries et al., 2015). E-Government provides numerous benefits for government, businesses, and citizens (Edelmann & Mergel, 2022) and aims to increase the efficiency, transparency, and accessibility of government services (Gupta, 2019). E-Government can improve citizens' quality of life and create a more responsive and accountable administration by automating administrative procedures, reducing bureaucracy, and improving online access to information and services (Toll et al., 2019). Therefore, developing and implementing E-government initiatives is a crucial aspect of modernizing and improving administrative processes and services (Zuiderwijk et al., 2021). Recent efforts in E-government include the development of the e-ID or the creation of electronic delivery options. The focus has been on making services user-centric, including creating faster processes through the automation of administrative procedures. In recent years, the topic of automation has become increasingly important (Desouza et al., 2020) (Aoki, 2020) and includes both full and partial automation. Currently, automation is mainly considered in Unified Modeling Language (UML), which is suitable for representing rules and relationships that non-experts can understand. The execution of the rules is still up to an imperative programming language and the underlying predefined routines. Advances in AI research have led to increased consideration of its potential to automate administrative processes. This approach is not new and has been explored in E-government for more than 3 decades, with projects aimed at using AI to automate laws or support the legislative process. Two different research streams have evolved in the field, rule-based AI and machine-learning AI systems, which are the two main systems of artificial intelligence. Rule-based AI systems use a set of pre-determined rules to solve problems and make decisions and are therefore considered particularly suitable for law. These systems can be precise and accurate in their decisions, but they are limited by the rules they have been programmed with and cannot adapt to new situations. On the other hand, machine-learning AI systems are designed to learn from data and make decisions based on patterns and relationships found in that data. They have the potential to make more accurate predictions and decisions but require large amounts of data to learn from and can sometimes make unexpected or incorrect decisions. The various systems, their potential to automate administrative processes, and the associated challenges are the focus of our studies.

Automation through rule-based systems holds significant potential in the continental European legal system, for example, in Germany or Austria, which is a result of the nature of the legal system itself (Legrand, 1996) (Horton, 2011). In the civil law system that prevails there, laws are codified and clearly defined, providing a comprehensive framework for the administration of legal decisions (Fon & Parisi, 2006). This structure makes it easier for rule-based AI systems to automate processes and aid in decision-making because the rules are clearly defined and predictable.

In contrast, the Anglo-American legal system, also known as the common law system, relies on judicial decisions and the principle of "stare decisis," i.e., the notion that legal decisions should be based on past precedents. This system relies on reasoning processes in which legal decisions by higher authorities are considered binding on lower bodies (Scalia, 1995). For this paper, we chose to focus on the civil law system with examples from Germany and Austria, where the principle of legality prevails, as a blueprint for other civil law countries. The principle of legality states that all public administration may only be executed based on the law. This principle holds that all citizens are subject to the law and that all public power must be exercised within the limits of the law. This means that individuals and institutions, including the government and the judiciary, are bound by the law and must act in accordance with it. In countries where the principle of legality is predominant, the "Law is Code" concept needs to be examined in more detail. The idea that law can be encoded as computer code and integrated into automated systems aligns well with the principles of legality and transparency: by codifying laws clearly and concisely, automated systems can ensure that they are applied consistently and fairly, reducing the risk of human error, and improving the efficiency of the legal process. This has the potential to improve access to justice and increase trust in the legal system, particularly when the legal process can be complex and time-consuming.

Our paper deals with the research question: what are the benefits, major challenges and limitations, and framework conditions for the use of automation and AI in administrative procedures?

To provide a thorough analysis in the legal context, we focused our studies on Austria and Germany, two countries with well-established legal systems. As legal scholars with extensive expertise in these legal frameworks, we can conduct an in-depth and nuanced analysis of the legal context surrounding our research questions. By focusing on these specific countries, we provided a comprehensive and detailed understanding of the legal and regulatory framework that informs the issues under consideration. Due to the high degree of formalization and the close legal ties of administrative action, administrative law is well-suited for legal automation. However, ensuring that certain framework conditions are met is important to facilitate successful implementation.

In the following section, we examine the background and development of automation in public administration. This analysis serves as a crucial foundation for understanding the current state of the field and the opportunities for improvement. Additionally, this section presents a comprehensive overview of the various stages at which automation can be implemented. Subsequently, the paper proceeds to present the research design. This section is followed by a discussion section that addresses the research questions, which are divided into subsections: First, the potentials of using rule-based and machine learning systems are presented to show the benefits AI can bring to public administration. However, it is also important to consider the challenges and considerations that arise when implementing AI systems. Therefore, the following section discusses these hurdles, limitations, and implications. Finally, we have developed frameworks based on our research and a thorough review of the relevant literature to provide a guide for implementing AI in administrative processes.

Background

Digitization of Law

Digitization of law describes the use of digital technologies in a legal context and does not take place in a vacuum but is rather integrated into the topic of technology and culture, and they mutually influence each other (Boehme-Neßler, 2008). The associated technical terms can be clearly defined, while "culture" and the associated social and economic impact cannot.

In the context of culture and to what extent the culture of law or society is changing, there are discussions such as *Lessig's*: Thus *Lawrence Lessig's* book "Code and Other Laws of Cyberspace" is shaping the discourse with "Code is Law," which describes the law-like effect of hardware and software in digital cyberspace (Lessig, 1999). Alongside the system of order that a constitution provides for citizens, a technical system of order has developed among the platform operators such as Google, Facebook, and others. These platforms have become an integral part of the public space, significantly shaping public opinion and discourse. However, their actions, like content moderation, are often characterized by a lack of transparency and democratic legitimation. Digital marketplace providers or cloud service providers, like Amazon Web Services (AWS), Microsoft, or Google, may even withdraw access to marketplaces or cloud infrastructure services. A prominent example became the case of the social network Parler, which evolved into an online space for right-wingers and was used to promote and organize the attack on the Capitol. As a reaction to the attack, Parler was removed from the app stores by Google and Apple, as well as banned from the AWS cloud services (Munn, 2021). Platform operators have assumed supranational supremacy, operating basic infrastructures, communication networks, and public discourse spaces moderated or made visible by programmed algorithms. This phenomenon can be described as a digital curtain draped over our real lives (Scholz et al., 2020). On the other hand, the concept of "Law is Code" describes that programming is already done in the law (Mohun & Roberts, 2020) (Danish Agency for Digitization, 2018) (Novak et al., 2021). There is a growing need to develop legal frameworks that enable the implementation of automation in a manner that is ethical, sustainable, and socially responsible. To achieve a successful implementation, it is essential to study and understand the criteria required for the formulation of such laws at an early stage, which involves identifying the potential risks and challenges associated with automation, as well as the societal and ethical implications of its use. This issue also presents an opportunity for further research.

