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Judicial Administration 4.0: strengths, challenges and opportunities of a proactive approach to AI regulation in Spain

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Abstract: The use of predictive artificial intelligence (AI) has profoundly transformed research on criminal procedures and the operations of judicial bodies, particularly in areas such as predictive surveillance and investigations. Generative AI has also emerged, further automating the administration of justice by enabling judicial decisions to rely on data generated through intelligent chat systems, and even incorporating robot judges. This evolution can be termed Judicial Administration 4.0. This paper discusses the benefits of predictive AI tools in crime prevention, investigation and the criminal process alongside the advantages of generative AI for enhancing judicial efficiency. It also examines the risks associated with these technologies from a proactive law perspective, addressing concerns about citizens' fundamental rights and proposing meditated regulatory measures to mitigate these risks while promoting compliance. By highlighting AI's transformative impact on traditional judicial activities, this study further aims to assess whether the potential risks necessitate binding regulations or whether codes of conduct (soft law) are sufficient.

Keywords: *crime prevention, generative AI, Judicial Administration 4.0, predictive AI, predictive criminal investigation, predictive justice, proactive law, process automation*

https://doi.org/10.2478/bjes-2025-0007 *TalTech Journal of European Studies*, 15(1(41))
Tallinn University of Technology (ISSN 2674-4619)

1. Introduction

The discourse surrounding artificial intelligence (AI) has intensified in recent years, with many likening its transformative potential to that of the Industrial Revolution and framing it as part of the Fourth Industrial Revolution. Despite this contemporary focus, AI is rooted in a rich history. The term was introduced by John McCarthy (1956) during the famous Dartmouth Conference in 1956, which is recognized as the official inception of AI as an academic discipline (Doroudi, 2023). At this event, McCarthy and other prominent scientists proposed 'artificial intelligence' to define the study of systems capable of tasks requiring human-like intelligence (McCarthy *et al.*, 2006). Researchers from diverse fields, including computer science, psychology, linguistics and philosophy convened to explore the creation of machines with cognitive abilities akin to those of humans. The conference thus marked the beginnings of "the science and engineering of creating intelligent machines" (McCarthy, 2006, p. 2). An additional cornerstone of AI is Alan Turing's (1980) influential article 'Computing machinery and intelligence'. Turing's seminal article first posed the question of whether machines can think, introducing what is now known as the Turing Test. It involves a human interacting with a machine through a text interface to determine whether the machine's responses are indistinguishable from those of a human. Turing argued that if a machine can successfully pass this test, it should be considered intelligent. While such tests do not evaluate understanding or consciousness but simply a machine's ability to simulate human behavior, Turing's insights continue to influence contemporary AI discussions and developments (Sadurní, 2024). He has stimulated extensive research on the development of interaction design and natural language processing.

Apparently, Turing's test capacities have been surpassed by contemporary developments in AI assessment. Some examples are worth mentioning. The first is the Lovelace 2.0 test, conceived in 2001 and updated in 2014, which shifts the focus from conversational mimicry to the realm of creativity, requiring AI to produce a work of fiction, compose a poem or create a painting that receives validation from experts (Riedl, 2014). This test evaluates a machine's capacity to execute complex cognitive tasks, such as understanding relative sizes and synthesizing disparate concepts. Generative AI (GAI) models, such as Stable Diffusion (AI Pro, no date) and ChatGPT (no date), have demonstrated their proficiency by easily passing this test. The second example is called the Winograd Schema Challenge,

which consists of resolving anaphors by specifically identifying which noun or noun phrase a pronoun is replacing when references are unclear. It aims to study AI's natural-language-processing capabilities because, while AI performs well in solving structured problems or algorithmic questions, machines struggle with the pragmatics of everyday language (Browning and LeCun, 2023). This is followed by the General Language Understanding Evaluation (GLUE), which further tests language comprehension across various tasks. The last is the Eugene test, which examines machines in areas such as computer vision and speech recognition. Among the challenges posed are tasks such as deciphering video content or assembling furniture (Warwick and Shah, 2015).

As the implications of AI unfold, it is clear that this technology is transforming the law and requires an examination of its applications across various fields. This work focuses on criminal procedural law, specifically in the prevention, investigation and administration of justice (Weisburd and Majmundar, 2018) from a proactive law perspective (Pohjonen, 2006; Schartum, 2006). Proactive law strengthens legal systems beyond its marked private and policy-related practices and has been applied in criminal justice, particularly through crime prevention and deterrence strategies, for instance, in policing (Weisburd, Braga and Majmundar, 2023). Despite the controversies it inspires (Hildebrandt, 2010), some streams of research indicate that proactive measures may lead to positive outcomes in this context, including reduced crime rates and improved community relations. These studies stress the importance of integrating proactive strategies into the criminal justice framework but do not incorporate technology considerations. Therefore, this principled study of strengths, weaknesses and opportunities presented by predictive and generative AI elaborates on what AI may mean to crime prevention and investigation and criminal justice and informs the choices available for regulatory development. Finally, the paper explores whether formulating strategic and ethical guidelines would be sufficient to regulate the use of AI by the judiciary or whether there is a pressing need for robust legislative frameworks grounded in positive law, considering the procedural justice and fairness implications of decision making in the judiciary.

