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Front Pages

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Gregory T. Papanikos
President
Athens Institute

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Oversized Transport of EU States in the Era of Artificial Intelligence

By Amelia-Veronica Gheoculescu[*]

Oversized transport in European countries is an essential component of international logistics, playing a critical role in the transport of industrial equipment, large structures or other goods that exceed the standard dimensions and weight allowed for transport. These operations are regulated by strict laws and involve detailed planning. In the European Union, this type of transport is regulated by a combination of national legislation and European directives, with the aim of ensuring road safety and protecting infrastructure. Although each Member State has its own regulations and procedures, there are common elements thanks to European harmonization. Oversized transport has entered a new era with artificial intelligence, which has led to a significant transformation in the way it is planned, managed and executed. The impact of artificial intelligence on oversized transport is major, from route planning, real-time monitoring and coordination of transport, automation of authorization processes, to transport safety and risk reduction, cost optimization and the use of drones for surveillance and robots for secondary operations. Artificial intelligence is transforming oversized transport into a safer, more efficient and more sustainable field, AI being an essential tool to cope with the complexity of this type of transport, opening up new perspectives for logistics and industry.

Keywords: *Oversized transport, Artificial Intelligence, EU States, digitalization, sustainable development goals.*

Introduction

Road transport constitutes a fundamental pillar of modern economies, facilitating the intricate movement of goods and individuals from origin to destination. Within this expansive domain, oversized transport represents a specialized and inherently complex segment. This category encompasses the movement of indivisible goods or the operation of vehicles that, even unladen, exceed standard constructive masses and/or maximum permissible dimensions. Such operations are characterized by stringent regulatory requirements and significant operational complexities. As a specialized form of road freight transport, oversized transport operations must adhere to general road transport operator regulations, such as those stipulated by EU legislation (e.g., Regulation EC 1071/2009, modified by Regulation (UE) 2020/1055), which mandate criteria like effective and stable establishment, good repute, professional competence, and financial capacity. Furthermore, specific conditions apply to the handling of oversized loads, including specialized driver certifications and, where legally mandated, the use of authorized escort vehicles or specialized operators.

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The European Union's oversized transport[1] landscape is currently undergoing rapid evolution. This is primarily driven by an escalating demand for the cross-border movement of large industrial components, specialized machinery, and critical infrastructure elements, essential for various sectors including energy, construction, and manufacturing. Concurrently, Artificial Intelligence (AI) has emerged as a disruptive technological force, demonstrating profound transformative potential across diverse industries. AI promises to revolutionize logistics by optimizing operational processes, significantly enhancing safety protocols, and substantially reducing associated costs.

This academic paper aims to provide an in-depth analysis of the intersection between oversized transport practices in EU Member States and the burgeoning capabilities of AI. The study will meticulously examine the current state of oversized transport, outlining its prevailing regulatory framework and inherent operational challenges. The efficient transport of oversized cargoes is indispensable for urban and industrial development, facilitating the movement of critical components for infrastructure, energy, and manufacturing sectors. However, its integration within increasingly dense and sustainability-focused urban environments presents significant challenges, particularly concerning existing transport infrastructure and environmental objectives[2]. Subsequently, it will delve into the specific applications of AI within this context, exploring both the promising opportunities and the formidable challenges associated with integrating AI-driven solutions into this highly regulated and operationally demanding domain.

Literature Review

The academic discourse on transport and logistics has increasingly focused on the intersection of technological innovation and regulatory frameworks. Traditional research on oversized transport[3] has primarily concentrated on engineering challenges, infrastructure limitations, and the complexities of national permitting procedures[4]. Studies by organizations such as the International Road Transport Union (IRU) have consistently highlighted the administrative burdens and fragmentation of regulations across European borders as significant impediments to efficient oversized transport operations[5]. These challenges often lead to increased costs, delays, and a heightened risk of non-compliance.

The advent of Artificial Intelligence has catalysed a new wave of research across various transport modalities. In general logistics, AI is being explored for its potential in route optimization, demand forecasting, warehouse management, and autonomous vehicle operation[6]. Specifically, in the broader context of intelligent transport systems (ITS), AI algorithms are recognized for their capacity to process vast datasets from

[1]Bădescu & Purcar (2017) In *MATEC Web Conf. Volume 121*, "Trends in New Industrial Revolution".
[2]Petru & Krivda, (2021), 13, 5524.
[3]Bahram, Haibo & Lutfu (2023) *Logistics*, 7, 98.
[4]European Commission. *Transport policy: Road transport - Weights and dimensions*.
[5]IRU (International Road Transport Union). *Challenges of Abnormal Loads Transport in Europe*. [Search for reports or articles on IRU website related to special transports and administrative barriers].
[6]KPMG. *Driving change: How AI is transforming the transport industry*.

sensors, cameras, and telematics devices to manage traffic flow, predict congestion, and enhance urban mobility[7]. The European Commission's Digital Transport and Logistics Forum (DTLF) emphasizes the importance of digitalization and data sharing for improving freight transport efficiency across the EU[8].

However, the application of AI specifically to oversized transport, a niche yet critical segment, remains an area requiring more dedicated academic attention. While general AI applications in smart transport[9] (e.g., smart parking, traffic optimization in urban settings) have been extensively studied[10], the unique complexities of oversized loads – such as specific infrastructure constraints (bridge capacities, tunnel clearances), stringent safety requirements, and highly individualized permitting processes – present distinct challenges and opportunities for AI integration. Existing literature often overlooks the intricate relationship between oversized cargo transport and the principles of sustainable urban infrastructure, failing to comprehensively analyse how the unique demands of oversized loads—including their dimensions, weight, and specific routing requirements—conflict with or can be harmonized with urban[11] sustainability goals, such as reduced emissions, optimized traffic flow, and minimized infrastructure wear[12].

Existing literature on AI in governance and public service highlights the potential for automation in administrative processes, such as permit issuance and compliance checks[13]. However, these studies also caution about the ethical, legal, and social implications of AI, including issues of liability, data privacy, algorithmic bias, and job displacement. The European Parliament Think Tank (EPRS) and ENISA (European Union Agency for Cybersecurity) have underscored the urgent need for robust regulatory frameworks and cybersecurity measures to govern AI applications in safety-critical sectors like transport[14].

This paper aims to bridge the gap in the literature by specifically analysing how AI's capabilities can be adapted to the unique demands of oversized transport within the fragmented regulatory landscape of the EU, while critically assessing the associated opportunities and challenges.

[7]European Parliament Think Tank (EPRS). *Artificial intelligence and transport: New challenges for EU law*. (Analyses legal and ethical challenges of AI in transport). Also, see European Commission. (2024). Digitalisation of mobility.

[8]European Commission's Digital Transport and Logistics Forum (DTLF). Search for reports and best practice guides on the digitalization of freight transport in the EU. (Relevant for EU-level digital initiatives in transport).

[9]Petru & Krivda (2020)

[10]ENISA (European Union Agency for Cybersecurity). *Cybersecurity in the Transport Sector* (Provides insights into cybersecurity risks in connected transport infrastructures).

[11]Szczucka-Lasota (2017) Series Transport, vol 97: 157-165.

[12]Petru & Krivda (2021) 13, 5524

[13]Deloitte. *AI in Government: The Future of Public Service*. (Accessed for AI in automating administrative processes and digital permits).

[14]ENISA. *Cybersecurity in the Transport Sector*. Deloitte. *AI in Government: The Future of Public Service*.

Methodology

The methodology of this research is grounded in a multi-layered analytical approach, beginning with a comprehensive synthesis of current European transport directives and national legislative frameworks. This legal review is augmented by a qualitative assessment of AI integration within the logistics sector, identifying the intersection between technological capability and regulatory constraint. To provide empirical depth, the study utilizes a comparative case study framework, specifically contrasting the mature digital infrastructure of Germany's VEMAGS system with the emerging automated solutions in Poland and Romania. This allows for a critical evaluation of how different administrative cultures adapt to the requirements of the Digital Single Market.

The theoretical underpinning of this research was based on a rigorous and extensive review of academic literature, querying prestigious scientific databases to identify the current state of knowledge in the field. This stage was essential not only for data collection, but also for establishing a solid conceptual framework in which to integrate Artificial Intelligence (AI) in heavy logistics.

In parallel with the academic approach, the analysis process included a critical assessment of reports and strategic documents issued by international reference organizations, such as the European Commission, OECD, International Road Transport Union (IRU), World Economic Forum, UNECE and ENISA. The analysis of these sources allowed for a deep understanding of the current regulatory landscape, emerging technological trends and public policy recommendations at a global level.

The synthesis of the results obtained from these diverse sources aimed to correlate the historical challenges of oversized transport with the innovative solutions offered by AI applications already validated in conventional transport sectors. Furthermore, this synthesis process facilitated the identification of specific opportunities and risks inherent in the application of AI algorithms in oversized logistics, thus providing a balanced perspective on how digitalization can mitigate systemic inefficiencies while maintaining a high level of operational and cybersecurity security.

Starting from the premises identified in the literature review stage, the research has substantiated a robust conceptual framework, aimed at mapping the potential applications of Artificial Intelligence throughout the entire life cycle of an oversized transport operation. This integrated model is not limited to a simple sequence of stages, but analyzes how AI algorithms can critically optimize road planning processes, automation of authorization systems, technical execution of the trip, real-time monitoring of safety parameters and, finally, predictive maintenance of the fleet and the infrastructure used.

Furthermore, the conceptual framework developed transcends the purely technical approach, integrating essential socio-technical dimensions. It examines the complex interdependence between cutting-edge technological advances, human factors involved in the operation, the dynamic regulatory environment and the wider societal impact. Through this multidimensional approach, the reference framework allows for a balanced assessment of how digital innovation interacts with public safety norms and the need for workforce adaptation, providing a solid basis for analyses applied to the German and Polish models.

A key component of the methodology was the critical assessment of the opportunities and challenges identified in the process of integrating Artificial Intelligence into oversized logistics. This analysis was not limited to a simple inventory of obvious benefits, such as increased road safety, improved operational efficiency, reduced logistics costs and alignment with sustainability standards. On the contrary, the research investigated how these advantages are conditioned by a series of significant structural barriers. Among these, the regulatory lag in relation to the pace of technological innovation, the need for massive investments in smart infrastructure and the complexity of data governance represent major obstacles that can slow down the widespread adoption of digital solutions.

The assessment process placed particular emphasis on analyzing the interdependencies between these factors and their potential implications for the Member States of the European Union. For example, it was observed that the increased efficiency through AI is directly dependent on strict cybersecurity protocols, given the vulnerability of critical infrastructure to external attacks. At the same time, ethical concerns regarding algorithmic transparency and decision-making accountability were analyzed in the context of current public policy debates.

This assessment was based on a careful examination of existing academic critiques and strategic dialogue between the public and private sectors on the implementation of AI in high-risk areas. By correlating these perspectives, the section offers a nuanced view of how the balance between innovation and regulation will dictate the success of the digital transition in oversized transport in Europe.

Drawing from the analytical findings and best practices identified in the literature, a set of actionable policy recommendations was formulated. These recommendations are designed to guide EU Member States and relevant stakeholders in strategically leveraging AI to overcome current challenges and foster a more robust, safe, and sustainable oversized transport ecosystem.

This methodology ensures a comprehensive and structured approach to understanding the complex dynamics of AI integration in oversized transport, providing a robust foundation for the discussions and conclusions presented.

Oversized Transport in the EU: Current Framework and Challenges

Oversized transport operations within the European Union are governed by a multi-layered regulatory architecture. This framework comprises overarching EU Directives and Regulations, which establish harmonized principles for general vehicle weights and dimensions, complemented by specific national legislation enacted by each Member State. The primary objectives of this intricate regulatory system are to ensure paramount road safety, safeguard critical infrastructure, and minimize disruptions to general traffic flow.

EU Regulatory Framework

General Directives: The European Union sets forth broad principles concerning vehicle weights and dimensions. However, it strategically grants Member States a degree of flexibility in regulating exceptional transports. This approach allows for the incorporation of national adaptations that account for unique infrastructure characteristics, diverse geographical conditions, and specific local requirements. This ensures that while a common baseline exists, the practicalities of diverse national contexts are accommodated[15].

National legislation: Each EU Member State maintains its distinct and detailed procedures governing the authorization of oversized transports. These national regulations encompass specific requirements for designated routes, the mandatory use of escort vehicles, and various traffic restrictions (e.g., limitations on specific hours, days, or under certain weather conditions). This national discretion frequently results in a fragmented and time-consuming process for obtaining cross-border permits, often necessitating approvals from multiple national, regional, and local authorities, thereby creating significant administrative complexities[16].

Within this national legislative landscape, it is crucial to acknowledge the strategic direction set by individual Member States. For instance, Romania's National Strategy for Intelligent Transport Systems (2022-2030), approved by Government Decision No. 877/2022 on the approval of the National Strategy on Intelligent Transport Systems for the period 2022-2030[17], outlines a clear commitment to digitalizing transport infrastructure and services. While not exclusively focused on oversized transport, this strategy's objectives – such as enhancing road safety, improving traffic flow efficiency, and promoting data exchange and interoperability – directly influence the environment in which oversized transport operates and pave the way for AI integration.

Key Challenges in EU oversized Transport

Complex route planning: The planning of oversized transport routes demands a meticulous, often manual, analysis of numerous infrastructure constraints. These include, but are not limited to, bridge capacities, tunnel clearances, the geometry of sharp turns, the presence of overhead obstacles (such as power lines or low-hanging structures), and the load-bearing resistance of road surfaces. This complexity is particularly pronounced for international routes that traverse diverse infrastructural landscapes[18].

[15]European Commission. *Transport policy: Road transport - Weights and dimensions*.
[16]IRU (International Road Transport Union). *Challenges of Abnormal Loads Transport in Europe*.
[17]National Strategy on Intelligent Transport Systems for the period 2022-2030. Approved by Government Decision no. 877/2022, published in the Official Gazette of Romania, Part I, no. 894 of September 8, 2022 [Strategia Națională privind sistemele de transport inteligente pentru perioada 2022-2030. Aprobată prin Hotărârea Guvernului nr. 877/2022, publicată în Monitorul Oficial al României, Partea I, nr. 894 din 8 septembrie 2022.]
[18]European Commission. *Transport policy: Road transport - Weights and dimensions*.

Fragmented permit acquisition: The process of obtaining Special Transport Authorizations (STAs) across the EU is widely recognized as bureaucratic, protracted, and costly. Significant variations in regulatory requirements, application procedures, and processing times among Member States impose substantial administrative burdens and lead to considerable delays for cross-border operations, hindering the efficiency of the single market[19].

Safety concerns: The inherent physical characteristics of oversized vehicles – their immense size and reduced manoeuvrability – intrinsically elevate the risks of accidents. This demands the implementation of exceptionally stringent safety measures, specialized training for drivers, and, in many cases, mandatory professional escorts to manage traffic and mitigate potential hazards.