From a technical perspective, two categories can be distinguished: legal documentation and legal automation (Pohle, 2022). Legal documentation is the use of IT for documentation and information. Typical examples are the transfer of data storage to electronic registers and databases or the provision of information. Legal automation is the possibility of full or partial automation of legally relevant actions such as judgments, administrative acts, or contract conclusions. The

interaction of legal automation and legal documentation can be well demonstrated through the example of family allowance without application in Austria: the payment of family allowance without application, as it has been possible in Austria since 2015, would not be possible if there were no corresponding registers and databases from which the data could be mapped in a logical process. This example clearly illustrates the interaction between automation and documentation and that automation is impossible without documentation.

An example from the area of civil law is smart contracts. These are self-executing, autonomous computer protocols that can facilitate, execute, and enforce agreements between parties (Corrales et al., 2019). Here, the requirements and consequences of entering a contract are programmed in advance in an algorithm (Forgó & Zöchling-Jud, 2018). Compliance with the agreements can be checked in real-time, and if there is a discrepancy, a penalty can be imposed, for example. The automation of contract law can be programmed in a tamper-proof manner with the help of blockchain technology (Corrales et al., 2019)—and is, again, both documentation and automation of the law. Fully automated legal processes or legal assistance systems are also known as LegalRobots (Wagner, 2020). These technical developments, such as smart contracts, blockchain technologies, or LegalRobots, are in the broadest sense referred to as *legal tech* (Corrales et al., 2019).

Digitization of law has had a significant impact by streamlining processes, reducing bureaucracy, and increasing transparency. Digital platforms and E-government services have made it easier for citizens to access information about their rights and obligations and to complete administrative procedures online, which has led to a more efficient and user-friendly public administration system that reduces processing times and improves citizen experience (Gasova & Stofkova, 2017). The digitization of law has also made it easier for public authorities to monitor compliance with and enforcement of laws, contributing to more efficient and effective use of public resources (Umbach & Tkalec, 2022). Overall, the digitization of law has significantly impacted administrative procedures, making them more accessible, transparent, and efficient for citizens.

In the field of administration, which encompasses a broad range of tasks, automation has the potential to streamline administrative processes, reduce manual errors, and free up valuable resources for more critical tasks. As such, automation is emerging as a game-changer in administration (Berglind et al., 2022). Assistance systems to support legal users are already in use. They are expected to increase in the next few years due to the available data, technical development, and innovative spirit—from supporting research to supporting the creation of legal texts to checking conclusive argumentation (Crawford & Schultz, 2019) (Collenette et al., 2023). These systems can also be used in the field of legistics to test and simulate the enforcement of laws (Atkinson et al., 2020).

The emergence of blockchain technology has opened a wide range of opportunities and rethinking of public administration. By integrating authentic state registry data into their processes, blockchain providers could incorporate the state registry date of individuals and their objects into smart contracts in case of a transfer or ownership. For example, the new ownership of a property or a car is intended to be transferred to state registers through automated contracts without any interaction of

public servants. These changes will lead to an entirely new form of administration and thus need an in-depth discussion about the constitutional and societal consequences and the role and meaning of administration. If contracts are programmed in civil law, the question arises as to what extent laws could be programmed as code. Administrative law can lend itself to this because of the high level of formalization and the large amount of data available in registers and applications of the administration or even the economy.

Our research paper explores the potential and hurdles for the automation of administrative procedures. The issue of aligning administrative law with civil law is beyond the scope of this study but represents promising future research opportunities.

The Beginnings of Mechanized/Automated Systems in Public Administration

"Automation" describes the execution of a process by means of technical performance without human action or intervention (Houy et al., 2019). The term that precedes the idea of automation of the computing age is that of *mechanization*, presumably inspired by the various automata of the time, such as *Vaucanson's* mechanical duck from 1738. This duck was able to take grains from a hand, swallow them, digest them, and excrete them again at the end. In his criticism of the "naïve" automation euphoria of the legal tech hype, *Jhering* used the duck as a comparison to the judicial application of the law, "The case is pushed in at the front and comes out at the back as a verdict" (Meder, 2020, p. 24).

The vision of mechanized law has a centuries-old tradition dating back to Roman law (Kantorowicz, 1925). The "mechanized" law was supposed to allow the direct application of legal regulation without interpretation. The motive for this was often the conflict of power and the distrust between the legislator and the person exercising the law. This situation was especially the case in absolutist state systems with a lack of separation of powers, in which the legislative, executive, and judicial branches were united in "one ruler." Thus, the ruler had to ensure that, although he had to rely on human decision-makers for the actual execution of his laws, he controlled the interpretation of the law. He had to ensure the judiciary was closely bound to him in interpreting the law. Such considerations were already made when the "Corpus iuris" was compiled under Emperor *Justinian*—any editing of the sources beyond the mechanical was forbidden (Meder, 2020) (c) (Savigny, 1814). Another example can be observed in the political discourse leading up to the drafting of the Prussian General Land Law. According to *Hattenhauer*, a cabinet order dated July 27, 1780, aimed to achieve two central reform objectives. Firstly, all legislation for the states and subjects was to be composed in their native language, with precise definitions and comprehensive collection. Secondly, in line with the arguments of the legal philosopher *Beccaria*, the authority of judges was to be restricted or even eliminated, through the creation of a law commission charged with interpreting and advancing the law (Hattenhauer, 1995).

Absolutist systems failed with their vision of a final mechanical administration and jurisprudence acting according to their will. The attempt to represent the

diversity of life in a definitive set of laws has also failed (Fiedler, 1985). In many cases, the legal system has evolved horizontally openly, allowing for different interpretations and ensuring dynamic legal development. The discussion of the mechanization or automation of law has continued over the centuries but has remained primarily a theoretical discussion.