A descriptive, analytical, comparative and propositive methodology was selected. It is descriptive, analytical and comparative in the conceptualization of the terms AI, predictive and generative AI, and propositive as it presents a regulatory strategy for these technologies to safeguard citizens' fundamental rights in the context of the judiciary in Spain.

The first part of the paper clarifies the relevant technical concepts to delineate the scope and provide the necessary background of proactive law and the characteristics of predictive and generative AI. It then traces the evolution of these systems within the legal field and the administration of justice, leading to the emergence of a legal-tech ecosystem in this domain. Next, the paper discusses AI tools with preventive, investigative and other functions that can be implemented in criminal justice. The analysis identifies the strengths, challenges and opportunities associated with predictive and generative AI in the administration of justice, forming the basis for the final conclusions.

2. Theoretical and conceptual background

2.1 Proactive law

The proactive law perspective (Pohjonen, 2006) grounds the objectives, tasks and research questions of this work, emphasizing strategic forecasting and envisioning of legal risks and problems before they emerge rather than merely describing and interpreting current laws to decide on their application to past events. Proactive law evolves from the preventive law movement, which was pioneered by Louis M. Brown in the 1950s and became known primarily through his work 'The practice of preventive law'. Brown (1951) promoted risk management and compliance, encouraging lawyers to act as strategic planners (Williams, 1953; Salmi-Tolonen, 2011; Berger-Walliser, 2012).

The proactive practice is strategic and responsive to various needs. It is collaborative in that it tries to prevent disputes and promote compliance when conflicts already exist but before issues escalate. In principle, it involves measures that encourage individuals and organizations to adhere to legal standards and best practices. Therefore, it is posited here as applicable within the scope of criminal justice, as it has become essential to explore alternative regulatory scenarios that can support policies while protecting fundamental rights when predictive AI systems are applied in the prevention and investigation and the administration of criminal justice, as well as when GAI is integrated into what is referred to as Judicial Administration 4.0.

Furthermore, the use of predictive and generative AI could be seen as proactive because it clearly demonstrates an interest in the simplification and efficiency of legal processes as well as regulatory developments. If legal regulation is deemed necessary, proactivity could support frameworks that are adaptable to the context in which technologies will be deployed.

This approach also encourages the drafting of better laws or amendments to existing ones to ensure a more dynamic legal system that can respond efficiently to emerging issues. Its emphasis on prevention helps manage legal risks in advance, so stakeholders can take steps to mitigate them before they result in violation of the law and/or legal disputes.

In summary, proactive law is especially suited to all spheres of law subject to digital and AI transformations by guiding improvements in the overall legal environment, not only in terms of efficiency but also the effectiveness and fairness of the legal system.

2.2 AI and related concepts

To fully appreciate the transformations in the field, it is essential to understand AI as an object of this study. AI refers to a wide domain dedicated to the development of systems that replicate human intelligence. This field ranges from traditional algorithms to advanced deep-learning models, which are also referred to as AI. The literature on AI is extensive but some works are worth mentioning: Russell and Norvig (2021) present a comprehensive overview of AI concepts, techniques and applications; Poole and Mackworth (2017) cover relevant historical and perspectives on computational sciences; and among prior and more foundational works, Luger (2008) and Negnevitsky (2011) stand out for their detailed explanations, including discussions about the Dartmouth Conference and its impact on the field by the latter.

More clarity about the interdependencies between AI, data and data governance and their meaning among policymakers, regulators and legal experts is vital to address the complexities of AI deployment more proactively. Data refers to the raw, unprocessed facts, figures or symbols that fuel AI systems, forming basic, uninterpreted building blocks that may or may not carry meaning without further processing or context (Zins, 2007). Data governance is concerned with the policies and practices that manage their collection, storage sharing and use. AI relies heavily on data, and its effectiveness and sophistication depend on its access to large volumes of high-quality data. In 2023, the global data traffic surged dramatically, with 3,100 networks exchanging 59 exabytes of data, 23% more than in 2022. Predictions indicate that by 2025, this figure will rise dramatically to 175 zettabytes (*Portal ERP*, 2024). This exponential growth requires strategic governance measures (*ex ante*) to ensure accessibility while observing the robustness requirements established in the relevant regulatory framework.

Predictive AI is a specialized branch of AI models that apply machine-learning (ML) capacities, statistical analysis and techniques to deliver "probable" outputs and "forecasted" results based on historical data and detected patterns. It employs machine-learning techniques and statistical analysis, developing models applicable in various fields, including law. ML operations involve several phases: data collection (either labeled for supervised learning or unlabeled for unsupervised learning), preprocessing (cleaning, transformation, normalization and encoding mechanisms), model selection, training and initial adjustment of performance parameters, evaluation (testing) and final adjustment and model optimization (Alpaydin, 2014).

AI learning is categorized into several types: supervised learning includes classification and regression; unsupervised learning encompasses clustering and dimensionality reduction; semi-supervised learning combines both labeled and unlabeled data; and reinforcement learning focuses on decision-making through interaction with the environment (Bobadilla, 2020, p. 14).