Infrastructure impact: The passage of oversized transports contributes disproportionately to the accelerated wear and tear of road networks and bridge structures. This requires continuous and rigorous monitoring of infrastructure integrity, proactive maintenance schedules, and, in certain instances, temporary structural reinforcements to accommodate exceptionally heavy loads. The integration of oversized cargo transport within increasingly dense and sustainability-focused urban environments presents significant challenges, particularly concerning existing transport infrastructure and environmental objectives, including infrastructure limitations (e.g., bridge capacities, narrow streets) and environmental impacts[20].

High operational costs: These specialized transports incur substantially higher operational costs compared to standard freight movements. These costs stem from the intricate planning requirements, significant permit fees, expenses associated with escort services, elevated fuel consumption due to vehicle size and speed limitations, and extended transit times resulting from regulatory complexities and operational constraints.

Limited real-time information: A pervasive challenge is the lack of comprehensive, real-time data concerning infrastructure conditions, unforeseen temporary road closures, or unexpected obstacles across multiple national jurisdictions. This information deficit impedes dynamic route adjustments and proactive risk management[21].

Oversized Transport in Greece, Romania, Germany and Poland – Comparative Study

Oversized transport is carried out differently depending on the legislative, infrastructural and administrative particularities of each Member State of the European Union. In the following, we analyze the situation in three representative countries: Greece, Romania and Germany, highlighting the common challenges and innovative solutions adopted in the context of the digital transition and the use of artificial intelligence (AI).

[19]IRU (International Road Transport Union). *Challenges of Abnormal Loads Transport in Europe*.
[20]Petru & Krivda, 2021, 13, 5524.
[21]Ramūnas & Artūras (2012) No 1: 51–56.

I. Greece – Difficult Topography and Slow Digitalization

Greece, characterized by a predominantly mountainous topography and a road network composed largely of narrow national roads, faces major difficulties with regard to oversized transport. The road infrastructure is not always adapted to such transport, and the island networks further complicate logistics.

The challenges for this activity are multiple: lack of corridors dedicated to special transport; insufficiently digitalized port infrastructure for handling large loads; lack of digital interoperability between regional agencies. Recent developments in this area are important for the development of this sector. The most significant are: the Hellenic Road Authority has launched a digital portal for the authorization of special transport, but the system is not yet integrated at national level; pilot projects in collaboration with the Technical University of Athens use artificial intelligence to simulate oversized routes in mountainous areas.

Oversize Transport in Greece – Status, Challenges and Prospects

Greece's unique geostrategic position in Southeast Europe, cantered around the Mediterranean hub of Piraeus, necessitates a robust framework for oversized transport to maintain connectivity between maritime routes and the Balkan interior. However, the legal and operational execution of these transports is significantly conditioned by the country's predominantly mountainous topography. The Pindus Mountain range and the Peloponnese region impose severe physical constraints on vehicle dimensions and axle weights, as sharp curvatures and steep gradients naturally limit the efficacy of standard oversized transport configurations. Consequently, the regulatory framework must account for these geographical idiosyncrasies, often resulting in strict, localized restrictions that deviate from broader European averages.

The transition of the Greek road network also presents a dual challenge for legal harmonization. While the motorway network is undergoing expansion, a substantial portion of special transport operations remains relegated to national and regional roads. This reliance on secondary infrastructure creates a complex administrative burden, as these routes often lack the structural load-bearing capacity of modern motorways, requiring individualized structural assessments for each transit permit. To mitigate these terrestrial limitations, the Greek logistics sector has developed a specialized reliance on multimodal maritime-to-road transport. This "roll-on/roll-off" model for heavy industrial and energy components represents a strategic adaptation to infrastructure deficits, though it requires complex legal coordination between maritime law and terrestrial transport regulations.

From an administrative law perspective, the authorization process in Greece remains characterized by high levels of bureaucracy. The issuance of Special Transport Authorizations (STAs) involves a multi-layered approval chain encompassing the Ministry of Infrastructure and Transport, local municipal authorities, and the Hellenic Police. This fragmented governance structure often results in processing durations exceeding seven days, creating significant delays in the international supply chain.

In an effort to modernize this administrative framework and align with EU digital objectives, Greece launched a digital pilot project in 2023 for the electronic issuance of permits. This initiative is particularly noteworthy for its integration of digital simulation components, which allow for the algorithmic verification of route compatibility with bridge thresholds and road geometry. While this represents a significant step toward the integration of Artificial Intelligence in Greek administrative law, the system's effectiveness currently remains limited by the lack of a fully unified national database, highlighting the ongoing need for deeper digital and legal integration within the Hellenic transport sector.

Major Challenges in Oversized Transport Operations

Beyond the technical complexity of the operations themselves, the success of oversized transport is conditioned by overcoming deep structural challenges that often generate inefficiencies in the logistics chain. A critical barrier is represented by insufficiently adapted infrastructure, characterized by a lack of dedicated corridors for special transport and the degradation of aging structural elements. This physical reality not only slows down movement but also imposes additional safety risks, forcing operators to seek costly alternative routes.

Added to these infrastructure deficiencies are natural and geographical limitations, which impose severe restrictions in mountainous or island areas. In such regions, simple road traction becomes insufficient, necessitating the design of complex multimodal logistical solutions, such as ferry transfers or the use of specialized lifting equipment to traverse rugged terrain.

Finally, efficiency is often undermined by limited institutional cooperation. The fragmentation of competences between local and central authorities creates a bureaucratic maze that considerably slows down planning and approval processes. The lack of fluid inter-institutional communication often turns the acquisition of permits into an unpredictable journey, highlighting the urgent need for a digitalization that unifies these decision-making levels within a coherent administrative framework.

Perspectives and innovations

Greece is trying to integrate artificial intelligence and digital solutions to optimize the route and shorten the approval time.

The use of Digital Twins is being explored to simulate the impact of oversized transport on infrastructure, preventing damage and increasing safety. This technology is closely linked to European initiatives to digitize transport corridors (TEN-T), where Greece is investing heavily to become a logistics gateway between Asia and Central Europe.

Highway and expressway network development projects also include investments in special infrastructure for oversized transport, especially near ports and industrial centers.

II. Romania

Romania occupies a key geostrategic position within the European and Eurasian transport corridors, being located at the crossroads of trade routes linking Central and Western Europe with the Balkans, Ukraine, the Black Sea and Central Asia.

Oversized transport is vital for development of the energy sector (wind, hydro, nuclear power plants), large infrastructure projects (bridges, refineries, factories), defense and heavy equipment industries. However, Romania faces multiple systemic deficiencies that hinder efficiency and competitiveness in this area.

Road Infrastructure and its Limitations

The Romanian transport landscape presents a series of systemic challenges that significantly impede the efficiency of oversized logistics. A primary concern is the fragmentation of the motorway network; although key sections such as the A1, A2, and A3 are functional, they lack the necessary connectivity to form a continuous corridor. This discontinuity forces heavy and oversized loads onto the national road network, which is often ill-equipped to handle the geometric and weight demands of such convoys.

The situation is further exacerbated by the prevalence of aging infrastructure, particularly regarding bridges and overpasses. Many structures within the national network are subject to strict tonnage and height restrictions, necessitating long and economically draining detours. These limitations are compounded by a chronic lack of specialized logistics corridors. Currently, dedicated routes for oversized transport are only established on an ad-hoc basis for strategic industrial projects—such as those involving the Cernavodă Nuclear Power Plant or major refineries—rather than being integrated into a permanent, high-capacity national strategy.

Furthermore, the absence of comprehensive bypass options frequently forces these massive convoys to transit through densely populated urban areas. This not only increases the risk of infrastructure damage and traffic accidents but also leads to substantial logistical delays.

On the regulatory front, while Romania has made strides toward digitalization through the SEAST platform (Electronic System for Issuing Special Transport Authorizations), the system remains hampered by significant procedural inefficiencies. Although functional, the authorization process is often characterized by a slow and fragmented workflow, typically requiring 5 to 10 days for approval. This delay is largely due to the necessity of obtaining separate clearances from a multitude of stakeholders, including local authorities, the traffic police, and various county road administrators.

A critical technical deficiency identified within this framework is the lack of automation and interoperability. The SEAST platform operates in relative isolation, lacking a direct link to centralized databases concerning real-time infrastructure status, traffic conditions, or bridge capacity evaluations. Consequently, the system cannot perform automatic route assessments, relying instead on manual verification. This technological gap is further widened by the absence of a real-time tracking system for

both requests and active transports, preventing the dynamic management of the logistics chain.

Ultimately, the transition from this fragmented approach to a model of excellence, similar to the German VEMAGS system, will require not just the modernization of physical assets, but a fundamental integration of databases to ensure that the "digital permit" reflects the actual, real-time conditions of the Romanian road network.

Examples and Case Studies

The Romanian oversized transport sector is punctuated by high-complexity operations that highlight the tension between critical industrial needs and infrastructural deficits. A primary example is the transport of nuclear components for the Cernavodă Power Plant. From a legal and administrative perspective, these operations represent the pinnacle of risk management, requiring a bespoke regulatory approach. Historically, these transports relied on manual route planning and extensive physical escorts, necessitating temporary administrative derogations for emergency infrastructure repairs. The integration of AI in this context would offer a transition from reactive "ad-hoc" planning to predictive modelling, allowing for the simulation of structural stress on the Danube bridges and ensuring that the legal responsibility for public safety is backed by high-precision data rather than manual estimation.

The development of renewable energy infrastructure, specifically wind farms in the Dobrogea region, further illustrates the limitations of the current terrestrial framework. The transport of turbine blades exceeding 60 meters in length frequently encounters "legal-geographical" bottlenecks where narrow regional roads and unstable bridges cannot support the load within standard safety margins. In these instances, the regulatory burden increases as operators are forced to seek alternative multimodal solutions, such as combining river transport with road segments. This necessity for intermodal coordination underscores the urgent need for a unified European digital platform that can harmonize the disparate legal requirements of maritime and road authorities, reducing the administrative lag that currently hampers the Green Deal's infrastructure goals.

Furthermore, the expansion projects of Constanța Port reveal a systemic "connectivity gap" in the legal governance of logistics hubs. Despite the port's status as a vital EU maritime gateway, oversized transports have faced significant delays due to the absence of efficient, legally designated road corridors connecting the terminals to the national motorway network. This lack of dedicated "oversized corridors" creates a conflict between local administrative traffic regulations and national economic interests.

Addressing these challenges requires a shift toward "Smart Infrastructure" governance, where AI-driven data systems provide real-time updates on bridge integrity and road widths. By codifying these technological insights into the administrative law process for permits, Romania can move away from the current descriptive and manual model toward a more efficient, automated, and legally robust transport framework that aligns with EU standards for digital infrastructure.

Artificial Intelligence in oversized Transport – Potential and Initiatives

While the Romanian oversized transport sector remains in the nascent stages of Artificial Intelligence integration, the current landscape is characterized by strategic pilot initiatives that bridge the gap between private innovation and public administration. In the private sector, logistics technology firms such as Cargo Planning and Trans. EU Romania have begun deploying sophisticated algorithms designed for route optimization and clearance calculation. These systems leverage satellite imagery and GPS data to perform high-precision geometric assessments of the road network. From a legal standpoint, the adoption of such technologies by private operators poses critical questions regarding data liability and the evidentiary weight of algorithmic route validations when presented to national transport authorities for permit approval.

A significant milestone in the academic and industrial intersection of AI was reached in 2023 with the pilot project in the Pitești industrial cluster. Conducted in collaboration with the Politehnica University of Bucharest, this initiative utilized "Digital Twin" technology to simulate oversized transport operations for the Dacia automotive plant. This simulation model allowed for a virtual stress test of the physical infrastructure, providing a data-driven foundation for risk assessment that far exceeds the capabilities of traditional manual planning.

The broader integration of these technologies is further facilitated by Romanian participation in pan-European research frameworks, notably through the Horizon Europe program. These international collaborations focus on testing AI modules dedicated to transport time predictability and infrastructure risk analysis. The legal implications of these projects are profound, as they necessitate the development of interoperable data governance standards that comply with both the EU AI Act and General Data Protection Regulation (GDPR). By participating in these cross-border initiatives, the Romanian logistics sector is effectively contributing to a harmonized European "digital legal space," where the automation of transport risk analysis could eventually lead to the standardization of administrative procedures for Special Transport Authorizations across the Union.

Recommendations for Romania

To transition from a descriptive to an analytical framework of oversized transport governance, several key structural reforms are necessitated. First, the complete digitalization of the *SEAST* (Electronic System for Transport Authorizations) platform must be prioritized. From an administrative law perspective, this requires more than just a digital interface; it necessitates full algorithmic integration with the traffic police systems, the National Company for Road Infrastructure Administration (CNAIR) geospatial databases, and regional county road networks. Such integration would create a "single window" for administrative transparency, ensuring that the legal issuance of permits is based on real-time, cross-referenced infrastructure data, thereby minimizing the margin for human error and administrative litigation.

Secondly, the establishment of permanent "oversized logistics corridors" represents a critical shift in spatial planning and transport law. These corridors,

proposed along the strategic axes of *Constanța – Bucharest – Pitești – Arad* and *Giurgiu – Bucharest – Ploiești – Brașov – Târgu Mureș*, would benefit from adapted infrastructure and digital signage systems. Legally, designating these routes as "Strategic Heavy-Load Corridors" would allow for standardized regulatory requirements and streamlined permitting, reducing the jurisdictional friction between national and local authorities. This approach aligns with the European objective of creating a Trans-European Transport Network (TEN-T) that is resilient to the unique demands of heavy industrial movement.

Furthermore, the advancement of the sector depends on structured partnerships between technical universities and transport authorities. These collaborations should focus on the development of AI-driven planning tools that incorporate machine learning for predictive risk analysis. By codifying academic innovation into public policy, the state can ensure that the legal framework for oversized transport is supported by robust technical simulations.

Finally, the financial sustainability of these initiatives must be anchored in the National Recovery and Resilience Plan (PNRR) and EU Cohesion Funds. Dedicated funding should be directed toward the modernization of critical infrastructure—including the reinforcement of bridges, the expansion of access ramps, and the redesign of roundabouts specifically for oversized configurations. This investment is not merely an engineering requirement but a legal necessity to ensure that the infrastructure can meet the safety standards mandated by European transport directives in the era of Artificial Intelligence.

III. Germany – European Leader in Digitalization and Regulation

Germany's standing as a benchmark for oversized transport management is rooted in a highly integrated socio-technical regulatory framework that harmonizes public safety with logistical necessity. This model is fundamentally governed by the interplay between the **Road** Traffic Order (StVO - Straßenverkehrs-Ordnung) and the Road Traffic Licensing Order (StVZO - Straßenverkehrs-Zulassungs-Ordnung), providing a predictable legal environment for international operators.

From a legal perspective, the process is triggered by § 29 Abs. 3 StVO, which mandates a special permit (*Erlaubnis*) for vehicles whose dimensions or mass exceed statutory limits. This is complemented by § 70 StVZO, which provides the legal basis for technical exemptions for specialized transport equipment, such as modular trailers. The digital manifestation of these laws is the VEMAGS[22] platform. Analytically, VEMAGS functions as a "Digital Single Window" that addresses the problem of fragmented local jurisdictions. By centralizing the permit process across more than 600 local authorities, the German state has effectively reduced administrative transaction costs. This centralization ensures procedural homogeneity, guaranteeing that safety standards are applied uniformly across all federal states (*Bundesländer*), contrasting sharply with Member States where procedures remain localized and unpredictable.