In the German administration, mechanical data processing began in the 1920s with the first punched card machines in the postal and railroad administrations to support human activities (Gräwe, 2011). According to a report to the Bundestag, 21 computer and EDP systems were in use in 1957 (Gräwe, 2011). By 1968, this number had risen to 3863 systems (BT-Drucksache V/3355, 1968). These were mainly used for their namesake activity of computation (to compute = to calculate something) and took over numerical mass and routine activities (Gräwe, 2011), including the calculation of payments and emoluments, the calculation of pensions, the postal check service, the preparation of statistics and the performance of scientific calculations, and, as a special feature, the maintenance of the Central Register of Foreigners (BT-Drucksache VI/648, 1970). Whereby the report to the Bundestag explicitly states as a rationalization effect that "[…] it must be stated that without the introduction of EDP, various tasks would not have been tackled at all and other tasks could no longer have been carried out properly due to the increased demands in terms of type and scope" (BT-Drucksache VI/648, 1970). The report also already contains plans for the subsequent development steps. In particular, the establishment of a register in which "[…] numerous personal and subject files are kept, with the result that the information required jointly by several administrative agencies can be stored by one agency for all and retrieved by everyone" (BT-Drucksache V/3355, 1968, p. 4). Ideas are already discernible here that were to reemerge decades later under the designations "once-only" and "digital-ready legislation" (Schmidt et al., 2021) (Lachana et al., 2018) (Justesen & Plesner, 2022).

Levels of Automation in Administrative Procedures

Based on the findings in the literature, different levels of automation of administrative action can be categorized as follows: full automation, partial automation of administrative action, and assistance systems that offer specific automated support functions for administrative staff.

In the case of *full automation*, all sub-steps and the coordination of the entire process are transferred to a system (Etscheid, 2018) so that all procedural steps can be carried out without human intervention (Guckelberger, 2019). For example, in Austria, no-application procedures ("no-stop-shops") can be used to pay out family allowances without any application from citizens.[1] For simply structured and standardized procedures with an external trigger that gives rise to a claim, full automation

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[1] The payment of family allowance in Austria is an application-free procedure, as the conditions for the granting of family allowance are checked automatically based on the child's data recorded by the registry office after a birth. If all the necessary data is available, all further steps up to the payment of the family allowance are carried out automatically.

without a dedicated application is conceivable and, as the first procedures have shown, possible (Kompetenzzentrum Öffentliche IT). In Austria, the only technical implementations of these procedures are rule-based standardized administrative procedures carried out by querying data points from registers or specialized applications, including family allowances and income tax returns.

In *partially automated administrative processes*, some procedural steps are taken over independently by technical systems (Guckelberger, 2019). Individual steps that cannot be automated are processed by humans. The human-generated results are transferred to a technical system for further processing, and potentially automated decisions can be made. AI systems are not obligated to check the results of the partial steps performed by humans; the overall responsibility remains with the human (Etscheid, 2018). A similar variant of partial automation is the preparation of a decision with automated checking of the legally relevant facts, whereby humans take the final decision. Partial automation can be further classified depending on when it is used. Ex ante, for example, information can be provided as a basis for decision-making, or decision proposals can be made; ex post, human decisions can be reviewed (Braun Binder & Spielkamp, 2021). The two major related problems here are the high level of trust in machine-based decisions ("automation bias") and the associated reduction in the decision corridor of the human. The more extensive the review and preparation of the decision, the greater the associated risks. The extent to which the need for human review in the event of a positive decision in a single-party procedure could be omitted should be discussed. From the perspective of partial automation of administrative action, the concept of "augmented intelligence" is helpful, which relies on the synergy of humans and machines. Here, AI does not replace humans but explores the synergistic interaction of humans and machines (Kirste, 2019). Research on augmented intelligence aims at concepts of joint solution finding between humans and machines (Carter & Nielsen, 2017). By combining data science, machine learning, and human intelligence, the legitimacy of administrative action can benefit the decision-making phase ().

The third variant of automation is *assistance systems*. In this category, automation does not refer to the entire procedure but rather to specific elements in the procedure that are executed through automated data processing and provide results to administrative staff for further processing. AI-based systems that have been developed and trained for predefined tasks are particularly suitable for evaluating data sets. Assistance systems differ in that they merely facilitate processes of information procurement and evaluation through automation but do not automate administrative action to a predominant degree—the boundaries between assistance systems and partially automated administrative action are fluid.

Research Design

Our studies are based on a scoping review (Munn et al., 2022) and the use of jurisprudential methods. We decided to use a scoping review approach to identify knowledge gaps, clarify key concepts, and determine the body of literature on the topic of automation in public administration (Munn et al., 2018). The first step was to define

the research questions, which served as a guideline for our studies (Peters et al., 2015): What are the potentials, limitations, and framework conditions for the use of AI and automation in administrative procedures? Subsequently, we searched for relevant literature and studies published in international journals and the Austrian and German legal literature. The literature was reviewed and evaluated based on predetermined inclusion and exclusion criteria (Sucharew & Macaluso, 2019). Inclusion criteria for the literature review included studies relevant to the research question, providing clear and transparent methods and results or investigating the relationship between law and society, or the impact of automated decisions on social outcomes. Keywords and topics by which we defined relevant results included "automation in public administration," "artificial intelligence," "administrative procedures," "transparency in public administration," "transparency and artificial intelligence," "history of automation," and "use cases AI in public administration." Exclusion criteria were a lack of relevance for our research question or inaccessibility due to restrictions. The total number of sources considered in more detail was about 130, which we then reduced to the most essential for our studies. Finally, the main findings were synthesized, and conclusions were drawn to respond to the research questions. Our approach allowed us to identify knowledge gaps and provide a solid theoretical and empirical basis for new research on this topic. In addition to the scoping review, we have also applied jurisprudential methods as legal scholars. These methods are the techniques and approaches used to study the law and legal systems and include, among others, comparative law, legal history, legal philosophy, and legal reasoning. Using jurisprudential methods ensures that the findings are grounded in a strong theoretical and conceptual framework. Combining a comprehensive literature review and using jurisprudential methods provides a solid foundation for our studies.

Discussion

This section addresses the research questions: What are the advantages of automation in administrative procedures? What are the main challenges and limitations that need to be overcome? And what are the factors that need to be considered when introducing AI into administrative procedures? By examining these questions, this paper aims to provide insights into the potential of automation in administrative procedures, as well as the challenges and opportunities that must be navigated to ensure its successful implementation. This section is structured into three corresponding subsections to provide a comprehensive overview of the addressed questions.

Potentials of Automation in Administrative Procedures

IT systems in widespread use in business and public administration follow imperative programming, in which humans give the instructions, rules, and the operational sequence to the computer system. As aids for programming, independently of the selected programming language, UML (Unified Modeling Language) became established for the graphic representation and modeling of expirations, terms, and

relations, which is suitable for the representation of rules and relations, which can also be understood by laypersons. The execution of the rules is further incumbent on an imperative programming language and the underlying predefined routines. Different from this are the rule-based and machine-learning systems described below.