For instance, in supervised learning, models are trained using labeled datasets in which the input data is paired with the correct output that can classify customer reviews as positive, negative or neutral by identifying text features such as sentiment-laden words and phrases. In a regression instance, an AI model can predict the future sales of dairy products in a retail store based on past sales data, market trends and promotional activities. In contrast, unsupervised learning utilizes unlabeled data to discover patterns without predefined categories. To illustrate, AI can group businesses into categories based on their tax return data and financial behaviors (e.g., investment strategies) for tax authorities to detect trends and anomalies that may indicate potential evasion. Dimensionality reduction is a step before clustering or regression, aimed at simplifying the data (Bobadilla, 2020, pp. 17–18). When sparse and lacking useful information, datasets are "compressed", reducing the number of variables or features (through selection and/or extraction) while retaining essential information to avoid overfitting and a decreased performance of the model. Dimensionality reduction can be applied to tax return data when datasets include irrelevant or incomplete data, in addition to important financial indicators such as income, deductions and expenditures. The system can then condense this information, leading to more ethical and effective audits as well as sharper detection of anomalies and risks concerning tax compliance.

Semi-supervised learning combines labeled and unlabeled data to increase the system accuracy while reducing extensive—manual—labeling. A practical

application could be training a tax fraud detection tool with a set of labeled tax returns that have been flagged for evasion alongside a larger group of unlabeled ones for the model to learn the patterns indicative of discrepancies. Finally, reinforcement learning is a training technique that leads AI agents to optimize their performance based on continuous interactions, thereby improving their decision-making without direct instructions. It incorporates reward systems to gain positive feedback for accurate predictions (Bobadilla, 2020, p. 18). Specifically, AI can predict traffic violations, enabling real-time adjustments to traffic signal duration or immediate notifications for law enforcement. As the system collects more data and analyzes outcomes, it continuously refines its strategies for managing traffic flow, helping to prevent incidents and enhance compliance with traffic rules.

For its part, *generative AI* focuses on creating new and original content: images, text, music or videos that are generated from models trained on large amounts of data. It also produces outputs in the form of content that did not previously exist (Casar Corredera, 2023). There are several types of GAI (Foster, 2023): first, there are generative adversarial networks, known as GANs. These consist of two neural networks that work together: a generator and a discriminator. The generator is responsible for producing new data such as images, while the discriminator analyzes their authenticity by comparing them to the real examples used during model training. Both networks interact within the system, competing and refining each other until they reach a point where the generated data are indistinguishable from the real data and humans cannot differentiate it from the original. Autoregressive models, such as the Generative Pre-trained Transformer (GPT), generate sequential data by predicting the probability of the next word in a sequence based on prior context. GPTs are capable of producing coherent and understandable text. Next, variational autoencoders (VAEs) compress data into smaller representations to decompress the samples again and generate new ones, for example, music clips (Kingma and Welling, 2018; *Statistics Easily*, no date). In addition, diffusion models, such as the text-to-image DALL-E and Stable Diffusion, generate synthetic data by adding noise and "denoising" real data (Fernández, 2024; Sunil, 2024).

GAI is based on different types of models that create new content based on patterns learned from existing data. Transformers are a prominent type of GAI because they enable advanced natural-language-processing capabilities; Bidirectional Encoder Representations from Transformers (BERT) is well known for considering all data as part of a whole, relating them simultaneously. Flow-based models generate complex data by

calculating inverse functions to transform simple inputs into more intricate outputs; they are used in image generation and density modeling tasks in which having an explicit probability of the output data is important. Growth networks create complex structures such as graphs or networks to simulate natural or social phenomena. They are applied in biological process modeling, creating distribution networks or simulating ecosystems. They are also used in social networks to explain interactions among components—for instance, why some people have a disproportionately high number of connections (friends, contacts) while most people do not (Vaswani *et al.*, 2017). And, finally, rule-based generative models combine AI with predefined rules to achieve high precision in their applications. Although they are less flexible than deep-learning-based models, they are useful when control and precision are needed. Examples include legal document generation, where they ensure that texts adhere to specific legal standards and formats and automated financial reporting to comply with regulatory requirements by following strict guidelines and templates.

3. Development of the justice-tech ecosystem and Judicial Administration 4.0

Expert Systems were the first intelligent assistants in law, initially offering basic legal reasoning through computational models. They evolved to incorporate analytical and interpretive skills, benefiting from training on large datasets using deep-learning techniques. In addition, jurimetrics, introduced in the 1950s, applies statistical methods to analyze legal data. Currently, this approach measures outcomes and forecasts future scenarios to improve decision-making. The use of jurimetrics simplifies processes, reduces costs and supports the development of more effective legal strategies through analysis of historical data (Barona Vilar, 2023).

In recent years, and especially since the COVID-19 pandemic, there has been a noticeable transformation in judicial procedures. The need to adapt to the technological constraints imposed by lockdowns and mobility restrictions has imposed a shift from traditional in-person models in the administration of justice. Judicial Administration 4.0 increments technology-mediated government operations and digital interactions that require infrastructure upgrades. The implementation of electronic filing systems and the adoption of AI-assisted decision-making tools to improve the functionality and

responsiveness of public services as well as virtual hearings have become commonplace. Behind these visible changes are the development of new institutional setups, the enhancement and modernization of judicial (and other public sector) infrastructure and retraining of legal experts and public officials (Martinho, 2024).