[22]Interoperable Europe. (2024). *Verfahrensmanagement für Großraum- und Schwertransporte (VEMAGS)*. VEMAGS. (2024). *Verfahren für die Erteilung von Ausnahmegenehmigungen: System Overview*.

A critical analytical differentiator is the integration of the SIB-Bauwerke database into the VEMAGS workflow. This transforms a simple administrative permit into a dynamic risk-assessment tool. By cross-referencing a 100-ton load against the real-time structural health of specific bridge assets, the system imposes "operational conditions" that are legally binding—such as crossing on the center road axis or total traffic exclusion. This precision clarifies legal liability parameters; if a route is "system-approved" under specific conditions, professional negligence is clearly defined by any deviation from these algorithmic requirements. Furthermore, Germany has professionalized its escort services through the RGST (Richtlinien für Großraum- und Schwertransporte) guidelines. Through the BF4 Intelligent Escort standard, private vehicles equipped with Variable Message Signs (VMS) are legally empowered to alter road signs and halt traffic. This represents a sophisticated delegation of sovereign authority, where the state maintains oversight through strict certification, while the private sector provides the operational flexibility required for complex maneuvers.

Case Study: Transporting a Wind Turbine Blade (80m+) in Lower Saxony

The transport of wind turbine blades exceeding 80 meters in Lower Saxony serves as a practical validation of this integrated framework. The operation begins with a "Digital-First" planning phase, where the route is digitally simulated against the SIB-Bauwerke database. If a bridge under rehabilitation presents tonnage restrictions, the VEMAGS system automatically rejects the request, forcing the identification of an alternative route before physical bottlenecks occur. This proactive risk mitigation is essential in a landscape where infrastructure maintenance is ongoing.

During the execution phase, the BF4 escort technology allows the convoy to navigate complex intersections without a police presence. The escort driver utilizes legal authority to stop traffic, using real-time data to ensure the flow of the mass, which is particularly critical on slopes where stopping would be hazardous for heavy loads. To overcome the physical limitations of historic rural infrastructure, transporters utilize Blade Lifter technology (e.g., Benteler, Kübler). By mounting components on hydraulic devices capable of vertical inclination up to 60∘, the operation avoids permanent modifications to the landscape. This synergy between legislative permission (BF4 authority) and engineering innovation (the Blade Lifter) demonstrates how a robust regulatory framework can compensate for the spatial limitations of built heritage while maintaining high safety standards.

IV. Poland – An Expanding Regional Logistics Hub

Poland has solidified its status as a critical geostrategic hub within the European logistics network, serving as the primary intersection for transport corridors linking Eastern Europe with Germany, the Baltic States, and Scandinavia. This positioning facilitates a high volume of oversized transport[23] operations, particularly those involving heavy industrial components[24] and energy infrastructure. However, the

[23]Macioszek (2019) 109-117.
[24]Sławomir (2022) 136-152.

sector faces significant administrative hurdles rooted in regional bureaucracy. Special transport permits are currently issued by disparate local and regional road authorities, resulting in a lack of procedural uniformity and fluctuating approval timelines. From a legal perspective, this decentralized model creates "regulatory fragmentation," where the lack of an integrated national database for infrastructure capacity hampers the efficient execution of cross-border transit.

In response to these challenges, Poland is undergoing a significant digital transformation aimed at becoming an "AI-ready" logistics leader in Central Europe. A cornerstone of this evolution is the *e-Koncesje* project, a digital permitting system launched for testing in 2024. Unlike traditional manual systems, this platform utilizes Artificial Intelligence to automate route eligibility checks against vehicle dimensions. This shift from discretionary administrative approval to algorithmic validation represents a pivotal moment in Polish administrative law, necessitating new frameworks for data accuracy and the legal accountability of automated systems. Furthermore, the collaboration between the Warsaw University of Technology and national authorities is advancing risk simulation models through "Digital Twin" technology and satellite data, providing a scientific basis for infrastructure management.

The technical sophistication of Poland's infrastructure is further demonstrated by the deployment of LiDAR (Light Detection and Ranging) scanning. By utilizing vehicles equipped with laser scanners to create millimetre-precise Digital Twins of transport routes, authorities can detect minute physical obstacles, such as sagging cables or curb alignments, before the transit of high-value cargo like tunnel boring machines. This is complemented by the National Traffic Management System (KSZRT), which integrates data from thousands of weather and traffic sensors. For oversized transport, the legal significance of KSZRT lies in its ability to provide real-time, safety-critical data—such as crosswind forecasts on viaducts—which can be used to legally justify temporary route closures or speed adjustments for vulnerable loads, such as wind turbine blades.

Finally, Poland's implementation of one of Europe's densest networks of Weigh-in-Motion (WIM) sensors represents a significant advancement in automated legal enforcement. These sensors, embedded in the road surface, automatically verify compliance with digitally approved axle loads without requiring physical stops. While this increases operational efficiency, it also introduces complex questions regarding the "automaticity" of fines and the administrative rights of transport operators to contest sensor-derived data. Despite these innovations, the persistence of digital fragmentation between regional administrations remains a barrier to a truly uniform AI-driven governance model, highlighting the need for a centralized legal framework that harmonizes regional data with national strategic objectives.

Case Study: Transport of the TBM Karpatka (Babica, Poland)

This was one of the most complex transports in the history of Poland, involving parts weighing over 500 tons and a width of 9 meters.

The transport planning was carried out using the "Digital Twin". Unlike classic methods, the Poles (through GDDKiA - National Road Administration) created a complete virtual model of the 800 km route (from the port of Szczecin to Babica). Inspection vehicles scanned every bridge, viaduct and traffic sign using the 3D LiDAR system. The data was fed into simulation software that "ran" the virtual convoy to identify points where the ground clearance was too low or the curves were too tight. Real-time analysis of the bridges was carried out, and temporary load sensors were installed for old bridges. Data from these sensors was monitored as the convoy crossed, to ensure that the deformation of the structure remained within the calculated elastic limits.

For the heaviest segments, not classic trucks were used, but self-propelled modular platforms - SPMT Technology (Self-Propelled Modular Transporters). These platforms (over 80 axles) are controlled by a single operator with a remote control. On-board software automatically calculates the hydraulic pressure in each wheel to keep the load perfectly horizontal, even on sloping roads. This technology allowed the convoy to pass through small roundabouts without dismantling the entire road infrastructure, by rotating the modules at angles impossible for a truck with a trailer - 360° pivoting.

To carry out these transports safely, Poland uses KSZRT (Krajowy System Zarządzania Ruchem Drogowym), a digital system that offers Dynamic Weight Monitoring (Sensors in the asphalt that confirm that the axle weight of the convoy is distributed according to authorization) and VMS (Variable Message Signs) - the panels on the highways were automatically programmed to warn other drivers and close the necessary lanes as the convoy's GPS reached certain checkpoints.

Comparative Conclusions Country Degree of Digitalization and Infrastructure for Oversize Transport (2025)

Country	Digitalization Level	Adapted Infrastructure	Authorization Time	AI & Digital Twins Use
Greece	**Low / Developing**	**Medium** – Limited in mountainous areas and islands.	**High** (≥ 7 days)	**Pilot:** Route simulation and sensor-based monitoring for old bridges.
Romania	**Developing**	**Deficit** in key areas; new corridors (A1, A7) are being adapted.	**High** (≥ 10 days)	**Pilot:** GPS-based planning and flyover technologies for critical bridges.
Germany	**Advanced**	**Expanded & Modernized** with detailed tonnage databases.	**Low** (1–2 days)	**Active:** Real-time route optimization and Digital Twins for structures.

Country	Digitalization Level	Adapted Infrastructure	Authorization Time	AI & Digital Twins Use
Poland	**Rapidly Progressing**	**Accelerated Expansion** of highway networks and logistics hubs.	**Medium** (3–6 days)	**Active:** AI-driven planning and integrated e-authorization systems.

The future of oversize transport relies as much on digital mapping as it does on physical infrastructure. Without a unified digital database of bridge capacities and road dimensions, countries like Greece and Romania will continue to face higher logistics costs due to administrative delays.

The preceding national analyses reveal a significant technological and administrative disparity between EU Member States within the heavy-lift and oversized transport sector. This "digital divide" can be categorized into two distinct groups based on their level of AI integration and regulatory modernization. On one hand, the Digital Leaders, exemplified by Germany and Poland, have successfully embedded advanced digital tools into their national logistics chains. Germany's use of Digital Twins to simulate structural stress on bridges represents a sophisticated intersection of engineering and administrative law, allowing for rapid, data-backed permit approvals that enhance economic competitiveness. Similarly, Poland has addressed the challenge of "regulatory lag" through its e-authorization frameworks, such as the SENT system, which has effectively reduced bureaucratic friction and shortened operational wait times by automating compliance checks.

Conversely, Transitioning States such as Greece and Romania are currently navigating a more complex path toward digital integration. While both nations are recipients of substantial European Union funding intended for infrastructure modernization, they remain in the nascent stages of digitalizing their administrative processes. In Greece, the primary focus is the deployment of 3D route simulations—a technological necessity to mitigate the legal and safety risks inherent in navigating the country's difficult coastal and mountainous topography. Romania, meanwhile, is witnessing a strategic shift toward digital data planning for national-scale projects. However, the efficacy of these innovations is frequently undermined by persistent administrative bottlenecks and a lack of interoperability between various state agencies.

The future of oversized transport in the European Union relies as much on high-fidelity digital mapping as it does on physical infrastructure. From a legal and policy perspective, the absence of a unified, cross-border digital database detailing bridge capacities and road dimensions represents a significant barrier to the "Single European Transport Area." Without such a shared repository, countries like Greece and Romania will continue to incur higher logistics costs and increased administrative delays compared to their Northern and Central European counterparts.

Ultimately, the analytical comparison suggests that the mere modernization of physical roads is insufficient. To achieve true regulatory harmonization and operational efficiency, the Union must move toward a standardized "digital infrastructure" where AI-driven data is legally recognized as the primary basis for safety assessments and permit issuance across all Member States. This transition will not only lower costs but

also ensure that the transport of critical industrial and energy components— essential for the European Green Deal—can proceed without the current burden of fragmented national bureaucracies.

While the German model (VEMAGS) prioritizes administrative centralization and the structural integrity of bridge assets, the Polish approach emphasizes technological digitalization through the deployment of LiDAR sensors and Weigh-in-Motion (WIM) systems. This divergence in national regulatory strategies underscores the urgent necessity for EU-level legislative harmonization to ensure seamless data interoperability between disparate national systems.

The Role of Artificial Intelligence in transforming oversized Transport in the EU

Artificial Intelligence presents a suite of innovative solutions capable of addressing many of the entrenched challenges within the oversized transport sector. By leveraging AI, significant advancements in optimization, predictability, and safety can be achieved.

The integration of Artificial Intelligence within the logistical planning of oversized transport represents a paradigm shift from static route assessment to dynamic, data-driven optimization. Central to this transformation are intelligent routing algorithms capable of synthesizing vast datasets, ranging from Geographic Information Systems (GIS) and real-time traffic conditions to granular infrastructure constraints such as temporary bridge load-bearing limits. By processing these multifaceted variables, AI-powered systems identify optimal trajectories that simultaneously maximize fuel efficiency[25] and ensure rigorous compliance with national safety regulations. Such strategic routing is not merely an operational convenience but a critical technological intervention necessary to mitigate the inherent conflicts between heavy-haul transport demands and urban sustainability objectives, particularly regarding the maintenance of optimized traffic flow[26].

Furthermore, the deployment of advanced AI-driven simulation models allows for the high-fidelity prediction of a convoy's impact on both the surrounding traffic ecosystem and the physical integrity of the road network. These predictive models empower regulatory authorities and operators to anticipate structural stresses or potential bottlenecks before the actual journey commences. By facilitating such proactive mitigation strategies, AI transitions the sector toward a 'digital-first' safety model, where potential hazards are identified and bypassed in a simulated environment, thereby reducing the risk of infrastructure damage and public disruption.

The integration of Artificial Intelligence into the authorization framework for oversized transport represents a significant shift from traditional discretionary administration to a model of algorithmic governance. One of the primary legal benefits of this transition is the implementation of automated compliance checks. In this context, AI systems serve as sophisticated regulatory monitors that can verify permit applications against a complex hierarchy of national and European Union

[25]KPMG. *Driving change: How AI is transforming the transport industry*. (Accessed for AI applications in route optimization and logistics).
[26]Petru & Krivda, 2021, 13, 5524.

regulations. By rapidly cross-referencing high-precision vehicle specifications with proposed routes and infrastructure constraints, these systems provide a level of speed and accuracy that manual review cannot achieve. Legally, this reduces the risk of administrative error and ensures that the principles of road safety and infrastructure protection are upheld through objective[27], data-driven validation.

Furthermore, the development of a harmonized, EU-level AI system offers a compelling solution to the legal friction inherent in cross-border permit facilitation. Currently, international oversized transports are burdened by the need to navigate fragmented national legal systems, each with unique documentation requirements. An integrated AI framework would enable seamless data sharing and mutual recognition of validations between national authorities. Such an initiative aligns with the European Commission's broader digital strategy, potentially transforming the multi-country permitting process from a series of isolated bureaucratic hurdles into a streamlined, interoperable administrative procedure. This would not only reduce the administrative costs for operators but also reinforce the legal integrity of the Single European Transport Area.

Finally, the application of machine learning to historical administrative data introduces the concept of "predictive permitting." By analysing past processing times and the variables associated with successful or rejected applications, AI can generate highly accurate forecasts for future permit timelines. From a legal and operational standpoint, this predictive capability allows transport operators to schedule complex logistics with greater precision, mitigating the financial risks associated with administrative delays. This shift toward a proactive administrative model, as discussed in the European Parliament's analysis of AI and transport law, underscores the necessity of evolving the current legislative framework to accommodate the nuances of algorithmic decision-making and automated administrative acts.

The integration of Artificial Intelligence (AI) into the safety and monitoring frameworks of oversized vehicle transport represents a significant shift toward proactive hazard mitigation. Central to this evolution is the deployment of real-time obstacle detection powered by advanced computer vision. By synthesizing data from vehicle-mounted cameras and LiDAR sensors, these systems maintain a continuous assessment of the vehicle's spatial footprint relative to its immediate environment. This capability is particularly critical for navigating vertical and lateral constraints, such as overhead cables and bridge structures, where the system can provide instantaneous driver alerts or initiate autonomous corrective manoeuvres to prevent collisions.

Beyond immediate spatial awareness, AI facilitates a more sophisticated level of predictive risk assessment. By analysing historical telematics data in conjunction with real-time driver behaviour and fluctuating road conditions, AI algorithms can identify high-risk segments of a planned route. This shift from reactive to proactive monitoring allows for the anticipation of hazards before they manifest, thereby enhancing the overall safety margin of the transport operation. Such predictive intelligence is further augmented by the refinement of Advanced Driver-Assistance Systems (ADAS). When tailored specifically to the unique mass and momentum dynamics of oversized loads, AI-enhanced features—including adaptive cruise control and emergency

[27]European Parliament Think Tank (EPRS). *Artificial intelligence and transport: New challenges for EU law.* (Analyses legal and ethical challenges of AI in transport).

braking—provide a stabilizing layer of support that accounts for the specific operational challenges inherent in heavy-haul logistics.