Potentials of Rule-based Systems in Administrative Procedures

Rule-based systems have been developed for more than 4 decades, including expert systems for decision support. Rule-based systems typically consist of a database that, depending on the domain, is equipped with formalized structured expert knowledge and can also be further developed. Based on the knowledge base, the rules are mapped to establish relationships between the data objects and are usually formed as conditional sentences: "If A, then B" (Timmermann, 2020). In the context of administrative procedures, the Austrian family allowance shocontrast to rule-based systems, whose programming reflects the lawuld be mentioned here: *If* persons are residents or usually reside in Austria and have a minor child, *then* they are entitled to family allowance. If–then decision rules contain factual prerequisites that must be examined in the administrative procedure. These include, for example, conditions, sub-conditions, or exceptions. Decision rules are usually codified in natural language (legal) texts, which lawyers use and often perceive as confusing by laypersons. Clear and precise specifications are necessary for programming to be able to represent legal rules (Etscheid, 2018). Therefore, from the perspective of technology, a clear decision-making structure of the laws and the associated procedural sequences are the basis for automating administrative procedures.

Rule-based systems have the programmed logic specified in advance and are built on clear, fixed, and finite criteria that justify the rule selection made—this makes the systems transparent. (Zalnieriute et al., 2019). These clearly defined calculation, action, and/or processing rules for solving a problem are called algorithms. To model the knowledge base, the rules must be represented in as simple a syntactic form as possible. This increases comprehensibility (Beierle & Kern-Isberner, 2019) and makes visualizations in tree structures possible. Legal statutes are structured into individual pieces of information stored in nodes of a navigable knowledge tree and linked to each other according to a rule-based logic. This makes requirements with possible alternatives, exceptions, and their relationship to each other visible. Similarly, obstacles and ambiguities can be more easily identified in advance. In addition, flowcharts and tree diagrams serve as visual communication between lawyers and software developers and support the communication of legal rules and processes. The representation and quality of generally valid rules are suitable for simple closed systems but find their limits in complex and open systems. The logical structure and the connections between rules enable rule-based systems to describe the path to the result, so there is a high degree of transparency in the system, and the verifiability by the user is ensured.

In addition to the formalization of legal principles and terms, the compilation and formalization of the facts are a necessary basis for subsumption and determining legal consequences. The use of templates for formalizing facts has a long tradition in administrative procedures and is the basis for the automated subsumption of facts

under elements of the law. Provided that no further fact-finding is required, the necessary formalizations can be solved without (great) technical effort.

The basics for automated administrative procedures are the formalization of the law by explicitly representing the administrative procedure's structure and the respective material law in combination with formalized legal terms with the help of ontologies and a formalized set of facts via the structured capture of forms. Under these conditions, automating administrative procedures with algorithms is possible in principle. If one condition is not met, the feasibility is limited to partial automation or assistance systems for the legal user. Therefore, the scope of application is limited to non-complex issues that can be recorded with structured forms.

Potentials of Machine-learning Systems in Administrative Procedures

In contrast to rule-based systems, whose programming reflects the law text as accurately as possible, machine-learning systems do not apply legal norms to arrive at their decisions. These systems learn inductively and require a large amount of data, e.g., of relevant cases or decisions. This data provides the basis for using machine learning algorithms to identify patterns and relationships statistically significant to the decision (Rühl, 2020). The first machine-learning systems can already be found in legal practice.

Two developments are particularly noteworthy from a legal application perspective. One is the progress in the developments of AI-assisted text generation, such as GPT3, published by OpenAI. Based on the analysis of selected texts, the GPT3 algorithm can be trained in such a way that, once the training phase is complete, it can mimic the common writing style of a domain. First projects have also led to results for the legal field, which are suitable as a support service, for example, for drafting legal texts. The algorithm creates legal texts without knowing the actual legal context—these AI systems could be described as non-knowing artificial lawyers. These capabilities are suitable for creating first drafts of decisions or finding content in legal databases.

The second development is machine-learning systems that use semantic algorithms to search independently for rules in legal texts and can also present and apply them in a way that is comprehensible to humans. Another area of machine-learning use in an administrative procedure context is the data-supported prediction of a decision in a concrete lawsuit. Two different types of systems are used here: metadata and fact-of-the-case analyses (Rühl, 2020). The LexMachina system, for example, is based on (training) data from over 100,000 cases, with information about the parties involved, their representatives, and the judges. Based on the metadata or descriptive data of the persons involved, the system calculates the probability of a successful outcome of the case without analyzing the data regarding similar cases. In contrast, the facts-of-the-case analyses work by comparing the case's facts with other relevant cases and the decisions made in these instances. These systems, which are already in use, do not make an independent decision and do not provide a reason for their decision but rather predict a possible outcome of proceedings.

If the corresponding prerequisites are met (sufficiently high quality and quantity of the training data and protection against bias in data and systems or the systems or

the guarantee of explainability of the results and transparency of the AI systems), it is conceivable for administrative procedures that the parties are presented with a decision drafted by machine-learning. They can decide whether they still want to conduct the proceedings in front of a human being or accept the "AI decision."

Challenges and Limitations for Automation in Administrative Procedures

Integrating automation and technology in administrative procedures has the potential to revolutionize how public services are delivered. However, this approach is not without its challenges and limitations. In this chapter, we examine some of the key issues that arise when integrating automation into administration. Specifically, we consider the challenges that arise from the formalization of the law, the discretion afforded to administrative authorities, the availability and quality of data, and potential bias in automated decision-making.

Formalization of Law

Fully automated processes take over administrative action, while in partial automation, only parts run automatically. The starting point of digitization and automation is standards, laws, and the associated hurdles of formalizing the law. *Viktor von Knapp* attempted to transfer parts of divorce and alimony law to a computer and laid out early on the central role that the problem of formalizing legal processes plays in automation (Gräwe, 2011) (Knapp, 1963).