The use of digital solutions and justice-tech is occurring in most countries that have adopted Judicial Administration 4.0 and are interested in digital transformation in the public sector, leading to sustainable improvements in service delivery and governance (Morison and Harkens, 2019; Fabri, 2024). For instance, Estonia, a long time at the lead, is currently focusing on strong design, security and maintenance standards for future judicial digital infrastructures. These are conceived to support innovative services, including the existing e-filing systems and future AI-assisted decision-making tools (Cantero Gamito and Gentile, 2023). Meanwhile, other countries, such as Argentina and Colombia, are already using expert systems which aid in processing legal cases with some degree of automation. Argentina uses Prometea (Corvalán, 2017; 2018), while Colombia's Pretoria AI supports the Constitutional Court in managing urgent cases that require human oversight (Corvalán, 2020; Calderon-Valencia, Perez-Montoya and de Morais, 2021). In Spain, the Ministry of Justice's 2021 AI initiative automates the cancellation of criminal records for those who have fulfilled their legal obligations, freeing staff for tasks that require human judgment. Furthermore, the enactment of 'Royal Decree-Law 6/2023' (2023) marks a significant advancement in judicial automation in the country.

4. Proactivity in the administration of justice and AI applied to prevention, investigation and predictive criminal justice

4.1 AI for preventive and proactive policing and in criminal investigations

Developing and adopting AI tools for prevention, investigation and predictive criminal justice is fundamentally proactive. This approach is closely related to predictive policing, also known as predictive surveillance (Perry *et al*., 2013, pp. 33–41), which incorporates environmental criminology or criminometrics. By analyzing data from various digital platforms such as forums, websites, social media and mobile apps, AI systems can identify areas at high risk of crime and generate digital crime maps that pinpoint zones

with elevated crime rates. Computational/statistical methods help efficiently anticipate locations, plan police operations, intercept criminal activities and resolve past incidents through data-driven forecasting (Barona Vilar, 2023, pp. 425–456). Consequently, these facilitate targeted security measures and optimize the distribution of police resources, improving community safety as a result. Risk maps, for example, have become essential in policing (González-Álvarez, Hermoso and Camacho-Collados, 2020).

Similarly, intelligence-led policing (ILP) has emerged in recent years as a response to the growing challenges in law enforcement as a model that provides a modern approach to identifying and planning corrective measures against transnational threats, such as organized crime, and applies to daily proactive police planning and management. According to the Organization for Security and Cooperation in Europe (OSCE), activities in this field include "the systematic collection and evaluation of data and information through a defined analytical process that transforms it into strategic and operational analytical products *that serve as the foundation for improved, well-documented decision-making processes*" (OSCE, 2017, p. 6). It has explicitly stated that "promising results in recent years have led law enforcement agencies to adopt the intelligence-led '*proactive approach* across all aspects of police management as a comprehensive *business model*'" (OSCE, 2017, p. 6, *emphasis added*), and that ILP inspires

> a proactive policing approach, complementing the traditional, reactive policing model. It has proved to be an effective tool to address organized crime, to make better use of resources, and to identify and address priority tasks in a targeted manner. The proactive and future-oriented approach of ILP facilitates crime prevention, reduction, disruption and dismantling. (OSCE, 2017, p. 10)

Predictive policing technologies can be traced back to 1920's Chicago with the use of a system known as BIG DATA, marking the emergence of the application of AI in crime prediction (Barona Vilar, 2023, p. 12). In Europe, the first predictive tool, Anacrim, was used in France in 1994. Later, in 2005, they were replaced by the i2 Analyst Notebook (i2AN), creating a national database for sharing information between agencies. Other European countries have followed suit, introducing their own systems. In 2007, Italy implemented KeyCrime in Milan, to predict serial crimes. PredPol was adopted in 2013 in Kent, United Kingdom (UK) for crime prevention, while Belgium and the Netherlands implemented the Crime Anticipation System (CAS). In 2015, Germany introduced Skala, a system

that takes into account socioeconomic factors and communication networks to identify high-crime areas. In Spain, Madrid's Municipal Police and the National Police have used the geographic information system (SIG) since 2015, supporting geopreventive strategies and enhancing the understanding of crime dynamics in relation to their geographical context.

Other systems include CATT in Spain, which focuses on linguistic analysis to detect abusive discourse, and Australia's SWEETIE, a virtual agent designed to identify potential pedophiles on chat platforms and dating sites (Borges Blázquez, 2021). Spain also developed the AI tool VERIPOL in collaboration with Complutense University of Madrid (2018), which uses natural language processing to assess the veracity of police reports.

In the field of criminal investigation, law enforcement agencies use advanced tools such as Visual Analytics for Sense-Making in Criminal Intelligence Analysis (VALCRI). This system helps investigators connect evidence with data stored in police databases using biometric and facial recognition technologies (Jiménez Conde and Bellido Penadés, 2019). Biometric models also support the identification and authentication of unique physiological traits, including fingerprints, hand geometry, iris patterns, facial features and ear shapes (Boulgouris, Plataniotis and Micheli-Tzanakou, 2010). These technologies improve law enforcement capabilities by enabling more accurate and faster investigations while reinforcing security protocols.