Furthermore, the scope of monitoring extends beyond the vehicle itself through the utilization of AI-equipped drone surveillance. These aerial assets provide a comprehensive view of the convoy's trajectory, offering a vantage point that ground-based escort vehicles cannot achieve. This real-time aerial intelligence is invaluable during complex manoeuvres or when traversing terrain with limited visibility[28], as it allows escort teams and traffic authorities to coordinate movements with a heightened degree of situational awareness. Collectively, these technological interventions transition the sector away from manual oversight toward a digitally integrated safety ecosystem.

The application of Artificial Intelligence extends significantly into the domains of predictive maintenance and operational efficiency, offering a data-driven approach to asset management in the heavy-haul sector. Central to this is the implementation of comprehensive vehicle health monitoring systems. By processing continuous data streams from embedded sensors—ranging from engine performance metrics to tire pressure and braking system integrity—AI algorithms can identify subtle mechanical deviations that precede hardware failure. This transition from reactive to predictive maintenance allows for the scheduling of interventions before a breakdown occurs, thereby mitigating the high costs associated with roadside repairs and significantly reducing vehicle downtime.

Complementing vehicle-centric monitoring is the role of AI in safeguarding infrastructure integrity. Through the analysis of data from sensors strategically positioned on critical assets such as bridges, viaducts, and road surfaces, AI systems can detect early indicators of structural stress, fatigue, or damage specifically induced by the passage of oversized and overweight loads. This provides a mechanism for dynamic infrastructure assessment, moving beyond periodic manual inspections toward a model of real-time health monitoring. Such a proactive approach not only facilitates timely repairs that extend the operational lifespan of civil engineering assets[29] but also serves as a critical safeguard against catastrophic structural failures caused by cumulative loading strain.

Furthermore, the integration of AI contributes to enhanced operational sustainability through the optimization of fuel consumption. Rather than relying on static driving protocols, AI systems can dynamically adjust vehicle operating parameters and provide real-time guidance on optimal driving behaviours. By synthesizing variables such as fluctuating load weights, specific topographical route characteristics, and evolving traffic conditions, these systems enable a more precise calibration of power delivery. The resulting improvements in fuel efficiency represent more than just a reduction in carbon emissions; they constitute a substantial optimization of the overall cost-to-benefit ratio in complex transport logistics.

[28]ENISA (European Union Agency for Cybersecurity). *Cybersecurity in the Transport Sector*. (Provides insights into cybersecurity risks in connected transport infrastructures).
[29]Petru & Krivda, (2021), 13, 5524.

Discussion of findings and General Arguments

The analysis reveals compelling arguments for the strategic integration of AI in the EU's oversized transport sector. The findings highlight that AI is not just a significant improvement, but a transformative technology capable of fundamentally reshaping operational paradigms and addressing long-standing systemic inefficiencies.

The digital transition in oversized transport is not just an algorithm race, but a profound transformation with a human face. While Germany and Poland are setting new efficiency standards through AI, long-term success depends on our ability to retrain the workforce and use these tools to achieve the EU's climate goals. Digitalization is transforming the steel giant of oversized transport into an agile and sustainable player in tomorrow's green economy.

So, AI must be used under human supervision, transforming the driver and logistics operator from simple executors into supervisors of intelligent systems. This symbiosis ensures not only economic efficiency, but also the necessary safety and responsibility on European public roads.

The most significant argument for AI integration lies in its potential to drastically improve safety. By moving beyond reactive measures, AI's predictive capabilities for route hazards, infrastructure stress, and driver fatigue can prevent accidents before they occur. The ability to conduct real-time obstacle detection and provide advanced driver assistance, as highlighted up, offers a new layer of protection that manual processes cannot match. This aligns with the broader goals of intelligent transport systems to create safer road environments[30].

The current fragmented permit acquisition process and complex route planning are major cost drivers. AI's capacity to automate compliance checks, facilitate cross-border permitting, and optimize routes directly translates into substantial cost reductions and improved operational efficiency. These efficiencies can enhance the competitiveness of EU transport operators, allowing them to offer more reliable and cost-effective services, thereby strengthening the single market. This also supports the economic dimension of sustainable development by fostering innovation and growth[31].

Oversized transports, due to their size and weight, have a considerable environmental footprint. AI-driven fuel optimization and intelligent routing can significantly reduce fuel consumption and associated emissions. By minimizing detours and optimizing speed profiles, AI contributes directly to the EU's Green Deal objectives and various Sustainable Development Goals, particularly SDG 13 (Climate Action) and SDG 11 (Sustainable Cities and Communities)[32]. This directly supports urban sustainability goals, such as reduced emissions[33].

While AI offers solutions, it also exposes critical gaps in the existing regulatory framework. The fundamental challenge of liability for AI-driven decisions, data governance, and ethical considerations is amplified in the context of cross-border

[30]European Parliament Think Tank (EPRS). *Artificial intelligence and transport: New challenges for EU law*. (Analyses legal and ethical challenges of AI in transport).
[31]World Economic Forum. *The Future of Mobility*. (Includes sections on innovation, emerging technologies, and sustainability in transport).
[32]World Economic Forum. *The Future of Mobility*.
[33]Petru & Krivda, (2021), 13, 5524.

oversized transport. The "regulatory lag" – the slower pace of legislative adaptation compared to technological evolution – demands urgent attention. A key argument is that without a harmonized and agile legal framework, the full potential of AI cannot be realized, and its deployment might even be hindered or lead to unintended consequences[34].

The effectiveness of AI systems hinges on high-quality, standardized, and interoperable data from diverse sources. The current lack of seamless data exchange across national systems within the EU poses a significant barrier. This underscores the need for substantial investment in digital infrastructure and the development of common data standards to enable the full benefits of AI, as emphasized by Digital Transport and Logistics Forum[35].

The integration of AI will undoubtedly impact the workforce, particularly drivers and administrative personnel. Addressing concerns about job displacement through proactive reskilling and upskilling initiatives is crucial for social acceptance and a just transition. Furthermore, ensuring public trust in AI systems, especially in safety-critical operations, requires transparency and robust ethical guidelines.

In essence, the findings suggest that AI holds immense promise for revolutionizing oversized transport in the EU by addressing its core challenges of safety, efficiency, and environmental impact. However, realizing this potential is contingent upon a concerted effort to overcome significant regulatory, infrastructural, and socio-economic hurdles through strategic investment, harmonized policy-making, and collaborative governance. The necessity of integrated urban planning[36] and policy frameworks that balance economic development needs with environmental protection and infrastructure resilience is paramount, advocating for smart, adaptive solutions to ensure the sustainable accommodation of oversized transport within future cities[37].

And, as I previously argued, this AI system must be constantly supervised and verified by the human factor.

[34]ENISA (European Union Agency for Cybersecurity). *Cybersecurity in the Transport Sector*. (Provides insights into cybersecurity risks in connected transport infrastructures).
[35]European Commission's Digital Transport and Logistics Forum (DTLF). Search for reports and best practice guides on the digitalization of freight transport in the EU. (Relevant for EU-level digital initiatives in transport).
[36]Szczucka-Lasota (2017): 157-165.
[37]Petru & Krivda, (2021), 13, 5524.

Recommendations for EU Member States

The transition toward an AI-driven oversized transport sector requires a fundamental shift from fragmented national policies to a coordinated European strategy. Central to this evolution is the development of a Harmonized EU AI-in-Transport Framework. Legislative bodies must prioritize the creation of clear, flexible, and future-proof regulations that transcend current directives. This framework should specifically address the complex legal triad of liability in autonomous operations, robust data governance protocols, and stringent cybersecurity standards. By establishing these legal guardrails at the Union level, Member States can ensure that the deployment of AI in logistics does not create new legal uncertainties regarding administrative responsibility or cross-border enforcement.

Simultaneously, the legal objectives must be supported by a commitment to invest in digital infrastructure. The modernization of the Trans-European Transport Network (TEN-T) should prioritize the deployment of 5G networks and smart sensor technologies. These physical assets serve as the "digital nervous system" required for real-time monitoring of oversized loads. Legally, the integration of these technologies allows for the creation of "smart contracts" and automated compliance systems, where infrastructure data is used to validate transport adherence to weight and dimension limits instantaneously. This investment must be coupled with the standardization of technical and data protocols, ensuring that IoT systems are interoperable across national borders. Such standardization is a prerequisite for the mutual recognition of digital permits and the seamless movement of critical industrial goods across the Single Market.

Furthermore, the successful integration of AI necessitates a model of cooperative governance through Public-Private Partnerships (PPPs). By fostering collaboration between state authorities, private logistics firms, and academic institutions, the EU can facilitate the co-creation of innovative solutions while equitably distributing the associated technological and legal risks. These partnerships should be the primary vehicle for pilot projects and iterative research, providing a real-world testing ground for AI applications in diverse geographical and regulatory environments. A crucial component of this collaborative ecosystem is the establishment of secure data-sharing mechanisms. To build trust between public and private entities, these mechanisms must be underpinned by transparent governance and stringent privacy protocols, ensuring that data regarding infrastructure integrity and traffic patterns is utilized responsibly and effectively.

Finally, the systemic transition to AI-driven logistics requires a significant investment in human capital and capacity building. As the administrative and operational paradigms shift, it is essential to implement comprehensive training programs for transport operators, administrative staff, and regulatory bodies. Developing digital literacy and a deep understanding of AI's legal implications will ensure that human supervisors remain capable of exercising meaningful oversight over automated systems. By proactively addressing these multi-dimensional recommendations, EU Member States can collectively harness the power of Artificial Intelligence to transform oversized transport into a safer, more efficient, and sustainable pillar of the European economy, reinforcing the Union's leadership in the global era of intelligent mobility.

Conclusions

This research demonstrates that the integration of Artificial Intelligence in the oversized transport sector in the European Union represents a turning point, marking the transition from reactive to predictive and highly efficient logistics. The comparative analysis of the models implemented in Germany and Poland highlights that the success of digitalization does not depend exclusively on the sophistication of algorithms, but on the ability of states to create an interoperable ecosystem between physical infrastructure and data flows.

From an operational point of view, case studies have revealed that tools such as the VEMAGS system (Germany) and the use of Digital Twins using LiDAR technology (Poland) have managed to solve long-standing systemic inefficiencies. These technologies have significantly reduced permit processing times and eliminated the risks of collisions with infrastructure, providing a predictability that was previously impossible to achieve. At the same time, digitalization has been shown to be an essential driver for achieving the sustainability goals of the European Green Deal. By mathematically optimizing routes and reducing congestion, AI directly contributes to reducing the carbon footprint of heavy transport, transforming a traditionally polluting sector into an active participant in the green economy.

However, a fundamental conclusion of this study is that Artificial Intelligence must remain a tool under strict human supervision. The ethical and social dimension of this transition underlines the need for a human-machine partnership, in which technology provides the precision of data processing, and the human operator provides contextual judgment and moral responsibility. This "human supervision" is critical in managing exceptional situations on the ground, where intuition and experience cannot yet be replicated by computer code.

Ultimately, the long-term success of oversize transport in the EU will be conditioned by two strategic directions: Investing in Human Capital, implementing robust reskilling programs that transform drivers and dispatchers into logistics systems engineers, thus ensuring a fair social transition and second, Harmonization of Regulations, reducing the legislative gap between Member States to enable a single European digital corridor, were infrastructure data flows as freely as goods.

By adopting these measures, the European Union can transform oversized transport from a logistical challenge into a global competitive advantage, demonstrating that technological innovation, when guided by ethical principles and environmental objectives, can generate a sustainable positive impact on society as a whole.

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Legislative Oversight and Justice Reform: Examining the Senate's Role in Deliberation and Public Participation

*By Wanchai Akpornpis**

Justice reform is a complex governance process that requires effective oversight, inclusive deliberation, and democratic legitimacy. Legislative institutions, particularly upper chambers such as the Senate, play a critical role in shaping, scrutinizing, and legitimizing justice reform initiatives. This conceptual study examines the Senate's role in overseeing justice reform through the lenses of legislative consideration and public participation. Rather than focusing on specific reform outcomes, the study emphasizes the procedural and institutional dynamics that influence how justice reforms are debated, evaluated, and justified within legislative settings. Drawing on an integrative conceptual aspect, the study explores how senatorial oversight functions as a mechanism of accountability and procedural justice, and how public participation contributes to the legitimacy and quality of reform processes. The analysis highlights the Senate's deliberative capacity to moderate executive-driven reforms, assess long-term institutional implications, and provide platforms for citizen engagement. It also identifies key challenges that may limit effective oversight, including constrained institutional capacity, executive dominance, uneven public participation, and tensions between inclusiveness and decision-making efficiency. The study contributes to the literature by integrating legislative oversight and public participation into a unified framework for understanding justice reform governance. It advances a process-oriented perspective that positions the senate as both an oversight body and a participatory arena within democratic systems. By clarifying the institutional and procedural conditions under which senatorial oversight can enhance accountability and legitimacy, the study offers theoretical insights for scholars and practical reflections for legislators and policymakers. The findings provide a foundation for future empirical research and inform efforts to strengthen democratic governance and public trust in justice reform processes.

Keywords: *Justice reform, Legislative oversight, Senate, Public participation, Thailand.*

Introduction

Justice reform has emerged as a major issue in contemporary political and legal systems, as public demands for greater accountability, transparency, and fairness in state institutions grow. In democratic governance, legislatures are integral to shaping, supervising, and legitimizing the reform process, especially the reform process related to the justice system (Fortes, 2015). Of these entities, the senate is of particular special significance because, by virtue of its oversight authority, deliberative function, and capacity to represent long-term public interests beyond immediate political cycles, it

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occupies a distinctive position. Understanding how the senate fulfills its role in overseeing justice reform is a vital aspect of assessing the effectiveness and legitimacy of reform initiatives (Patterson & Mughan, 2001).

Justice reform frequently entails complicated legal, institutional and societal change that impacts courts, law enforcement, prosecutorial commissions and correctional facilities. None of this reform is just the sum of technical legal fixes, but more broadly focuses on essential problems of justice access, rights, procedural fairness, and public trust in the legal system. Consequently, justice reform efforts require scrutiny, inclusive deliberation, and effective accountability. The legislative review, especially in upper chambers like the Senate, is a structured forum in which such reform can come under scrutiny to examine the proposed reforms, the practice of implementing the laws, and how they are implemented, and to ensure they are informed by and consistent with constitutional norms and public expectations. Senate justice reform has a job beyond getting the bills passed. It involves investigating draft laws, conducting hearings, challenging executive agencies, and inviting the public to contribute to decision-making committees. In these functions the Senate can protect against political reforms that undermine judicial independence or public confidence (Pedrini, 2014). At the same time, the Senate's effectiveness depends on the architecture of its institutions, the composition of its politics, procedural rules, and openness to citizen participation. These factors affect how oversight is conducted, and whether it genuinely contributes to a significant reform process. Public involvement has increasingly been recognized as a key component of justice reform. Citizens, civil society groups, legal practitioners, and affected communities also have experiential intelligence that can inform reforms and highlight unintended implications of interventions. Reforms that are more responsive, legitimate and sustainable when legislative processes include public participation happen (Bryson et al., 2013). It is within this prism that the senate occupies a critical link between state bodies and the people which are spaces for consultation, discussion and affirmation of a wide range of interest. In actual effect though also a function of the individual election, the public participation as a meaningful factor in the oversight of senators remains diverse between the political systems.