The formalization of law is sometimes described as both impossible and undesirable. Legal language could by no means be considered unambiguous and precise. This also results from the aim of the law to reflect the complexities of real-life situations within a regulatory framework. To accomplish this, a certain degree of ambiguity is intentionally incorporated to enable decision-making through subsumption and assessment by individuals. The formalization of legal terms is limited in theory and practice, e.g., by missing specifications of local or temporal dimensions (e.g., "temporary"), by the use of different threshold values (e.g., for company sizes) or because of the use of terms which are used differently depending on the law or the legal field (e.g., "child," "household," "income," or "habitual residence") (Kar et al., 2019) (Berger & Kolain, 2021). Concepts in the legal norm, such as "residence" or "minor," must therefore be linked to clear definitions and criteria. Synonymous terms must be related via ontologies, and supposedly synonymous terms must be unambiguously resolved. Unambiguous, formalized legal terms are a prerequisite for a (partially) automated enforcement of laws in the form of "if–then" rules (Raabe et al., 2012). Despite all these difficulties, the need for clear definitional criteria does not necessarily mean that legal terms must be completely standardized, i.e., fully harmonized. In a report on the concept of "income," the German National Standards Control Council examined the possibility of a more differentiated approach: the "modularization" of the concept of income (Normenkontrollrat, 2021).

Administrative Authority's Discretion

Through the increased automated processing of structured parts, administrative procedures that require human intervention, judgment, and the exercise of discretion become more visible (Ringeisen et al., 2018). The term "discretion" is used in this context to describe administrative latitude. These grant the responsible decision-makers freedom of choice, within a certain legal framework, as to which decision they will make (). Such weighing processes for decisions are considered hurdles for automated decisions, and this is because administrative staff must intervene at this point and process the case. In these cases, however, partial automation should be considered, which can already lead to a considerable reduction in the workload (Kar et al., 2019).

The (non-)suitability of administrative processes for automation cannot be determined solely based on the discretion granted: Not all procedures that do not require discretion are suitable for automated processing. Reasons can be a lack of data availability, insufficient data quality, or complex fact-finding (Braun Binder, 2020). On the contrary, norms that grant discretionary powers do not necessarily mean that automation is ruled out (Etscheid, 2018). With rule-based systems, discretionary decisions can be "measured" in an automated manner if, for example, sufficient empirical knowledge or supreme court decisions are available from which rules on the mapping of the consideration criteria can be derived. This enables the formulation of decision rules with test criteria and a weighting of these. Using the rule-based systems, an automated discretionary decision can be made, which can also be justified by the system. It would also be conceivable to have a group of experts define the scope of the discretion (Commission, 2019).

Mechanically automated subsumption of cases in the sense of a "subsumption machine" is, therefore, only possible in exceptional cases. The term "subsumption machine," frequently used in this context, is to be understood as a theoretical construction still far from being implemented (Meder, 2020). This position is confirmed by legal informatics projects of the last 4 to 6 decades, which have not led to full automation of the actual subsumption process but have found their limits in assistance systems (Raabe et al., 2012).

Availability and Quality of Data

To derive generally valid rules statistically, significant sets of similar events are necessary. Machine-learning systems can be used in administrative procedures only if the number of cases is sufficiently high. According to a study, approximately 500,000 court rulings are issued annually in Germany (Kaulartz & Braegelmann, 2020). However, based on case analysis, this number may be too low for AI training. The figure of 500,000 should not be seen as an absolute number; sufficient data depends on the specific task and the learning model approach chosen. In addition to the necessary amount of data, methods must be developed suitable for extracting rules from the existing data sets. If the data quality is sufficient, insights can also be gained through small-data analyses. For successful data analyses, the relationship of the data to the research question is crucial. For this, data must be available in
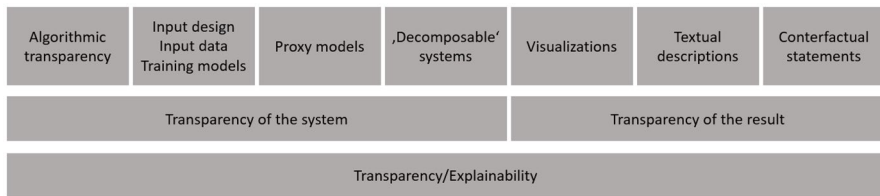
acceptable quantity and quality (Datenethikkommission, 2019). However, data, even if available in high quality, may not be suitable for the desired purpose and context due to the specific characteristics of the data set.

Data quality can play a role in very different ways; the decisive factor in determining the necessary quantity of data are the relationships between requirement, learning model, and data quality. In cases where it is impossible to obtain sufficient data in the necessary quantity or quality, synthetic data can be a possible solution (Raji, 2021). In the case of the fundamental suitability of synthetic data for the respective application area, they can be generated in the necessary quantity, and the data quality can be measured during the creation process. Likewise, the bias of the data can be counteracted during the generation of the data. In practice, a combination of real and synthetic data can be used, the so-called "augmentation." For this purpose, real data are supplemented with synthetic data in such quantity that they cover a more extensive set of constellations than the real data alone would not (Wong et al., 2016).

Another key challenge to developing data-driven systems is the availability of productive inputs. Questions arise about the availability of the relevant data, such as whether the algorithm has access to all factors that state the facts. Access to all factors that decision-makers have to take into account must be ensured in any case (Oswald, 2018). This access requires linking to digital evidence and registers, standardized interfaces to the data sources, and ensuring the quality of the available data. This circumstance opens a wide range of new data protection issues that will not be discussed further here. The decisive factor will be which data must be made available to the machine-learning systems at which stage of development. If the machine-learning system can be trained on a simulated register landscape with fictitious data and is only given access to the registers after the learning phase has been completed, this will certainly have to be evaluated differently than if the system has to be trained with access to real register data. Apart from data protection, it is also still unclear to what extent the quality of the learning results differs between real and synthetic register data and how the results of such machine-learning systems would be evaluated.

Consideration of Bias

Learning data provided to machine-learning systems form the basis of their subsequent decisions. In simple terms, they copy the logic patterns already present in the data. Accordingly, systematic biases in the data can lead to discriminatory derived rules. Insufficient representativeness or a low number of cases of a social group in the training data may lead to distortions and, thus, not taking into account the specifics of this group (Datenethikkommission, 2019). Although it should be noted that discriminatory or unfair decisions can also be made by humans, using a system with discriminatory effects can have a broader impact. Therefore, in the development of machine-learning systems, the detection of systematic biases is crucial, especially, but not only, when used in decision-making processes involving individuals or legal entities. Since data-based systems only consider statistically significant factors, important reasons that speak for or against a decision can be left out. This is referred to as an omitted variable bias (Mehrabi et al., 2021). Training data are considered representative if they represent an exact and merely structurally reduced image of

Algorithmic transparency	Input design Input data Training models	Proxy models	‚Decomposable' systems	Visualizations	Textual descriptions	Conterfactual statements
Transparency of the system				Transparency of the result		
Transparency/Explainability						

Fig. 1 Based on Waltl & Vogl, 2018

the population—if this is not the case, we speak of a bias due to the selection of the training data (sampling bias) (Mehrabi et al., 2021). It is also conceivable that factors such as class, rank, or confessions enter into the decision, either as direct factors or through correlations to factors that should not be relevant and contradict the principle of equality before the law (discriminatory bias) (Zalnieriute et al., 2019). For the use of machine learning systems, it must be ensured that no discriminatory characteristics are taken into account and that the result is not distorted by correlations in the data that are not causally related to the output (von Blumröder & Breiter, 2020a, b).