Elaborating on the use of criminal investigation technologies, it is essential to consider the EU Regulation on AI (the *AI Act*) regarding biometric data, biometric identification and biometric verification, as described in Article 3 of 'Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonized rules on artificial intelligence and amending Regulations (EC) no. 300/2008, (EU) no. 167/2013, (EU) no. 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Regulation)'. Accordingly, the National Police of Spain has been utilizing a biometric recognition system called ABIS for several months by the time of the completion of this article, which enables facial recognition of individuals with records (Fondos Europeos, 2023; Cortés Gómez and Santiago Romero, 2023; Pascual, 2024). Currently, there are thirteen operational ABIS stations across the country, soon to be fourteen; the Civil Guard operates two facial recognition stations in the capital and the Mossos d'Esquadra one additional system in Barcelona (Belda Esplugues, 2023, p. 23).

These systems extract faces from images using computer vision technology. An algorithm then analyzes the input to create a unique pattern that

differentiates each face from the others. This process allows for comparisons through extensive image databases to provide probabilistic coincidences. Facial recognition can even be applied in situations in which the police have previously relied on sketch artists.

In spite of their advantages, biometric recognition systems continue to be associated with biased outcomes which can lead to infringing decisions and enforcement procedures that disproportionately affect certain groups (Limantė, 2024; Li, 2024). The problem is further exacerbated as it is possible for AI to source and process all images published on public profiles and websites for future recognition purposes. This complex situation may violate fundamental rights, such as individuals' privacy and honor, considering that this is often done without the consent of the individuals involved. Clearview (no date) is an AI facial recognition tool. On its website, it is advertised as a collaborator with the State Security Forces and Corps to ensure public safety. They themselves state that they contribute to the "hunt" for sex offenders.

In the EU, the use of remote biometric identification systems in real time in public spaces is prohibited, except when it is strictly necessary for specific objectives, such as searching for kidnapping victims or missing persons, or to prevent serious and imminent threats to life or security ('Regulation (EU) 2024/1689', 2024).

4.2 AI in criminal justice

The judiciary increasingly utilizes predictive AI tools to support various judicial functions. Prominent systems, such as COMPAS in the United States of America (USA) and HART in the UK, exemplify the application of so-called predictive criminal justice (Armenta Deu, 2021, p. 262). As mentioned, the former applies machine-learning techniques within a supervised learning model, specifically a classification system, to assess the likelihood that an individual will reoffend, which translates into a binary classification task: recidivism or non-recidivism. The HART evaluates suspects based on 34 categories to determine whether they pose a low, moderate or high risk of committing further crimes over a specified time frame (Oswalda *et al.*, 2018). The Level of Service Inventory-Revised (LSI-R) is a system in place in the UK to evaluate defendants for parole and leave permits, weighing criteria such as criminal records, place of residence, education, employment, leisure activities, family, alcohol or drug abuse records and emotional and personal traits (Alemán Aróstegui, 2023, p. 17). RIS CANVI is used in Catalonia by

judges of penitentiary institutions to grant or deny prisoners temporary leave permits (Alemán Aróstegui, 2023). VIOGÉN is a similar tool used in Spain to assess the risk of recidivism in cases of gender-based violence (González and Garrido, 2015; Ministerio del Interior, no date).

The *AI Act* ('Regulation (EU) 2024/1689', 2024, Article 3.1.d) prohibits applications to assess the risk of an individual committing a crime solely based on their profile or personality traits, but not if it supports a human assessment involving objective and verifiable facts directly related to criminal activities.

Algorithmic intelligence applications include sophisticated methods for evidence processing, such as assessing witness's reliability. ADVOCATE exemplifies these capabilities, supporting the accuracy and transparency of judicial decisions. Legal experts must participate in the development of these systems to incorporate proactive rules that are, at the same time, principle-based and ethical by design.

The Spanish law indicates that this means of evidence shall be assessed according to the rules of "sound judgment" and maxims of experience, a criterion of free evaluation of evidence (*Law 1/2000 on Civil Procedure*, 2000). In addition, Article 376 of *Law 1/2000 on Civil Procedure* (2000) provides some parameters to guide the judge: the basis for the witness's knowledge, any challenges to the credibility of the witnesses and the specific circumstances surrounding their testimonies, as they must present the factual basis preceding the ruling. Although judges may make mistakes, the possibility of appeals exists as a safeguard against such errors. The lack of full automation in the judicial process supports procedural justice, as it allows for well-regulated human oversight. In automated environments, mistakes and the need for appeals would be harder to detect and articulate.

In sum, the integration of AI in law enforcement, criminal investigations and criminal justice matches proactive law principles, enhancing a preemptive approach and potentially supporting legally established protocols and due processes. Predictive tools not only improve executive and procedural efficiency but also decrease the workload of public officials. Furthermore, AI systems may help rationalize judicial functions when relying on accurate, high-quality data. The relationship between judicial tech implementation and the proactive application of law would then manifest in:

- *Crime prevention*: allowing for early and proactive intervention.
- *Risk assessment*: aiding courts in making informed decisions that enhance both public safety and legal compliance.

- *Procedural efficiency and satisfaction*: streamlining the resolution of straightforward cases, thereby contributing to a more agile judicial system.
- *Interdisciplinary support*: positively influencing the accuracy and fairness of judicial outcomes, promoting a closer fit to the purposes of the law.
- *Procedural fairness*: minimizing biases and pursuing fairness in judicial decisions through a comprehensive analysis of objective data.