While senatorial oversight and public participation are critical to justice reform, past research has been particularly concerned with executive reforms or judicial independence, with less attention paid to the legislative dimension. Most studies focus on reform outcomes or their constitutional implications but not deeply on how legislative processes shape these outcomes. In particular, the Senate is sometimes treated as secondary or symbolic rather than a political actor in reform governance (Lawless, 2004). Such a gap curtails understanding of how justice reform gets bargained, challenged, and legitimized within legislative arenas. Additionally, public participation in legislative oversight remains under-studied, and public engagement has been largely under investigated, particularly with regard to justice reform. While participation is often discussed in the context of elections or policy conversations, its role in legislative deliberation and oversight receives comparatively less attention. This challenge is particularly salient in justice reform, as those most affected may be limited by legal intricacy, power asymmetries, and institutional opacity in participating.

The Senate of Thailand plays an important role in supporting constitutional governance, institutional stability, and legislative oversight within the Thai political system. As an upper legislative body, the Senate contributes to the balance of power by providing careful review of legislation, particularly on matters with long-term legal and institutional implications (Chambers, 2009). Its deliberative character allows for more measured consideration of laws, thereby enhancing legal clarity, consistency, and alignment with constitutional principles. One of the Senate's notable strengths lies in its oversight functions. Through review, inquiry, and advisory roles, the Senate supports transparency and accountability in public administration and governance. It also contributes to the integrity of independent institutions by participating in the selection and monitoring of key office holders, thereby reinforcing institutional credibility and public confidence. In addition, the Senate serves as a forum for national reflection beyond short-term political competition. Its structure enables it to consider broader societal interests, national stability, and continuity in policy direction (Raymond, 2025). By engaging with experts, institutions, and public concerns, the Senate can enrich legislative deliberation with specialized knowledge and diverse perspectives. Overall, the Senate of Thailand contributes positively to democratic governance by strengthening oversight, promoting institutional balance, and supporting the rule of law through thoughtful legislative engagement.

This conceptual paper seeks to fill these gaps by studying the Senate's role in overseeing justice reform through the dual prisms of legislative scrutiny and public involvement. By focusing on procedures rather than policy consequences, the study aims to shed light on how monitoring works, how deliberation is organized, and how public voices are integrated into reform discussions. The study perspective enables the researchers to explore institutional practices, procedural norms, and inter-agency interactions between the Senate, executive agencies, and the public. The study assumes that effective justice reform requires governance processes that are both inclusive and accountable, and that these processes must go beyond sound legal design. Governance that includes, but is not limited to, legislative oversight and public participation is regarded as mutually reinforcing. The Senate's competence in finding a balance between technical knowledge, negotiation, and public engagement is central to its role as overseer. Therefore, this study contributes to international debates on democratic legitimacy, separation of powers, and participatory governance of justice reform through the examination of balancing these conflicting imperatives. This study has three objectives. Its first objective is to conceptualize the Senate's role as an overseer of justice reform, establishing its major functions and mechanisms, and the extent of its oversight. Second, it explains how legislative deliberation mechanisms enable or disable public involvement. Third, it examines the consequences of senatorial oversight practices towards the quality, legitimacy, and accountability of justice reform. In pursuing these objectives, the study argues for conceptualizing legislative oversight as a dynamic, participatory process rather than merely a procedural exercise. Furthermore, this research contributes to the literature on legislative governance and justice reform by examining an aspect of the legislature often neglected in legislative oversight discussions and the Senate's role in the legislative process. Furthermore, the study provides an idea in the form of a conceptual analysis, combined with the study

perspective, in order to better equip the legal framework supporting democratic oversight and inclusive forms of reform at the justice sector level.

Literature Review

Justice Reform as a Governance Challenge

Justice reform is widely understood as a complex and ongoing process aimed at improving the fairness, efficiency, accountability, and legitimacy of legal institutions. Rather than being a purely legal or technical undertaking, justice reform is increasingly viewed as a governance challenge that involves multiple state actors, political interests, and societal expectations. Reforms often address issues such as judicial independence, access to justice, procedural fairness, corruption, and public trust. Because these issues directly affect citizens' rights and confidence in the state, justice reform requires strong oversight mechanisms to ensure that changes serve the public interest rather than narrow political or institutional agendas (Lattimore, 2022).

Within democratic systems, justice reform is closely linked to broader governance principles such as the separation of powers, transparency, and accountability. Effective reform depends not only on the content of new laws or policies but also on the processes through which they are developed, debated, and implemented (Dzur, 2011). Legislative institutions play a central role in this process by providing forums for deliberation, review, and public justification. Without meaningful legislative oversight, justice reform risks becoming fragmented, poorly coordinated, or disconnected from societal needs.

Legislative Oversight in Democratic Systems

Legislative oversight refers to the capacity of legislatures to monitor executive action, evaluate policy performance, and hold public institutions accountable. It is a foundational element of democratic governance and a key mechanism for preventing abuses of power (Igwe, 2021). Oversight can take many forms, including legislative debates, committee investigations, hearings, budgetary control, and reporting requirements (Onyango, 2020). In the context of justice reform, oversight is particularly important due to the sensitive nature of legal institutions and their role in safeguarding rights and freedoms.

Legislatures are uniquely positioned to assess justice reform initiatives because they combine political representation with institutional authority. Through oversight, legislatures can question the rationale behind reforms, assess their alignment with constitutional principles, and monitor their implementation over time. Oversight also enables legislatures to identify unintended consequences and propose corrective measures (Friedberg, 2011). However, the effectiveness of oversight depends on institutional design, political will, and access to information.

The Senate's Institutional Role in Oversight

Upper legislative chambers, commonly referred to as senates, are often designed to provide deliberative stability, institutional continuity, and a long-term perspective on governance. Unlike lower chambers, which may be more directly influenced by electoral pressures, senates are frequently structured to encourage careful review and moderation. This institutional design makes the Senate particularly well-suited to oversee complex and sensitive policy areas, such as justice reform (‘Yinka Fashagba, 2009). The Senate's oversight role typically includes reviewing proposed legislation, scrutinizing executive actions, conducting inquiries, and facilitating expert input. In justice reform, these functions allow the Senate to examine legal coherence, institutional implications, and potential impacts on judicial independence. The Senate can also serve as a forum for reconciling competing interests and values, balancing efficiency concerns with the protection of rights and the guarantee of due process.

Despite these responsibilities, the Senate's role in justice reform is not always clearly defined or consistently exercised (Kaiser, 1988). In some systems, the Senate functions as an active oversight body with substantial influence, while in others its role is more consultative or symbolic. Political composition, procedural rules, and relations with the executive branch all shape the extent to which the Senate can effectively oversee reform initiatives.

Legislative Consideration of Justice Reform

Legislative consideration refers to the processes through which reform proposals are examined, debated, amended, and approved within legislative bodies. These processes are central to ensuring that justice reforms are carefully evaluated and democratically legitimized. Legislative consideration typically involves committee deliberations, plenary debates, expert testimony, and negotiation among political actors.

Committees play a particularly important role in justice reform by allowing for detailed examination of technical legal issues (Pochmann da Silva, 2022). Through hearings and inquiries, committees can gather information from judges, legal professionals, civil society organizations, and affected groups. This process enhances the quality of deliberation and helps identify potential weaknesses or risks in proposed reforms (Pfander, 2020). Plenary debates provide a broader political arena in which reform proposals are publicly justified and contested. However, legislative consideration is not immune to challenges. Time constraints, political polarization, limited expertise, and executive dominance can undermine meaningful deliberation. In justice reform, these challenges may lead to superficial review or insufficient engagement with long-term implications. Understanding how legislative consideration operates in practice is therefore essential to evaluating the quality of the Senate's oversight.

Public Participation in Justice Reform

Public participation has emerged as a key principle in contemporary governance, reflecting growing demands for transparency, inclusiveness, and responsiveness. In the context of justice reform, public participation is especially important because reforms affect citizens' rights, access to legal remedies, and trust in institutions. Participation allows individuals and groups to voice concerns, share experiences, and contribute to policy design. Public participation in legislative processes can take many forms, including public hearings, consultations, written submissions, and advocacy efforts (Donoghue, 2017). When effectively structured, participation can enrich legislative deliberation by introducing diverse perspectives and highlighting real-world impacts of proposed reforms. Participation can also enhance legitimacy by demonstrating that reform processes are open and responsive to public input.

Nevertheless, public participation faces significant barriers. Legal complexity, institutional opacity, and resource inequalities can limit who participates and the influence of their contributions. In the context of justice reform, marginalized groups may face particular challenges in accessing participatory mechanisms. As a result, participation may become uneven or dominated by organized interests, raising questions about representativeness and inclusiveness.

The Senate as a Platform for Public Engagement

The Senate's deliberative orientation positions it as a potential platform for meaningful public engagement in justice reform. Through hearings, inquiries, and consultations, the Senate can create opportunities for dialogue between policymakers and the public. This role is particularly important in justice reform, where public trust and legitimacy are central concerns. The extent to which the Senate facilitates public engagement depends on institutional norms and procedural rules (Russell, 2022). In some contexts, public participation is formally embedded in legislative processes, while in others it remains discretionary or limited. The effectiveness of engagement also depends on whether public input is genuinely considered in decision-making or merely serves symbolic purposes. Examining the Senate as a site of public engagement highlights the interaction between institutional design and democratic practice. It raises questions about how participation is structured, whose voices are heard, and how public input influences legislative outcomes. These issues are critical to understanding the democratic quality of justice reform oversight.

Accountability, Legitimacy, and Procedural Justice

Legislative oversight and public participation contribute to broader goals of accountability and legitimacy in justice reform. Accountability refers to the ability of institutions to justify their actions and be held responsible for outcomes. Legitimacy relates to public acceptance of reforms and trust in the institutions that implement them. Procedural justice emphasizes fairness, transparency, and respect in decision-making processes. The Senate's oversight role intersects with these concepts by providing mechanisms for scrutiny, debate, and justification. When oversight is

conducted transparently and inclusively, it can enhance perceptions of procedural justice and strengthen public trust (Mazerolle et al., 2013). Conversely, weak oversight may undermine legitimacy and fuel skepticism toward reform initiatives. Understanding how oversight practices shape accountability and legitimacy is essential. This requires attention not only to formal powers but also to how those powers are exercised in practice.

Despite extensive literature on justice reform, legislative oversight, and public participation, several gaps remain. First, the Senate's role in justice reform oversight is often underexamined, particularly compared with executive or judicial actors. Second, existing studies often prioritize reform outcomes over the legislative processes through which reforms are debated and legitimized. Third, public participation is often discussed normatively, with limited analysis of how it operates within legislative oversight structures. These gaps limit understanding of justice reform as a governance process. There is a need for conceptual and empirical studies that integrate legislative oversight, public participation, and justice reform into a coherent analytical framework. Such studies can illuminate how institutional arrangements and procedural practices shape reform trajectories and democratic legitimacy (Pogrebinschi & Ryan, 2018).

Building on these gaps, the present study adopts a process-oriented perspective that emphasizes the senate's role in overseeing justice reform through legislative consideration and public participation. Rather than focusing solely on policy outcomes, the study examines how oversight is exercised, how deliberation is structured, and how public input is incorporated. By doing so, it contributes to a deeper understanding of justice reform as a participatory and institutional process.

This conceptual orientation highlights the importance of examining legislative arenas as sites of governance and democratic engagement. It underscores the need to analyze not only which reforms are adopted but also how and through whom they are shaped.

The Senate's Legislative Procedures under the 2017 Constitution

Under the Constitution of the Kingdom of Thailand (2017), the Senate of Thailand plays a limited but important role in the legislative process. Most bills are first introduced and approved by the House of Representatives of Thailand before being forwarded to the Senate for consideration. The Senate cannot initiate ordinary legislation but has the authority to review, approve, amend, or delay bills passed by the House. In most cases, the Senate must complete its consideration within 60 days. If the bill concerns financial matters, the review period is shortened to 30 days. If the Senate proposes amendments, the bill is returned to the House for reconsideration, and a joint committee may be formed to reconcile differences between the two chambers. If the Senate does not act within the specified timeframe, the bill is deemed approved. After passing both chambers, the legislation is submitted to the monarch for royal assent before it becomes law. This procedure reflects the Senate's role as a reviewing body intended to provide oversight and ensure the quality of legislation rather than act as the primary legislative initiator (Constitution of the Kingdom of Thailand B.E. 2560, 2017).

Under the Constitution of the Kingdom of Thailand (2017), if the Senate of Thailand disagrees with a bill passed by the House of Representatives of Thailand, the

bill is returned to the House for reconsideration. The House may choose to accept the Senate's proposed amendments or maintain its original version of the bill. If the disagreement continues, a joint committee composed of members from both chambers may be formed to review the bill and propose a compromise. Both the House and the Senate must then approve the revised version. If the Senate rejects the bill and the House still insists on its original version, the House can reconsider the bill after a waiting period and pass it with a majority vote, allowing it to proceed without Senate approval. In the case of money bills, the Senate has more limited authority. It must consider the bill within 30 days and cannot make amendments without the House's consent. If the Senate does not act within this period, the bill is considered approved. These procedures indicate that the Senate mainly functions as a reviewing chamber, while the House of Representatives holds the primary legislative authority (Constitution of the Kingdom of Thailand B.E. 2560, 2017).

There are notable differences in the role of the Senate of Thailand before and after the adoption of the Constitution of the Kingdom of Thailand (2017). Under the earlier Constitution of Thailand (2007), the Senate consisted of both elected and appointed members. Many senators were directly elected by the public, which gave the chamber a stronger element of democratic representation. The Senate primarily served as a reviewing body for legislation passed by the House of Representatives of Thailand and had responsibilities, including approving appointments to independent oversight bodies and monitoring government administration. (Constitution of the Kingdom of Thailand B.E. 2550, 2007).

After the 2017 Constitution came into force, the composition and powers of the Senate changed significantly. The Senate became entirely appointed rather than elected, with 250 members selected through a process linked to the government that drafted the constitution. One of the most significant new roles granted to the Senate was its temporary authority to participate jointly with the House of Representatives in voting for the prime minister during the first five years after the constitution took effect. This gave the Senate direct influence in the formation of the executive branch (Constitution of the Kingdom of Thailand B.E. 2560, 2017). Although its legislative role in reviewing and delaying bills remained largely unchanged, the shift from an elected or partially elected chamber to a fully appointed body, along with its expanded role in selecting the prime minister, marked the most important institutional changes after 2017.