The discussion about possible biases in the training data of machine-learning AI systems and the potentially reinforcing discriminatory effect can also be used as an opportunity to bring the problems now made visible into the political discourse (Datenethikkommission, 2019). A possible distortion of reality by the AI systems can thus, upon closer examination, also prove to be an established prejudice. Transparency and insight can be used to design countermeasures to reduce prejudice and bias; from general awareness through open, transparent discourse to digital tools that can be used in the respective proceedings to draw attention to it or even to compensate for the biases and prevent a possible error of judgment.

Transparency and Explainability

The transparency of AI systems is an essential prerequisite for their use. Important elements for explainability are information on how the algorithm was programmed, what influences it was exposed to in a possible learning phase, and how this interaction led to the concrete decision. The relevant literature distinguishes different degrees of explainability of data-based systems. Building on *Lipton's* framework (Lipton, 2016), *Waltl/Vogl* have developed a model of explainability, differentiating between two types of transparency (Waltl & Vogl, 2018): those about system functionalities—the general logic, purposes or meanings, and intended consequences—and those about outcomes.

As shown in Fig. 1 based on *Waltl/Vogl*, a distinction can be made between the system's transparency and the result's transparency (Waltl & Vogl, 2018). The system's transparency includes information about the IT system, the algorithms used, and the data used—both the training data in the case of machine-learning systems and the processed data for the respective decision. In general, but especially in

applying automation in administrative procedures, the transparency and traceability of the result calculated by the machine are relevant.

Transparency of the System The system's transparency deals with the algorithms, rules, and calculations underlying a decision. In terms of the transparency of a system, a decision is transparent if it is technically comprehensible and can be explained (Zalnieriute, Moses, Lyria Bennett, & Williams, 2019). The transparency of the system functionality is given if the entire *algorithm* and its program components, databases, training models, and input data are published—this comprehensive publication may be opposed by the protection of business secrets (e.g., of the manufacturer or the supplier of the training data) or the protection of the AI system against manipulation by users (The Royal Society, 2019). In the case of machine-learning systems, the origin and structure of training data, the *input design*, the *input data*, and the *output design* should be documented to create comprehensive transparency (Engelmann & Puntschuh, 2020).

The transparency of the technical functioning of an AI system is intended for experts (The Royal Society, 2019). This form of transparency can be relevant for potential supervisory authorities or for experts from society who can review AI systems. Regular assessment of the algorithm and its components can be used, for example, to improve predictive accuracy or to check the equal treatment of groups (Zalnieriute et al., 2019); or, in the case of rule-based systems, to safeguard the functioning of the elements and to check that the derived information and rules underlying the result are up to date.

For broader access from society, additional models and representations can be applied that can also be understood by people with little or no AI competence. One way of implementing this is to develop a modular system that can be "*decomposed*" so that the decision can be analyzed based on individual stages and a weighting of these stages, which can contribute to low threshold explainability (The Royal Society, 2019).

To reduce the risk of manipulation in the case of extensive system transparency, the "proxy" model approach was developed. *Proxy models* describe the corresponding real AI system by a similar model without revealing the details of the developed algorithm to be disclosed. These interpretable models provide information about the basic mode of operation without allowing precise predictions about concrete decision ways (The Royal Society, 2019) and thus protect against manipulating the system's input by the users.

Another aspect that can contribute to transparency and subsequently to the acceptance of automated decisions is labeling automated decisions, especially in privacy-sensitive areas (Art. 13, 22 General Data Protection Regulation). Labeling can be done utilizing symbols that are visually easy to grasp (Guckelberger, 2019). The proposed AI regulation by the European Commission[2] plans to regulate

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[2] COM(2021) 206 final.

transparency obligations in more detail in the form of information obligations for AI systems and, to this end, has defined categories in the proposal for when AI systems must be labeled; for example, in the case, that humans interact with a system or systems record emotions.
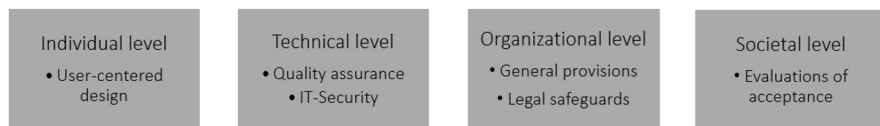
Transparency of the Result The focus of the transparency of results is the explainability of an AI system's outcome or decision. In the case of rule-based systems, the transparency of the result is ensured by the possibility of *visualizing* the decision-making process and the possibility of natural language reasoning. This is different when using machine-learning systems, which can visualize their rules and derivations or justify their decision only in the case of semantic algorithms but without transparently presenting a derivation. For this reason, machine-learning systems are also called black-box systems, which can lead to correct results, but it is not comprehensible for humans how their result is calculated. In the legal domain, the question remains to what extent the comprehensibility of the motives of a decision is mandatory if the result can be checked for correctness with the existing legal framework.

Compared to machine-learning systems, rule-based AI systems still have the advantage of comprehensibility of results, both in technical system transparency and transparency of the result. The technical layperson can check the *textual description* of the result, as well as the decision path. High transparency, therefore, continues to be of great importance in the "age of machine learning" in applying the law. Rule-based systems are therefore suitable for the automation of administrative action, e.g., for creating individual concrete legal acts, but only in exceptional cases for the full automation of an entire law. Machine-learning AI systems have the advantage of not relying on the formalization of law but require qualitative, context-specific data in sufficient quantity.

Furthermore, the results and their rationale are incomprehensible to the technical layman, and ML systems are therefore referred to as black-box systems. Further development cycles may lead to new decisions and decision patterns that are also untraceable.

Advances in the creation of natural language texts by machine-learning algorithms show the potential to independently compose legal texts in the future without knowing the actual legal context of the norms or the decisions. The potential lies in the interaction between humans and machines as assistance systems for legal users, which process the results generated by the AI system, for example, in a subsumption process.