As global legislation surrounding AI systems expands, it is essential to recognize that general regulatory strategies are insufficient. This is especially true in sensitive areas such as the judicial system, where ongoing ethical and legal challenges (e.g., issues related to data protection and discrimination) persist. The judicial system serves as a protective barrier that shields individuals from arbitrary power. Therefore, the rules on the implementation and use of AI must be cautiously designed to integrate seamlessly into the legal system, and to support rather than undermine its foundational goals.

5. GAI in the administration of justice

The automation of judicial processes in Spain is guided by 'Royal Decree-Law 6/2023' (2023), which has recently introduced electronic judicial files and regulated smart processes under three categories: automated, proactive and assisted. This legislation reflects the country's efforts, alongside other European countries, to integrate GAI in the administration of justice.

In a case from the Netherlands, the presiding judge of the Gelderland District Court used AI to gather critical data on solar panel lifespans and current electricity prices to resolve a financial dispute. The judge disclosed that the data came from ChatGPT, raising concerns about reliance on AI-generated information instead of expert testimony. This questions the reliability of non-specialist input in judicial decisions and the potential procedural justice problems it may create. It also brings attention to the concept of 'judge's private knowledge', in which a judge uses information not formally introduced as evidence in court, complicating appeals, as the basis of the AI's outputs or the reasoning behind the judicial decision becomes difficult to contest. If the parties cannot challenge the training data or algorithms, the use of automated systems will degrade the fairness and validity of the judicial outcome (De Hoyos Sancho, 2020).

Regulators could consider the core concerns about the legitimacy of GAI in judicial decision-making by addressing two questions: (1) Can a non-specialized robotic system obtain and process trustworthy data to replace expert opinions? and (2) In what circumstances does reliance on AI-generated information undermine the parties' right to appeal?

6. Discussion

6.1 Strengths of implementing predictive and generative AI in administration of justice

Predictive and generative AI in security and crime control have become essential for developing preventive measures, which serve as references for creating proactive strategies in the sector. These technologies excel in risk analysis and support timely interventions, helping to reduce human error in data interpretation and efficiently allocate resources to meet emerging needs. This results in cost savings and enhances public safety, making the administration of criminal justice a much better public service. However, since the EU mandates that trustworthy AI must be human-centric, the conformity of these systems also depends on the quality of human oversight.

Human-centric AI-driven predictive policing involves: *ethical oversight*; *contextual interpretation* that considers local knowledge and community dynamics; *decision-making authority* on final resource allocation and interventions, which should belong to human law enforcement officials; *community engagement* to promote collaborative governance and multi-stakeholder participation; *continuous evaluation* to adjust the systems' effectiveness and fairness as needed; and, *complementary skills*, which means that AI should augment human capabilities by combining its efficiency with human empathy, judgment and complex problem-solving skills. These assurances should make AI systems accountable, fair and responsive to the needs of the communities to serve (Tomaževič, Ravšelj and Aristovnik, 2023).

The focus in crime prevention planning reflects the view that preemptive action is preferable to punitive measures; however, deviant behavior will always occur. During criminal proceedings, AI can support judicial efficiency and impartiality, leading to more objective decisions, while strengthening public trust in the criminal justice system. By complementing expert testimony in criminal evidence, AI makes previously unattainable proof accessible, adding to the credibility of the process. Administration of

justice which incorporates contemporary technological developments allows authorities to remain current, interoperable across agencies and capable of integrating new tools and approaches.

6.2 Challenges of implementing predictive and generative AI in administration of justice

It is uncontested that the application of AI in judicial functions promotes a more efficient and faster justice system. After all, if certain tasks can be swiftly and safely performed by an algorithm, there is no reason to allocate human resources to handle them. Improving the efficacy of the administration of justice should be a priority. However, the enormous investment in developing and maintaining these AI systems must yield a higher return to be justified.

AI, while presumed to be neutral, is not devoid of flaws. Systems can exhibit biases and are vulnerable to malicious manipulation. Such algorithms risk introducing discrimination if used in cases as the sole basis for evidence. Furthermore, the inherent opacity of these systems obscures data-processing methods, diminishing the transparency and fairness of judicial processes.

A fundamental question concerning the growing reliance on AI is the potential erosion of reasoning in judicial decisions. Such tools can strip decisions of a valid motivation, an element of the essence of the due process and the rule of law. Inadequate justification of rulings can contravene the right to effective judicial protection (Llorente Sánchez-Arjona, 2022). In Spain, the Constitutional Court has ruled that the absence of sufficient justification violates this fundamental right ('Resolution 80/2023', 2023; 'Resolution 95/2021', 2021).

A long-standing weakness of AI is uncertainty in liabilities and attribution (Tversky and Kahneman, 1974). Assigning responsibility for errors made by AI is complex due to the multitude of stakeholders involved (from those commissioning the technology to those handling data governance and algorithm training and monitoring and interpreting the outputs for the application of the law). This still raises questions when AI-generated predictions lead to adverse outcomes: who, if anyone, bears the responsibility for predictive errors if AI is used only for guidance and its outputs do not constitute the decisive basis for a ruling, especially when adopting precautionary measures and why?