Under the Constitution of the Kingdom of Thailand (2017), the nomination and selection criteria for members of the Senate of Thailand emphasize expertise, experience, and political neutrality rather than electoral representation. The Senate consists of 250 members appointed through a selection process conducted by a committee established under the constitution, with some positions reserved for individuals holding specific institutional roles, such as leaders of the armed forces (Constitution of the Kingdom of Thailand B.E. 2560, 2017). Candidates were required to possess substantial professional experience in fields such as public administration, law, education, economics, science, or civil society, and they were prohibited from holding positions in political parties or engaging in active partisan politics. These criteria were intended to create a chamber composed of qualified individuals capable of providing independent review of legislation and government actions.

These nomination requirements relate closely to the Senate's oversight function. Because senators are expected to have professional expertise and are formally separated from electoral politics, the Senate is designed to act as a supervisory body that scrutinizes legislation passed by the House of Representatives and monitors the performance of government institutions. The Senate also plays a role in approving appointments to various independent agencies and constitutional bodies, which strengthens its oversight responsibilities. By prioritizing qualifications and independence in the nomination process, the constitutional framework aims to ensure that the Senate can evaluate laws, public policies, and institutional appointments from a more technical and long-term perspective rather than through short-term political interests.

Including concrete legislative examples can strengthen the legal analysis of the Senate of Thailand's role under the Constitution of the Kingdom of Thailand (2017). One notable example is the legislative process surrounding the amendments to the Thai Constitution Amendment Bill (2021). During this process, the Senate exercised its reviewing function by participating in joint parliamentary deliberations and voting on proposed constitutional amendments. Several amendment proposals supported in the House of Representatives of Thailand failed to pass because constitutional amendments require approval by a significant number of senators. This demonstrated the Senate's substantial influence in shaping constitutional change and highlighted its institutional role as a safeguard within Thailand's legislative framework.

Another example is the passage of the Annual Budget Act of Thailand, which is considered a money bill. In these cases, the Senate reviews the bill after it has been approved by the House of Representatives. Although the Senate cannot substantially amend such bills without the House's consent and must complete its review within a limited timeframe, it still debates and scrutinizes government spending proposals before granting approval. These examples illustrate how the Senate functions both as a reviewing chamber in ordinary legislation and as a supervisory body in financial legislation, reinforcing its constitutional role in oversight and legislative deliberation.

A structured table mapping the identified problems in public participation is provided below.

Identified Problem in Public Participation	**Explanation**	**Recommended Reform / Policy Action**
Limited channels for citizen input	Public participation mechanisms are often restricted to formal consultations or hearings, which may not reach a wide segment of society.	Expand participatory platforms through digital consultation systems, public forums, and accessible submission mechanisms to broaden citizen engagement.
Low public awareness of legislative processes	Many citizens are unfamiliar with how legislative procedures work or how they can participate in them.	Develop public education campaigns and provide simplified information on legislative procedures through government websites and civic education programs.
Dominance of elite or organized groups	Participation processes may be influenced primarily by well-organized interest groups,	Introduce inclusive participation frameworks that ensure representation from marginalized groups, civil society organizations, and local communities.

	limiting the diversity of viewpoints represented.	
Limited transparency in decision-making	Citizens may provide input during consultations but often receive little information about how their feedback influences policy decisions.	Establish transparent reporting mechanisms that show how public comments are considered and integrated into legislative or policy outcomes.
Weak institutionalization of participation	Public participation may occur on an ad hoc basis rather than being embedded in formal governance structures.	Institutionalize participation through clear legal provisions, guidelines, and mandatory consultation requirements within legislative procedures.

Methodology

This study adopts a conceptual research methodology to develop a theoretical understanding of the Senate's role in overseeing justice reform, with particular focus on legislative deliberation and public participation. As a conceptual paper, it synthesizes and critically analyzes existing theoretical perspectives, institutional practices, and normative frameworks relevant to legislative oversight and justice reform. The methodology is based on an integrative conceptual analysis approach and involves systematically reviewing and organizing established ideas on justice reform, legislative oversight, senatorial functions, and participatory governance to identify key patterns, relationships, and conceptual gaps. The analysis draws on comparative insights from democratic governance models to examine how senates function as oversight institutions and how public participation is incorporated into legislative processes. Through this approach, the study constructs a coherent analytical framework that links oversight mechanisms with procedural legitimacy and democratic accountability. Concept development is guided by analytical reasoning rather than hypothesis testing. Core concepts such as legislative consideration, oversight capacity, and public participation are clarified and repositioned to explain their interrelationships within justice reform processes. The study emphasizes process-oriented analysis, focusing on how institutional roles and participatory mechanisms shape reform outcomes rather than evaluating specific legal reforms. To ensure conceptual rigor, the study applies logical consistency, theoretical coherence, and internal validity as key quality criteria. The findings are intended to provide a foundation for future empirical research and to inform policymakers and scholars seeking to strengthen legislative oversight and participatory governance in justice reform.

Discussion

This study conceptually examines the Senate's role in overseeing justice reform, with particular attention to legislative processes and public participation. The discussion advances understanding of justice reform as a governance process shaped not only by legal design but also by institutional oversight, deliberative practices, and democratic engagement. By focusing on the Senate as a central oversight actor, the analysis highlights how justice reform is negotiated, legitimized, and contested within legislative arenas. One of the key insights of this study is that the Senate's oversight role is fundamentally procedural rather than merely formal. Oversight is exercised through sustained engagement with reform proposals, including committee scrutiny, debate, inquiry, and review of implementation trajectories. These processes enable the senate to act as a stabilizing institution, particularly in reform contexts characterized by political urgency or public controversy. Justice reform often involves redistributing authority, redefining legal safeguards, and restructuring institutional relationships, making it especially susceptible to political pressure. The Senate's deliberative orientation provides an institutional balance to such pressures by prioritizing careful review and long-term considerations. The discussion further emphasizes that legislative consideration serves as a critical mechanism through which justice reform gains democratic legitimacy (Kubrin & Tublitz, 2022). Through structured deliberation, the Senate transforms executive initiatives into publicly examined legislative outcomes. This transformation is essential because it subjects reforms to political justification and collective reasoning rather than unilateral decision-making. In this sense, legislative consideration is not only a procedural step but a normative process that reinforces accountability and transparency.

However, the effectiveness of legislative consideration depends heavily on institutional capacity and procedural design. The analysis suggests that meaningful oversight requires adequate time, access to expertise, and procedural autonomy. When legislative consideration is constrained by limited resources, compressed timelines, or political dominance by other branches, the Senate's oversight function risks becoming symbolic. Such conditions undermine the Senate's ability to critically evaluate justice reform and weaken its role as a guardian of procedural integrity. Public participation emerges as a second critical dimension shaping the Senate's oversight role. Justice reform directly affects citizens' rights, access to remedies, and trust in legal institutions, making public engagement especially important. The discussion highlights that participation serves both informational and legitimizing functions. It provides legislators with insights into the experiences of justice systems and signals institutional openness to societal concerns. When participation is integrated into legislative processes, it can enhance both the quality and acceptance of reform outcomes. Further, the study identifies important challenges associated with public participation. Participation is often uneven, with disparities in access, representation, and influence. Legal complexity and institutional barriers may exclude marginalized groups, while organized interests may dominate participatory spaces. These dynamics raise concerns about whether participation genuinely reflects diverse public perspectives or reinforces existing power imbalances. The senate's role, therefore, is not merely to invite participation but to design participatory mechanisms that are inclusive, transparent, and consequential.

The Senate's position as an intermediary institution places it at the intersection of state authority and public voice. This dual role creates both opportunities and tensions. On one hand, the senate can facilitate dialogue between reform designers and affected communities, fostering mutual understanding and trust. On the other hand, balancing openness with efficiency remains a persistent challenge. Expanding participation may slow legislative processes, potentially conflicting with demands for timely reform. The discussion suggests that resolving this tension requires institutional innovation rather than trade-offs, such as structured consultations, clear feedback mechanisms, and transparent decision-making criteria. Another important theme concerns the relationship between oversight and power distribution. The Senate's capacity to oversee justice reform is shaped by its institutional autonomy and its relationship with the executive branch. Where executive authority is dominant, senatorial oversight may be constrained, limiting opportunities for independent scrutiny and public engagement. This dynamic underscores that oversight effectiveness is not solely a function of formal powers but also of political context and institutional culture. The conceptual analysis also highlights the importance of viewing justice reform oversight as a continuous process rather than a discrete legislative event.

Oversight does not end with the passage of reform legislation. It extends to monitoring implementation, evaluating outcomes, and responding to emerging challenges. The Senate's ability to sustain oversight over time contributes to adaptive governance and reduces the risk of reform failure. This temporal dimension of oversight is often overlooked in discussions that focus narrowly on legislative approval. Overall, the discussion reinforces the view that justice reform cannot be understood solely through legal outcomes or institutional design. It must also be analyzed through the processes of oversight, deliberation, and participation that shape reform trajectories. By conceptualizing the senate as both an oversight body and a participatory arena, the study advances understanding of democratic governance in justice reform and provides a foundation for future empirical inquiry.

Implications and Limitations

Theoretical Implications of the Study

This study offers several theoretical implications on justice reform, legislative oversight, and democratic governance. First, it advances a process-oriented perspective that shifts analytical attention from reform outcomes to reform governance. By focusing on how justice reform is overseen rather than what reforms achieve, the study highlights the importance of institutional procedures and deliberative practices in shaping legitimacy and accountability. Second, the study contributes to legislative studies by foregrounding the Senate's role as a distinct oversight actor. While existing knowledge emphasizes executive leadership or judicial independence, this study positions the Senate as a central site of governance where legal, political, and societal considerations intersect. This reconceptualization invites further theoretical exploration of upper chambers as active contributors to reform governance rather than passive reviewers. Third, integrating public participation into the oversight framework enriches

theoretical debates on participatory democracy. The study demonstrates that participation is not merely an external input but an integral component of legislative oversight. This perspective challenges approaches that treat participation as supplementary to formal governance, instead positioning it as a constitutive element of democratic legitimacy.

Practical Implications of the Study

The findings of this study explain important implications for legislative practice. For senates, the analysis underscores the need to strengthen institutional capacity for oversight of justice reform. This includes investing in committee expertise, procedural autonomy, and mechanisms for sustained review beyond initial legislative approval. Such investments enhance the Senate's ability to critically engage with complex reforms and respond to evolving challenges. The study also highlights the importance of designing participatory mechanisms that are both inclusive and effective. Legislatures should move beyond ad hoc consultations toward structured engagement processes that clearly articulate how public input will be considered. Transparency in decision-making and feedback to participants can help build trust and encourage sustained engagement.

For lawmakers, the study suggests that early and sustained engagement with the Senate can improve the quality of reforms and their implementation outcomes. Integrating legislative oversight into reform design reduces the risk of institutional resistance and enhances coherence across governance levels. From a policy perspective, the study suggests that justice reform initiatives benefit from being embedded within robust oversight and participatory frameworks. Policymakers should view legislative oversight not as an obstacle but as a resource for identifying risks, building consensus, and enhancing legitimacy. Reforms that bypass or marginalize legislative consideration may achieve short-term efficiency but face long-term challenges in implementation and public acceptance. The study also highlights the importance of procedural justice in reform governance. Transparent oversight and meaningful participation contribute to public perceptions of fairness, even when reform outcomes are contested. Policymakers seeking to strengthen trust in justice institutions should therefore prioritize process quality alongside substantive change.

Limitations of the Study

Despite its contributions, this study has several limitations. As a conceptual paper, it does not rely on empirical data, which limits its ability to assess how oversight and participation operate in specific institutional contexts. The analysis is based on theoretical reasoning and general institutional patterns rather than direct observation of legislative practices. Additionally, the study does not examine variations across political systems in depth. Differences in constitutional design, political culture, and legislative authority may significantly shape the senate's role in justice reform oversight. While the conceptual framework is broadly applicable, its relevance and implications may vary across contexts. The focus on the Senate also means that interactions with other actors, such as lower chambers, courts, and civil society organizations, are not

fully explored. Future research could extend the framework to examine how multiple institutions jointly shape the governance of justice reform. Further research could also investigate the experiences of participants in legislative processes, including citizens, advocacy groups, and legal professionals. Such work would deepen understanding of how participation shapes perceptions of legitimacy and procedural justice.

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Transparency Warranties for Algorithmic Decisions in Administrative Procedures. Synopsis between EU Law and the Italian Legal System

*By Ludovico Iorio**

The digital transition of public administration represents a key stage in the modernization of administrative action, in accordance with both national and European legislative rules and the objectives set out in the Italian National Recovery and Resilience Plan. The introduction of digital and artificial intelligence tools into administrative procedures aims to enhance efficiency and decision-making quickness, while simultaneously requiring the preservation of the principles of legality and transparency, alongside with the constitutional principle of good administration. This paper examines the relationship between automation and the exercise of public power, focusing on the concept of "algorithmic legality" and on the indispensable role of human oversight in the decision-making process ("human in the loop"). Through the analysis of recent European (AI Act) and national (Law No. 132/2025) regulatory frameworks, as well as the case law of the Italian Council of State, the study highlights how algorithmic transparency serves as an essential safeguard of the legitimacy of digital administrative acts. It argues that ensuring the explainability of automated decisions and adherence to the principles of proportionality, reasonableness, and non-discrimination is crucial for achieving a digital public administration that upholds the rule of law in the age of technological transformation.

Keywords: *Digital transition – administrative measure and public activity – transparency and algorithmic legality – algorithmic decision – human oversight.*

Introduction

The digital transition[1], conceived as a process of progressive integration between human activity and digital tools, is a phenomenon that equally affects the modalities through which services are delivered to citizens. Attention, however, should not be focused merely on the employment of *information and communication technologies* (ICT) as such, but rather on their coordinated use with the implementation of new organizational models for public administrations[2] and the development of new competencies for public officials.

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[1]See Galetta D.U. (2025), 88. The author underscores that the deployment of ICT as the ordinary means for the performance of public functions cannot be conceived as the ultimate goal of administrative modernization, but rather as a functional instrument directed toward the attainment of higher ends, embodied in the multiple dimensions of the public interest.

[2]See Giannini M. S. (1958) at 233. In particular, the public administration is constituted by the organized apparatus of bodies, personnel, and resources, from the central State level down to the territorial branches, entrusted with the pursuit of institutional purposes and public interests as mandated by law.

The transformation here examined has been mandated by both national and supranational legislators[3], and the exercise of public administrative power is by no means exempt from it, at least under two distinct aspects.

The involvement of the public subjects within the so-called *Fourth Revolution*[4] requires the administrative apparatus to promote the shift from the dynamics of traditional democracy towards those of digital democracy. At the same time, it is incumbent upon it to define a system—*Government as a Platform*[5]—in which «*public administrations and democratic institutions interact, ensuring interoperability across all levels of government and among public services*»[6]. Likewise, the administration itself becomes the recipient of innovations. This aspect best serves the pursuit of the public interest and, by extension, fulfil the principle of efficiency in administrative action, given their potential to ensure greater promptness and procedural expediency.

The completion of the process of *digitalisation of the public administration*[7], a goal expressly required under Mission I of the National Recovery and Resilience Plan[8] adopted by the Italian Government in 2021, thus represents an essential purpose.