Another variant of the transparency of results is the presentation of counterfactual statements. Counterfactual statements show which data points would have to change for a desired result to occur. Multiple counterfactual scenarios can also be output since there are multiple desirable outcomes and multiple ways to achieve each of these outcomes (Wachter et al., 2017). While it is legally relevant to inform the parties of the considerations that led to the award, it is further essential to learn, through the rationale for the decision, what factors would have to change in order to lead to a different decision.

Individual level	Technical level	Organizational level	Societal level
• User-centered design	• Quality assurance • IT-Security	• General provisions • Legal safeguards	• Evaluations of acceptance

Fig. 2 Examples of framework conditions

To what extent machine-learning systems will independently generate a decision is questionable. Humans will only check for deviations or provide further safeguards to protect against disadvantageous decisions, e.g., with the restriction that only positive decisions will be issued automatically.

Conclusions on the Transparency of AI Systems Rule-based systems are highly effective in formulating digital-friendly laws because they can process large amounts of structured data and provide clear, concise results. On the other hand, machine-learning systems can be valuable as a support tool for legal professionals, but it is important to acknowledge that these systems require a high degree of expert knowledge and that biases must be considered. With the increasing use of technology in the legal industry, both rule-based and machine-learning systems have the potential to improve the speed and accuracy of legal decision-making processes significantly.

Framework Conditions for the Use of AI in Administrative Procedures

The proposal for an EU regulation on AI has already set the course for a framework for using artificial intelligence. According to this, a risk-based approach is chosen for AI systems, which provides a code of conduct for systems without the high risk and sets concrete requirements for data, documentation, traceability, information provision, transparency, human supervision, as well as robustness and accuracy for systems with high risk. The European Commission's White Paper on AI also focuses on the public sector. Accordingly, administrations in rural areas and public service operators should be prioritized in the dialog.

In the previous chapters, the challenges and use cases specific to rule-based and machine-learning systems were presented. In this chapter, based on a literature review, we set up frameworks to be considered when using AI systems to automate administrative procedures. For the framework conditions, we distinguish different levels, which we analyze, as shown in Fig. 2.

Individual Level

Assuming the case of (partially) automated administrative action, the interaction of humans and the influence of an AI-based assistance system on the decision corridor is crucial. In the current discourse on the use of AI-based systems, the safeguards of humans are cited as co-decision makers ("humans in the loop"): humans control and take the final decision. The "automation bias," which has been known for more than 2 decades (Skitka et al., 1999), shows in different experimental constellations

that humans rely on the recommendations of assistance systems, and experimental groups make better decisions without machine support. Another problem is the tendency of people to selectively accept algorithmic advice if it corresponds to their pre-existing beliefs and stereotypes (Alon-Barkat & Busuioc, 2021). The "human in the loop" concept is, therefore, a sensitive safeguard that has now become established as a standard but can ultimately also lead to undesirable results (Enarsson et al., 2021).

The partial automation of administrative action and the use of assistance systems to support administrative action should therefore be safeguarded at the individual level with measures to prevent disproportionate reliance on machine information or to counteract selective perception and use of information that reinforces existing beliefs (stereotypes). Especially in the case of systems that are developed to support legal users in their work—whether by adopting certain parts of the procedures or by providing decision support—these should be integrated into the design process at an early stage (user-centered design). In addition to joint design, the interaction of legal users with the system can be observed during the creation and test phases to calibrate it accordingly but also in order to be able to observe the effects on administrative action in the decision-making process. Beyond the test phases, continuous monitoring is recommended, in which the interaction with the system is observed. Here, particular attention should be paid to changes in the level of knowledge and judgment and to the way in which legal users deal with the information provided by the system.

Technical Level

IT security is a fundamental requirement in developing technical systems in the public sector, so this aspect is not examined in detail. Specific aspects of automation systems are increased quality assurance of technical systems, transparency of systems, and the possibility of verifying results. The risk-based approach of the German Data Ethics Commission classifies automation systems in administrative action as at least under level 3 (Datenethikkommission, 2019). This is associated with requirements such as transparency obligations, risk impact assessment, or ex-post control procedures. Regarding transparency obligations, in particular, the transparency of information on the system used, which can only be checked by specialists, ideally, committees should be set up which have sufficient technical and financial resources to be able to check and evaluate systems on an ongoing basis and accordingly also have access to training data or different levels of technology. Training data analysis and monitoring for possible biases, e.g., biases reflected in historical data, should be ensured. Due to the use of possible personal data in the learning phase, evaluations by committees must be carried out with sensitivity and safeguarded by legal requirements that regulate the types, scope, and access of the data that can be used.

Quality assurance and documentation should be ensured for both the initial development and the further development of the systems. Limits to transparency and a comprehensible representation of IT systems are an increasing problem due to the composition of different components and modes of operation, which exists independently of the lack of comprehensibility of machine-learning AI systems.

Publishing the specific mode of operation and decision-making of the algorithm represents a comprehensible limit to transparency because an excess of transparency can create a risk of manipulation. One way of achieving system transparency despite all this is to use proxy model approaches, which present the basic functions but do not allow any further derivations for the purpose of manipulation by users. An even more far-reaching requirement is the "counterfactual explanation" already described as part of the transparency of results, which shows which factors were missing in order to reach a positive decision (Wachter et al., 2017). In addition, in the case of administrative action, a particularly effective traditional safeguard can be provided by checking the results. (Partially) automated decisions in administrative action can also be reviewed via the formal and material specifications, regardless of the technology used, via the results. This is done on an ongoing basis via individual complaints but can also be done continuously as a quality assurance measure with the help of random sampling by the authority. This special feature of a review of the results of the (partially) automated decision enables continuous quality assurance, which, combined with appropriate transparency, can be evaluated as a high-quality safeguard for automation and algorithmic decisions.

Organizational Level

The public sector and its authorities have a special responsibility in the development and use of automated systems. The following aspects must be given special consideration:

The creation of general provisions for the necessary transparency and traceability of systems for (partially) automated decision-making should be ensured. Continuous further development and quality assurance should therefore be established. It must be ensured that the automation of administrative action corresponds to the current state of the law and produces results that are both technically and professionally correct. To this end, quality assurance systems should be developed to consider and integrate technical and legal further development. In order to identify potential dangers and sources of error, the use of risk management systems should be examined (Djeffal, 2019). Risk management systems can be used to establish an early warning system for legal violations (Martini, 2019).