AI systems do not eliminate judicial biases but can replicate and even intensify them, as noted by Simón Castellano (2021). They learn from historical decision-making data that may already be biased. Consequently, they do not account for individual case details or adjust their assessments of risk and proportionality based on unique circumstances. This issue is also highlighted by the European Union Agency for Fundamental Rights (2021) in their report on artificial intelligence and fundamental rights, which emphasizes the importance of vigilant AI application in the judiciary.

The delegation of tasks requiring human judgment to a machine or algorithm entails a high risk when using GAI, for the same reasons as stated earlier: errors, biases and the "black box" nature of AI can inhibit the parties' ability to challenge or appeal judicial decisions based on algorithmic outputs. The problem is further compounded when judges use AI to inform their decisions with data not admitted as evidence in court, breaching procedural fairness principles and affecting judicial impartiality (Judicial Ethics Commission, 2024, in Resolutions 1/19 of April 8 and 7/2019 of June 5).

Within the Spanish judicial system, if a judge bases decisions on AI-generated data, this can infringe upon core judicial principles such as the principle of contradiction of the parties, impartiality and requested justice (best described in English as 'party-driven justice'). It means that judicial decisions should be based on the evidence and issues brought forth by the parties themselves, in line with the role of the judge in adversarial systems, termed as 'adjudication on the merits' or 'adversarial justice', in which the judge serves as an impartial arbiter and the scope of the case is delineated by the parties' petitions and submissions), leading to potential violations of the right to effective judicial protection as mandated by Article 24 of the Spanish Constitution. This scenario would also block parties from appealing, as they would lack the means to challenge the algorithms' underlying data, configurations and decision-making processes. Reliance on opaque AI processes further compromises judicial independence and impartiality. In criminal and civil contexts where judicial discretion is relevant, it is imperative for judges to pursue "material truth" while adhering to the standards of impartiality and independence that govern ethical judicial conduct (Pagallo and Durante, 2016). This approach, emblematic of a proactive, public-interest-focused perspective as understood in Spanish judicial norms, aims to attain thorough and impartial justice in every case, regardless of the specific demands of the parties involved.

6.3 Opportunities in implementing predictive and generative AI in administration of justice

The opportunities presented by integrating predictive and generative AI in the administration of justice emerge from mitigating risks and maximizing the strengths previously discussed. The following synthesizes the potential and future directions for AI applications in criminal justice, emphasizing that proactive and innovative use of technology would be most helpful in judicial processes within a regulated and ethical framework:

Prediction of criminal trends: AI calculates objectively, detecting patterns and predicting the likelihood of deviant behavior. This capacity helps the authorities to focus on preemption and/or prevention in law enforcement management and the judiciary to understand the context in which conducts brought before the courts are taking place. For example, AI can be integrated with urban sensor networks and social media analytics to predict public unrest during major public events. It could process signals of crowd sentiments in real time, historical crime data and current event parameters for the law enforcement to deploy resources more strategically to prevent incidents and protect the population.

Enhanced decision-making: AI refines risk assessments, thereby improving decision-making in areas such as rehabilitation and supervision. When used proactively, it identifies priorities for intervention and optimizes police and judicial resources, ensuring early and effective responses to community needs. For instance, with AI, the authorities could dynamically adjust rehabilitation programs for offenders by processing legitimate behavioral data, therapy progress reports and authorized biometric indicators to personalize treatment plans.

Strengthened judicial impartiality: Algorithmic systems enhance the acquisition of accurate and reliable data, supporting a more objective evaluation of the evidence. Proactively designing dispute resolution systems with available and viable technological features is both ethically and pragmatically desirable to strengthen the fairness of processes and the impartiality and acceptability of judicial decisions. To illustrate, AI could be used to alert about potential biases or inconsistencies in judicial rulings or in real time during court proceedings.

The predictive capability of AI is especially relevant in criminal justice, where it can profoundly impact legal processes and outcomes. The above examples demonstrate how tailored AI technologies can enhance judicial

processes within a regulated framework, calling attention to the need for ethical guidelines and robust standards in their application.

In Spain, there are basic procedural principles and rules regarding evidence, alongside professional codes of ethics, such as the Code of Ethics of the Spanish Bar Association, approved in 2019. Similarly, prosecutors adhere to a code approved by the General Council of Prosecutors. However, as of now, there are no consolidated ethical standards governing the use of predictive or generative AI in the legal field, but in June 2024, a policy document for the use of AI in the administration of justice was approved by the General Secretariat of the State Technical Committee for Electronic Judicial Administration (2024). It sets boundaries to protect fundamental rights, including adherence to principles like non-discrimination, quality and security, respect for transparency, impartiality and fairness, user control, equity and universal access, prevention of biases and discrimination, protection of privacy and personal data, responsible innovation and continuous evaluation, training and capacity building and co-governance.

According to the UNESCO survey on the *Use of AI Systems by Judicial Operators*, 44% of the respondents have used AI for work-related activities, with 41% specifically mentioning ChatGPT or other chatbots. Furthermore, 55% considered the AI outputs for drafting their documents, 39% used them for reviewing and editing and 6% used the outputs directly, without any review or verification. (Gutiérrez, 2024)

In 2023, the Judicial Office of the UK published a guide to AI for judicial officeholders (Courts and Tribunals Judiciary, 2023). This guide outlines the risks linked to the use of GAI and suggests strategies to manage these concerns, focusing on protecting the integrity of administration of justice, maintaining confidentiality and privacy, as well as promoting accuracy and accountability. It also stresses the importance of being vigilant about potential biases, securing systems and considering that, in all likelihood, litigants are using AI tools.