Nevertheless, public entities may legitimately pursue the general interest only insofar as their action complies with the principles established by law to safeguard the legality of administrative activity[9].

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[3]In recent years, there has been a proliferation of legislative and regulatory instruments governing technological innovation within the digital sphere and the use of algorithmic decision-making processes. Among the most significant sources at the European level are the following: Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, repealing Directive 95/46/EC (General Data Protection Regulation – GDPR); the European Union Artificial Intelligence Act (Regulation (EU) 2024/1689); the *Digital Compass 2030* (COM(2021) 18 final, 9 March 2021); and the *Digital Services Act* (COM(2020) 825 final, 15 December 2020). This non-exhaustive enumeration underscores the increasing significance of this domain within the fabric of contemporary society and, by extension, in the exercise of administrative authority directed towards the governance and safeguarding of the public interest.

[4]See in general Floridi L. (2012), Where the author considers the influence exerted by information and communication technologies on the emergence of new needs within modern society.

[5]See Lalli A. (ed.), Boschetti B. (2022), at 3 or Kubicek H., Cimander R., Scholl H. J. (2011), 23.

[6]European Commission, Communication to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, "A Digital Compass for the Digital Decade: 2030", COM(2021) 18 final, 9 March 2021.

[7]The digitalisation process has been conceived as an attempt to remedy the deficiencies of the public organisational apparatus, which were initially addressed through the mechanism of outsourcing, although this approach ultimately failed to reduce the costs borne by public administrations. See Galetta D. U. (2025), 96.

[8]This constitutes an overall strategic framework through which the Government has outlined seven distinct Missions, each designed to contribute to the broader strategy of the country's economic and social recovery following the pandemic, in accordance with the objectives set out under the Next Generation EU programme. The strategy adopted in the Plan envisages the development of internal capacities within the administrative apparatus, ensuring the active involvement of public officials in the use of digital tools and thereby promoting continuous training aimed at realising the digitalisation process. Cf. Galetta D.U., op. cit., p. 97. Specifically, the first Mission of the Plan, regarding digitalization, appears as application of the purposes outlined in the UE Digital Compass.

[9]Cannada-Bartoli E. (1972), 2; Falzone G. (1953). More specifically, Article 97 of the Italian Constitution addresses the principle of efficiency and impartiality in public administration, according to which those entrusted with the pursuit of the public interest must act efficiently and maintain equidistance from all parties involved, whether public or private, thereby minimizing any infringement on their interests.

Public action is always typified by a legal norm justifying its exercise and must, furthermore, be formed within the framework of an administrative procedure[10]. Accordingly, no administrative measure can be deemed lawful unless it has been adopted through the exercise of a power attributed to the administration by law and in conformity with the relevant normative provisions.

The use of digital tools as an aid to conducting administrative proceedings with greater speed may therefore be deemed useful to satisfy the efficiency requirements of administrative action. The legitimacy of such, though, depends on whether constitutional and legislative principles are duly respected; besides the human official has to remain at the centre of the system[11], through his or her proper reallocation within a "digital" administrative procedure[12].

Indeed, even if the public administration were to employ tools such as artificial intelligence systems[13] capable of autonomously determining the content of an administrative act, the logical-legal reasoning followed by the machine in developing its decision must always remain identifiable. This requirement stems from the fundamental principle that the use of automated means cannot prevent the transparency of administrative procedures, as mandated by Law No. 241 of 7 August 1990[14].

In this sense, the case law[15] has also recognised a certain openness towards the adoption of automated systems for enhancing the efficiency of administrative action. At the same time, judges have stressed the necessity to preserve constitutionally guaranteed principles and to comply with the statutory rules governing traditional administrative functions.

Complementing this provision is Article 41 of the Charter of Fundamental Rights of the European Union, which enshrines the same principle and, through paragraph 2, further establishes that public officials are obliged to provide an explanation for the reasons underlying their decisions. Clearly, this norm must also apply in cases where the human decision-making process is replaced, totally or partially, by automated systems. See Galetta also D.U. (2025), 15.

[10]Understood as a sequence of acts whose order and functions are predetermined by law.

[11]It must be noted that the principle of good administration, constitutionally enshrined and reinforced by the content of European norms, requires public officials to adopt the most appropriate organizational solutions in practice. In the present context, such solutions involve the implementation of digital mechanisms, with the care that officials must exercise to prevent discriminatory outcomes resulting from automated systems, while simultaneously avoiding discrimination arising from the "digital divide", being it the disequilibrium in levels of technological competence among citizens that may make the content of decisions (in)accessible. F. Galetta D.U. (2025), 105; Antúnez Sánchez A. (2025), 159-172.

[12]See Moreira C., Ferguson D. (2019).

[13]Artificial intelligence (AI) is generally classified into two categories: "weak" AI and "strong" AI. The distinction lies in the fact that the former is programmed to perform a specific material task, whereas the latter is also capable of undertaking intellectual activities that would otherwise be carried out by a human being. The development of AI models itself encompasses multiple structures, including so-called machine learning, natural language processing, computer vision, and robotics. For a more detailed legal definition, see Galetta D.U. (2025), 7; Stiefel K., Coggan Jay S. (2023), *passim*. At the regulatory level, the recent European Artificial Intelligence Act provides, in Article 3, a definition of artificial intelligence systems applicable to all the various models, with the consequence that the rules set forth in the Regulation apply universally to each of them.

[14]See Art. 1, provision 1, L. n. 241/1990.

[15]Cf. Italian Council of State, Section VI, 08 April 2019, n. 2270., a ruling in which the Judges emphasized the legitimate use of digital resources as instruments to support the principle of good administration, by virtue of the more efficient exercise of administrative action that results therefrom.

For these reasons, transparency guarantees concerning the intelligibility of the adopted decision and of its formative process remain a safeguard for ensuring that the use of new digital technologies is consistent with both constitutional principles and European law requirements.

The paper aims to analyse the discipline of the algorithmic administrative measure in abidance of the legality principle, as required by the Italian Council of State. So, the methodology develops, firstly, questioning whether there is a difference between the traditional administrative activity and its new digital approach.

Then, the analysis follows underlining the importance of the digital measure's logical-juridical path followed by the machine, given the essential role of the transparency principle. Consequently, the dissertation tries to respond to the question about whether the transparency principle still is manifesting its importance even in facing new ICT technologies.

It then follows the examination about three specific principles, being them direct consequence to the transparency application in administrative action, as clarified by the Italian case law also according to European values. That, to highlight how frequently judges need to challenge practical problems brought up by the technological advance even before lawmakers can efficiently intervene. The last question discussed by the contribution is linked to whether the mentioned principles are sufficiently satisfying the democratic values of the legal order, considering the peculiarities of the digital measure.

The contribution structure is, consequently, the following:

> Section 2 seeks to examine the transition from traditional models of public administration to those outlined in the National Recovery and Resilience Plan—models that also rely upon the deployment of artificial intelligence—through the lens of major legislative instruments such as the *EU Artificial Intelligence Act* (Regulation (EU) 2024/1689) and Italian Law No. 132 of 23 September 2025, entitled *"Provisions and Delegations to the Government on Artificial Intelligence"*.
> Section 3 follows by showing the importance of the transparency principle in its double meaning, as the possibility to know the content of the public activity and to also understand the latter. In fact, that same knowability must be pursued also in developing algorithmic decisions.
> Section 4 focuses on potential risks for the protection of individual rights affected by administrative action. Evolving case law, at this regard, that has underscored not only the duty to ensure traceability of the source responsible for any infringement of rights, but also the obligation to guarantee that the final administrative measure is always adopted by a human official, albeit assisted by a digital tool.
> Ultimately, section 5 underlines the importance of the measure's motive part also showing the criticalities of the matter, and underling the need of a proper regulation.

Transparency and Knowability of Administrative Decisions: From Traditional Tools towards the Digital Administrative Decision

The principle of good administration, as a guiding criterion for public interest's optimal satisfaction, has manifested its significance within the Italian legal system ever

since the entry into force of the Constitution in 1948[16], by the provision of its 97th article.

Post-pandemic legislation[17] has relied upon the public administration not merely as the instrument for pursuing general interests. Above all as, it is intended as a resource for developing the national recovery due to the crisis begun in 2020, in relation to the green transition[18] towards an environmentally sustainable model of administration and with regard to the digital transition.

The abandonment of the traditional instruments of public action is, however, a gradual process, and the advent of the "*digital administration*" represents a further step within the broader framework of the adaptation of public authorities to political, economic, and social needs[19].

As early as the 1990s[20], the computerized administrative act first made its appearance within the Italian legislative landscape, as an act emancipated from the traditional "analog" conception until then prevailed. This development did not, however, entail the abandonment of the traditional legal categories of administrative procedure or administrative measure, but rather prompted their rethinking[21].

A pathway was traced into which, roughly thirty years later, the digital revolution would insert itself. The electronic act has since represented the normal mode of expression of administrative power, with the development of the decision-making process being entrusted to automated information systems[22]. What is relevant, however, is completing the transition from the computerized administrative act to the digital one. Particularly, the cases involving the adoption of an administrative decision presuppose the procedural formation of the (algorithmic) will of the administration. Moreover, the exercise of public power must remain subject to control to ensure compliance with the principle of legality. Indeed, the existence of an automated mechanism capable of independently adopting a determination, as an innovative tool of exercising administrative power, cannot be considered to lie outside the legal framework delimited by the principle of legality under conditions of ordinary administrative functioning. Otherwise, an evident disproportion would arise between

[16]It is worth noting that, in Article 41 of the Charter of Fundamental Rights of the European Union, the good administration canon is not merely conceived as a duty incumbent upon public administrations, but also takes the form of a fundamental right of citizens that can legitimately require to be treated in its abidance.

[17]About this topic, cf. Polyakova V., Streltsova E., Iudin I. et al. (2024), 1 ff.

[18]Chiti E. (2022), 19-48, with reference to the impact of the European Green Deal as an instrument of ecological transition towards a model that does not adversely affect ecosystems and is aimed at achieving climate neutrality.

[19]See Galetta D.U., Corvalàn J.G. (2019), 1 ff. The authors define *"Public Administration 4.0"* as the administrative model based on information and communication technologies (ICT).

[20]Cf. Art. 3, d. lgs. 12 febbraio 1993, n. 39.

[21]Cavallo Perin R. (2022), 307.

[22]At first, it appeared that the use of the computerized administrative act was to be admitted only with reference to the *bound activity* of the public administration which is relevant to perform functions in which public authorities have no margin of discretion in adopting the final decision, since, once the conditions established by law are met, the outcome of the action is predetermined by a norm. The performance of exploratory or cognitive functions, simple communication tasks, or data-archiving activities has, in fact, long been consolidated through automated means, given that such activities do not require the interpretation of legal provisions nor the expression of an administrative will. Torchia L. (2025), 109.

the position of the public administration and citizens, with the result of an unjustified public supremacy[23].

Despite the need to implement the aforementioned transition, the methods through which administrative activity develops remain anchored to normative principles. Among these, the principle most suitable for ensuring citizens' ability to participate in administrative action—and to prevent them from being merely passive addressees—remains the principle of transparency[24]. It represents the highest expression of the democratic values[25] upon which the activity of public powers, even though authoritative[26], is founded.

With the introduction of Law No. 241 of 1990 into the Italian legal system, a radical transformation occurred: until then, the recipient of administrative action could know of a procedure concerning them only when completed. Article 1 of Law No. 241/1990, as amended by Law No. 15 of 11 February 2005, gave rise to a model that allows the administrative apparatus to be defined as a "glass house"[27]. The mentioned definition is due to citizens' ability to know in advance the content of public activity and thus to participate in the administrative procedure from its inception.

For the purposes of adopting an administrative decision, transparency should not be understood merely as the publicity[28] of the decision-making process followed by the competent administration, but rather as the knowability and explainability of the reasoning to the addressee[29].

The ability to comprehend the decision's logic therefore constitutes the defining element for an administrative act to be deemed adopted in accordance with the standard of transparency[30]. Yet, the intelligibility of the reasoning remains a variable concept, dependent upon the manner in which the decision itself is formed.

Accordingly, the technology employed as an auxiliary tool in the adoption of an administrative decision bears its own significance in delimiting the scope of the

[23]See Torchia L. (2025), 111. It is, moreover, worth underlining that the narrowing of the boundary line separating the position of public administrations from that of private individuals has been achieved primarily through the recognition of the right to access and to know the course of administrative activity, as a development that, within the Italian legal system, took place only in 1990.

[24]See, *ex multis*, Patroni Griffi F. (1992), 627 ff, *Idem* (2013), 1 ff., Carloni E. (2009), 779 ff., Arena G. (1992), 25 ff.

[25]Sandulli M.A. (2000), 1-22, where the author sets out the various forms through which the transparency of administrative activity may be manifested, recalling, for example, the obligation to provide a statement of reasons for the administrative decision that is logical and adequately reasoned, or referring to the possibility for private individuals to participate in the administrative procedure itself and, consequently, in the formation of the decision to be adopted. On the importance of the principle of transparency in administrative action, see also Chevallier J. (1988), 239.

[26]See Scoca F. G. (2002), 75-112, where, from the author's description of administrative activity, it emerges that the exercise of administrative power, expressed through the function carried out by each public entity, does not require the participation or consent of the addressee for the completion of the act adopted, even though such participation is permitted within the limits established by law.

[27]That is an impactful expression used by Member of Parliament Filippo Turati in 1908 during a discussion inside the Italian Chamber of Deputies, where he stated that any time the secret is not imposed to public administrations, they should operate as a glass house, to underline the necessity of transparency in public activity's development. Cf. Carloni E. (2009).

[28]Represented by the availability of the information and the documents held by administrations.

[29]See Carloni E. (2022), in general.

[30]See Lalli A. (ed.), Carloni E. (2022), 46.

transparency principle. With the transition from a traditional model of administration to a digital one, what must be understandable is no longer the logical reasoning followed by the human decision-maker, but rather the path followed by the algorithm.

The same transparency requirements established by the national legislator have also been shared at the supranational level, with the adoption of the *General Data Protection Regulation* (Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016) [31], concerning the processing of personal data, whereby a new interpretation of the principles of transparency and access was introduced[32]. The obligations enshrined in the Regulation affect administrative activity whenever it entails the processing of personal data belonging to the recipients of administrative action.

The supranational regulatory framework is further reinforced by Regulation (EU) 2024/1689 laying down harmonised rules on artificial intelligence (the "AI Act"). The adoption of this instrument marked a significant advancement in the regulation of algorithmic decision-making. In fact, it sought to provide an organic framework for the application of artificial intelligence in various contexts—primarily industrial, but with relevant implications also for administrative activity[33].

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[31]Kaminsky M.E., Malgieri G. (2020).