In addition, further legal safeguards, such as labeling obligations, monitoring obligations, or extended legal remedies, up to and including retroactive healing of all incorrectly issued notices, should be examined. One question that still needs to be clarified for the future is how to deal with erroneous automated decisions that have already been issued and whether and what effect erroneous decisions have on other procedures. To this end, reviewing the established legal protection mechanisms in the context of automated procedures makes sense. It is important to bear in mind that different procedures and their corresponding automation modes can have different positive and negative effects on different protected interests or constitutional principles.

Societal Level

In view of the special responsibility of the public sector, an evaluation of the acceptance and possible consequences for society should be carried out before an AI application is developed or commissioned. In addition to careful planning, using automated administrative action may also be ethically imperative if positive effects are achieved, for example, in the case of targeted social transfer services through automated administrative procedures without the need for applications or if human bias can be ruled out through automated decisions. Due to the dynamic changes and unforeseeable or unpredictable side effects, continuous monitoring should also be ensured at the societal level, for example, through accompanying studies. The European Commission's White Paper on Artificial Intelligence recommends the development of two ecosystems: First, an "ecosystem for excellence" should be created between the public and private sectors that encompass the entire value chain. Furthermore, the European regulation of key elements should create an ecosystem for trust. In the context of this ecosystem of excellence, the question of competence building and continuing education also arises at the societal level. It is becoming increasingly important for legal practitioners to build up a fundamental interest in and knowledge of AI techniques such as machine learning.

Conclusions

The general digitization of administrative activities has a long tradition. For more than 5 decades, information technologies have been used for efficient and effective digital processes to streamline workflows. The high degree of formalization and the close legal ties of administrative action make administrative law particularly suitable for legal automation.

In this paper, we have presented potential applications, as well as hurdles that need to be encountered for the use of automated systems in administrative procedures. In addition, we have created a set of framework conditions that need to be considered.

One of the most important aspects is that regulation of automated administrative procedures with external effects is necessary. In addition to careful planning, using automated administrative procedures may also be ethically advisable if positive effects are achieved, for example, in the case of targeted social transfer payments through automated administrative procedures. No-stop or simplified procedures reduce the barriers for citizens to access state benefits. In addition, the establishment of automated procedures relieves clerks of routine work and frees them to focus on more complex cases. In addition to cost-effectiveness, the quality of the procedures is also increased. Conditionally programmed administrative regulations as "if–then" rules are particularly suitable for automation. Any existing discretionary terms must be checked for their measurability to enable full automation of administrative procedures throughout.

In developing and using AI systems for administrative procedures, the various forms of biases must be considered. AI systems are complex—in the design,

development, and training phase, as well as in actual use, and especially in the interaction between the legal user and the AI system. Errors can occur at any of these stages, which can lead to inequity. Quality assurance of the development and operation, as well as transparency of the systems, must be ensured. The concept of safeguarding AI systems by final human decision-makers ("human in the loop") is a safeguarding measure that should be viewed critically. In the worst case, this can legitimize biased or incorrect decisions by the AI through the human in the "decision loop." Decisive factors include whether there are sufficient time and resources to make recommendations, whether sufficient specific competencies are ensured to critically scrutinize the calculated information or how "uncontroversial" it is, or how "incontrovertible" information is presented. The human bias additionally increases these risks.

Legal users must be integrated into the design process of IT systems at an early stage (user-centered design). In addition to the joint design, the interaction of the legal users with the system must be continuously monitored to identify negative effects at an early stage and to make design adjustments. Even before an AI application is developed or commissioned, an evaluation of its acceptance and possible consequences for society as a whole should be examined. Because of the dynamic changes and unintended or unpredictable side effects, ongoing monitoring should also be carried out at the societal level.

Free access to legal data is a key foundation for the development and verifiability of AI systems, access is important for verification for both rule-based AI and machine-learning AI. Because of potential biases and prejudices that may reside specifically in training data, access to and review of personal data must be ensured by independent bodies. The provision of legal data is gaining importance with the ongoing digitization and automation of the law, as well as the establishment of assistance systems in applying the law. Shared data circles among participating organizations—from authorities to courts to companies—can lead to added value for all parties involved. Furthermore, free and open access to non-personal legal data promotes innovation, democracy, and the rule of law, so exclusive access should be avoided.

In the event of widespread use of AI systems to support the application of the law, the dynamic development of law that, among other things, also societal changes, must be ensured. To this end, provisions must be made for the ongoing development of the systems. Besides the potential advantages of the automation of the law and legal assistance systems, their use can also lead to a reduction or leveling of the quality of legal action.

This paper does not attempt to review the entire body of law when it comes to AI and law—rather, it offers an in-depth look at the potentials, limitations, and framework conditions for the use of AI and automation in administrative procedures. In addition, the importance and possibilities for addressing transparency and explainability for automating administrative procedures in the various AI systems are covered. It should be noted that this paper focuses on examples of automation of administrative procedures from Austria and Germany, where the principle of legality prevails. When analyzing Anglo-American scenarios, it is essential to remember that this paper was written from a continental European perspective. Further research includes, as indicated in the chapters above, the influence of data usage on

administrative procedures: If blockchain technology is used as a state registry and laypersons can change public registers by self-reporting, the effects would fundamentally change the role of public administration.

Legal informatics is now more than six decades young, and its research projects have fallen short of expectations, especially in terms of implementation and application in legal practice. The causes are manifold but can be grouped into three problem areas. The first field is the complexity of the open legal language, which can be formalized only selectively. The second problem field is the legal subsumption process, which cannot be represented mathematically and logically. And the third field was the lack of computing power, data storage capacity, and availability of legal data. In the first two problem areas, no new theoretical foundations were laid. The question remains to what extent the technologies and legal data available today can help to overcome the first two existing hurdles. The field of legal informatics, in general, is called upon to lay the foundations for the effective regulation of digital societies. The natural laws of the digital world challenge the legal system that has evolved over the analog centuries. Satisfactory, effective regulation is needed for data use, AI development, social media platform operators, and cloud infrastructure operators. This requires knowledge about how digital technologies work and their impact, not only for effective government regulation but also to understand and mapping digital processes of business models.

Automation of administrative procedures requires standards and laws that are suitable for this aim. For the drafting of standards and laws suitable for automation, the cooperation of legal experts with enforcement experts and computer scientists is crucial. As an interdisciplinary team, law and technology can be thought through, and technology can be thought out and designed together. Existing data can be used, or new data can be created. Law has the responsibility to shape the digital transformation that permeates all areas of life in an effective and balanced way and to develop the law for this purpose further.

Data Availability The authors confirm that the data supporting the findings of this study are available within the article.

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