Regulatory frameworks for AI in judicial systems should be diverse and clear, focusing on upholding certain principles, without necessarily relying on stringent legal measures. AI should support, rather than replace, human decisions in the judiciary, with ultimate accountability residing with judges. The use of AI must be nondiscriminatory and ensure the protection of sensitive data. Models and algorithms must be executed in secure environments with a traceable process and without alterations, as a matter

of data and procedural integrity. To balance intellectual property rights with values such as transparency and fairness would prioritize justice.

Given the nature of procedural law and the high stakes involved, algorithms utilized within judicial contexts should adhere to an elevated standard of transparency, perhaps even linked to the concept of understandability (which has not been mandated). It is advisable to maintain and publish records of the data related to the processes and any potential biases. Maintaining this level of transparency could cultivate a public perception of judicial decisions as equitable and just.

Public awareness and the ability to review AI systems are fundamental to informed citizen engagement regarding the role of technologies in judicial processes. It is imperative that individuals not only have the opportunity to challenge these technologies when necessary but also that society is prepared to address barriers related to socioeconomic status and demographics to ensure equal access to justice.

Regular audits of algorithms will be a common practice to identify and correct biases, and so will continuous assessments of the impact of AI on justice to inform responsible innovation. A major challenge is the training of legal professionals with the skills necessary to engage with these systems, especially those who are most reluctant to learn new ways of working.

Finally, co-governance or interdisciplinary, multi-stakeholder governance models should anchor the responsible, proactive development and ethical use of AI in public organizations. The judiciary on its own cannot harness AI to enhance public welfare. However, by safeguarding the integrity of the judicial process, administration of justice can support broader initiatives and participate in a statewide strategy to navigate current transformations.

7. Concluding remarks

The ongoing discussion about AI regulation, particularly within the Spanish judicial context, reveals the shortcomings of traditional legislative approaches and the insufficiencies of the current framework. The existing gaps threaten the protection of fundamental rights and the principles of procedural justice essential to the rule of law. As AI technologies increasingly intersect with criminal justice, adopting a dynamic and sustainable regulatory approach becomes imperative. The risks associated with AI technologies require the

establishment of a systematic and comprehensive regulatory treatment. While 'Royal Decree-Law 6/2023' (2023) has initiated the automation of judicial processes, it is vital to extend this initiative to encompass the Organic Law of the Judiciary and various procedural laws.

A proactive regulatory strategy shows the most promise. It would be systematic and reflective, allowing it to adapt over time as technologies evolve and new ethical and practical challenges emerge. Such a strategy would support the continuous reassessment and refinement of laws and guidelines to ensure that they remain effective in protecting equality before the law and upholding the integrity of judicial processes.

Future developments in Spain's judicial use of AI should focus on the following.

General legal developments, defining clear guidelines for the use and limits of AI in various aspects of the justice system (policing, investigating or in the administration of justice), for the state to create the necessary safeguards for the due process.

Normative specification of principles with an emphasis on preventing discriminatory treatment in predictive policing and ensuring human oversight by public authorities.

Normative specification of EU rules regarding special types of technologies and the ethical considerations that should be applied when permitted (the indiscriminate use of biometric and facial recognition technologies must be prohibited, with strict controls placed on any AI tools that facilitate these operations, most importantly, concerning the privacy and data sources used for identification).

Sharp delineation of regulatory limitations of the use of AI by the judiciary. For example, the assertion that judges should not relinquish their decision-making authority to AI systems is consistent with previous arguments on maintaining judicial integrity and human oversight in legal proceedings. The EU *AI Act* explicitly prohibits machines from making judicial decisions and Article 117 of the Spanish Constitution reserves this role solely for judges (discussed in Borges Blazquez, 2021; Montesinos García, 2022). Therefore, AI should not replace human judgment in the courtroom, necessitating specific regulatory guidelines for its supportive use.

Conversely, the *strict delineation of regulatory allowances* for AI use, especially by judges, responds to calls for clarity and structure. 'Royal Decree-

Law 6/2023' (2023) has regulated the automation of the judicial process but it lacks specificity. There is a pressing need to define in detail which actions within the processes may be automated, proactive or assisted. This includes clarifying whether tasks such as claim admissions or even judgments can be executed by algorithms, as has been implemented in other jurisdictions.

Rules about *transparency and accountability* of AI decision-making processes and procedural aspects themselves, as any decision influenced by algorithmic input or output, must disclose the sources of data, training methodologies and rules applied. This is to ensure that the parties can exercise their right to challenge the results of the process. Courts that use predictive AI should be required to inform of its application.

Responsibility and sanctions shall be proposed in each initiative. To solve the attribution problem, accountability mechanisms must exist for erroneous predictive outcomes.

Equally important and especially proactive is the *promotion of a compliance culture* to bring ethical practices in the public and private sectors to the fore and reinforce the notion of responsible innovation in AI (AI applications that respect judicial integrity and public welfare, guided by the principles of fairness and impartiality).

By instituting these regulatory measures, Spain can best navigate the complexities of integrating AI into its judicial system, while making sure that citizens' rights and well-being remain protected.

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