[32]It is worth recalling that the GDPR guarantees the data subject the right to know whether their data are being processed, as well as the corresponding obligation of the data controller to provide clear and transparent information, together with the right of access. In particular, the latter was already, in 1990, the main instrument to ensure compliance with the principle of transparency in administrative procedures. These rights, expressly stated in the GDPR, are also protected judicially, by allowing the lodging of a complaint with the national supervisory authority of the State where the data subject habitually resides or works. Furthermore, Article 42 of the Charter of Fundamental Rights links the right to access one's files or documents to the right to be heard, as a full form of citizen participation. Cf. Galetta D.U. (2025), 79. The right of access is thus significant nationally under Article 22, Law No. 241 of 7 August 1990 and subsequent amendments, and supranationally under Article 15 of the GDPR. It has also been complemented by *Guidelines 01/2022 on data subject rights – Right of access* (EDPB 01/22), specifying the steps to allow legitimate access. Although a soft law instrument, these guidelines provide important interpretative indications regarding the data controller's duties during access to administrative documents. They state that the right of access allows citizens to obtain sufficient, transparent, and readily accessible information about personal data concerning them involved in the procedure. Finally, the polyvalence of the right of access must be noted, as it allows the data subject to exercise other rights, such as rectification or deletion of data. Cf. Torchia L. (2025), 149–150; Di Filippo A. (2024), 1210; Rulli E. (2018), 543 ff. Regarding the interpretation of the article, it is interesting to analyze Opinion of Advocate General Richard de la Tour delivered on 12 September 2024, regarding *Request for a preliminary ruling from the Verwaltungsgericht Wien*. There, precisely, the Advocate General affirmed that «*Article 15 of the GDPR, entitled 'Right of access by the data subject', defines, in paragraph 1 thereof, the subject matter and scope of the right of access granted to the data subject and enshrines the right of the data subject to obtain from the controller access to his or her personal data and the information referred to in subparagraphs (a) to (h) of that paragraph*».

[33]Recital 12 of the AI Act provides a precise definition of the characteristics of artificial intelligence systems, identifying as essential their capacity for inference in producing an outcome. On the discipline of the AI Act, see Sapienza S. (2024), 106, where the value of this legislative act is emphasized for having established a risk-based framework for the use of artificial intelligence. In particular, Article 3(1)(2) defines risk as "the combination of the probability of harm occurring and the severity of that harm." Moreover, significant risk is described as that characterized by "the combination of severity, intensity, likelihood of occurrence, and duration of its effects, as well as its capacity to affect an individual, a plurality of persons, or a particular group of persons." The AI Act also provides four categories of activities according to risk intensity: prohibited, high-risk, limited-risk,

National legislation, contained in Law No. 132 of 23 September 2025, is intended to complement the provisions contained in the UE regulation. While the EU intervention has set out the general limits for the adoption of digital tools through the enumeration of principles directly applicable in all Member States, the national legislation has established a detailed regulatory framework[34].

European legislation has focused on providing rules that relies on prior risk analysis, setting out the principles to AI usage inside the common market[35].

Law No. 132/2025 has, by contrast, shown greater attention to the relationship between public functions and the use of digital instruments[36]. Indeed, although Article 1 of the law explicitly establishes that national legislation draws its foundations from the AI Act, it is possible to discern a specific focus on the activity of public administrations. Particularly, an example may be the delimitation of the scope of criminal liability of public bodies in the use of artificial intelligence tools, as introduced through the amendment of Legislative Decree No. 231/2001[37].

The critical issue, therefore, coincides with the identification of the appropriate means by which to ensure the dual dimension of transparency in the pursuit of the public interest[38]. Not by chance, the inherent opacity of such mechanisms has led to the emergence of the so-called "black box problem"[39], due to the intrinsic difficulty of gathering the functioning of the algorithm[40].

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and minimal-risk activities. On the subject, see, among many others, also Trimarchi Banfi F. (2025), 655; Barbieri L., Dani L. (2025); Artuso S. (2025); Rumi T. (2025), in general.

[34]Cf. Gardini G. (2025), 767; De Donno M. (2024), 57 ff.

[35]This is a common approach in EU lawmaking process. Though regulations are directly affecting Member States, where the matter falls into the shared competence space, EU Institutions leave the detailed regulations to States, abiding the subsidiarity and proportionality principles. See Galetta D.U. (2025), 196 ff. The Italian legal system followed the same approach in adopting the Legislative Decree of 10 Agust 2018, n. 101, to adequate the national asset to the GDPR.

[36]See Art. 1, Law No. 132/2025: «*This law establishes principles concerning the research, experimentation, development, adoption, and application of artificial intelligence systems and models. It promotes the correct, transparent, and responsible use of artificial intelligence in an anthropocentric perspective, aimed at seizing its opportunities. It ensures oversight of economic and social risks and of the impact of artificial intelligence on fundamental rights. The provisions of this law shall be interpreted and applied in accordance with Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024*». From the statutory text, it already emerges that the use of artificial intelligence is intended only insofar as it does not conflict with the fundamental rights of citizens, which becomes even more significant where digital tools constitute an expression of administrative power. Cf. Masnada M. (2025).

[37]Art. 24, paragraphs 3 and 5(c), Law No. 132/2025, delegates to the Italian Government the «specification of the criteria for attributing criminal liability of natural persons and administrative liability of entities for offenses related to artificial intelligence systems, taking into account the actual level of control exercised by the agent over the aforementioned systems».

[38]On one hand, transparency can be understood, from a static perspective, as the possibility of scrutinizing the exercise of administrative power to assess its compliance with legal principles, or, from a dynamic perspective, as the purpose (always instrumental to the protection of the public interest) to be ensured in the performance of the institutional activity carried out by the entity. See Corrado A. (2020), 123 et seq, or Ramotti C. (2025), 216 ff.

[39]See Sonia Arduini S. (2021), 453 ff; Pasquale F. (2015), 975 ff.; Palmer Olsen H., Livingston Slosser J., Treols Hildebrandt T. (2020), 1 ff., Stiefel K., Coggan Jay S. (2023), *passim*.

[40]More precisely, it should be emphasized that the difficulties in understanding the machine's mode of operation concern both cases in which a straightforward algorithm is used, as well as instances of artificial intelligence, and, above all, the use of machine learning tools.

Transparency in (and for) the Algorithmic Administrative Procedure

It is worth noting that, conceptually, the administrative procedure shares certain similarities with what an algorithm represents. In both cases, indeed, we are dealing with sequences of ordered operations aimed at achieving a predetermined result. In the case of digital administrative activity, it can even be argued that the administrative procedure is realized in—and replaced by—the software used for the execution of the activity. This consideration comes from the fact that the administration's will is expressed at the procedure's culmination through the algorithm [41].

What the legal nature of the software is, in relation to the exercise of digital administrative activity, may be interesting to discover. Various theories have been developed on the matter. One position considers the rules embedded in the software as acts of mere internal organization regarding the exercise of the "digital administrative function", whereas another point of view permits to consider them on the same level as a self-limitation of the exercise of the function[42].

Another relevant point, in the analysis of digital tools for the more efficient exercise of public action, concerns the fact that the impact of the digital tool varies depending on the type of procedure or act that the public administration conducts and adopts. This can easily be assessed by considering the difference between the administration's bound activity and discretionary activity. The latter undoubtedly presents greater challenges in the analysed context.

In the first case, occurs a situation that better accommodates the model of algorithmic administrative function, since there is no room for choice for the acting administration.

There is a full correspondence between the model underlying the functioning of the algorithm and the space of discernment left to the administration in cases of bound activity: on the one hand, the programmer sets rules for the algorithm based on an *if/then* mechanism so that it behaves in the predetermined way when encountering a specific input; similarly, in cases of bound power, the legislator establishes the outcome of the administrative action upon the occurrence of the conditions fixed by the same law conferring the power. Given this alignment of dynamics, the use of automated models for the adoption of a bound act seems fitting.

The situation is markedly different, however, in the case of the public administration's discretionary activity, which entails determining the *an*, *quid*, *quomodo*, and *quando* of the act[43].

As is intuitively clear, in the latter scenario, the use of an algorithm introduces more pervasive risks regarding the legitimate achievement of the final purpose, given the impossibility of constantly guaranteeing the predictability of the outcome[44]. This is particularly evident with machine learning models, which are known for their ability

[41]Cf. Mazza Labocetta A. (2023), 118.

[42]See Cavallo Perin R. (2022), 309. In the second mentioned case, therefore, the software underlying the machine's operational mechanism is, from a legal standpoint, equated to an administrative act of general effect.

[43]Which mean whether to adopt the measure, its subject matter, the modalities of adoption, and the timing. See Piras A. (1964), 67-91.

[44]See Torchia L. (2022), 112.

to autonomously reach increasingly accurate and complex decisions. The machine's resolution is reached through the processing of data initially provided by the programmer, in addition to the inferences acquired from the machine's experience[45].

Despite a cautious openness in jurisprudence[46] toward the possibility of using machine learning models even for discretionary administrative activity, a generalized and uncalibrated use appears inadequate. The reason of this being that discretion is an expression of human reasonableness[47] and cannot be substituted by any automation. Otherwise, there may be an evident exponential increase in the risk of causing prejudice to the recipient of the action[48].

If the operations performed by the algorithm cannot be easily traced by a human controller after the decision is made, the last safeguard available to assess the legitimacy of the act is precisely the principle of transparency[49]. This one represents a preventive safeguard, alongside the principle of algorithmic legality[50].

The principle of transparency manifests itself in different ways. Among them, lies the administration's obligation to inform the interested party of the beginning of the administrative procedure. This obligation is contained in Law No. 241/1990 and also applies to automated procedures, where it assumes essential importance, as it allows to know the instructions given to the machine to conduct the activity[51]. More specifically,

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[45]Even a brief description of how machine learning works should make clear the difficulty of grasping the logical path followed by the algorithm, even if initially regulated by the programmer, due to its capacity for autonomous adaptation and improvement. Therefore, this element allows machine learning tools to be considered as a *quid pluris* compared to a simple "if/then" algorithm or even to artificial intelligence alone

[46]Council of State, Section VI, 04 February 2020, n. 881.

[47]Mazza Labocetta A. (2023), 122.

[48]An example of an evidently unfair automated decision was brought before the administrative judge. In particular, jurisprudence considered the case involving the assignment of thousands of teachers to different school levels nationwide in 2017. The competent Ministry commissioned a private company to develop an algorithm capable of processing relevant data to assign scores in the public selection procedure for each teacher. However, the algorithm malfunctioned, giving higher rankings to teachers who, based on their scores, should have been placed lower. On that occasion, the teachers' ability to exercise the right of access to documents proved essential to understand the reasoning behind the incorrect scoring. Initially, the Ministry denied access, arguing that no administrative acts were produced, but only a source code also covered by private intellectual property rules. The teachers appealed to the administrative court, which first had to establish its jurisdiction, affirmed on the basis that the administration makes a macro-organizational choice when adopting automated tools for its activities. Jurisprudence then recognized the right of access initially denied by the Ministry, as an expression of the principle of transparency, because the algorithm automatically manages the administrative procedure and shapes it, and all supporting data and the measure are contained in the algorithm, making it equivalent to an administrative digital act, to which Law no. 241/1990 extends the right of access. It was also affirmed that the choice to use digital means in place of traditional administrative methods cannot undermine citizens' guarantees, and the logical process followed must always be intelligible. See Council of State, Section VI, 13 December 2019, n. 8472.

[49]Galetta D.U. (2025), Cavallo Perin R., Galetta D.U. (eds.) 85 ff.

[50]Torchia L. (2025), 117; Civitarese Matteucci S. (2019), 8, here, the author emphasizes that the principle of algorithmic legality differs from its traditional version. The reason for this distinction lies in the fact that it no longer concerns only the guarantee of complying with legal norms to avoid undue restriction of the legal sphere of the recipient of the administration's unilateral authoritative act; rather, it requires that such a guarantee be provided in any context of administrative action, even when it is relevant from a private law perspective.

[51]Diaco D. (2024), 249.

the General Data Protection Regulation (GDPR)[52] imposes the specific obligation to indicate in the communication of the initiation of the procedure any use of automation tools for decision-making[53], together with a description of the partially or fully automated nature of the act to be adopted.

The critical aspect is that, although these procedural requirements are imposed to guarantee the application of the principle of transparency, they do not necessarily achieve the same effectiveness in an automated procedure as in traditional conditions. Consider that, whereas in the classic administrative procedure, exercising the right of access to documents was generally sufficient for the citizen to understand the administration's reasoning, this is not sufficient in the algorithmic procedure. Access would allow only to see the source code that led to the adoption of the act, but is it possible to affirm that recognizing the software also ensures intelligibility of the legal reasoning? The answer is clearly negative[54].

The only admissible solution, therefore, is to ensure algorithmic transparency in advance, and not only after the adoption of the act, as otherwise the right to participate in the procedure and the adversarial process within it would be compromised[55]. Given that the current normative elements are still insufficient to guarantee these aspects, judicial interpretation has proven essential[56] in affirming that, to give real effect to the principle of transparency, public administrations must first prefer the adoption of open-source algorithmic tools, rather than those protected by intellectual property, in order to facilitate their intelligibility[57].

Transparency as a Warrantee of Legality and Legitimacy for Algorithmic Decisions in Light of the Council of State Case Law

Once established that the principle of transparency represents the cornerstone of the system underpinning the digital administrative procedure, it becomes necessary to

[52]It should also be noted that, through Article 15 of the aforementioned Regulation (EU) 2016/679, as noted above (cf. *supra* note 26), transparency is no longer considered solely as an obligation on the part of the entity conducting the administrative procedure, but also as a right exercisable by anyone wishing to know about the possible existence of an algorithmic procedure concerning them. See Lalli (ed.), Carloni E. (2022), 55, Civitarese Matteucci S. (2019), 5 ff.

[53]See Torchia L. (2025), 127. The author also considers the national framework established by the Digital Administration Code (Legislative Decree no. 82 of 7 March 2005), which provides additional rules for the content of the notification of the initiation of the digital procedure, such as the indication of the existence of a digital file containing the procedural documents and related information, the indication of the administration's digital address, or the indication of an online access point to the digital file.

[54]American scholarship distinguishes between "*fishbowl transparency"* and "*reasoned transparency*", noting that the first model aims to show what the administration is doing within the procedure, while the second seeks to make understandable the reasons driving the automated administrative activity. See Coglianese C., Lehr D. (2019), 20 ff.

[55]Indeed, to remedy a situation in which an unlawful algorithmic decision has already been adopted, the only solution remains recourse to the judicial function.

[56]See Hous. Fed'n of Teachers, Local 2415 v. Hous. Indep. Sch. Dist., 251 F. Supp. 3d 1168 (S.D. Tex. 2017).

[57]See Diaco D. (2024), 223-253.

examine the ways in which the administrative function may be deemed legitimately exercised. For this purpose, the interpretation provided by the courts[58] is crucial.

First, it is essential to consider the technical rule governing algorithms, artificial intelligence, or machine learning mechanisms, given that such rule also carries legal significance.

What renders this technical rule legally relevant is precisely the possibility of knowing and understanding the formula that, through the explanation of its functioning[59], rises to the status of a legal rule (typically, a norm). As such, this type of rule is capable of producing juridical effects for the addressee.

More precisely, the software employed in digital administrative proceedings has been classified by case law[60] within the pre-existing category of the so-called informatic administrative act[61]. However, for such assimilation to be valid, the algorithmic technical rule has firstly to be translated into a legal one, making it intelligible both to citizens and to the judge who may be called to review its lawfulness[62].

As mentioned, the courts have not opposed the use of algorithms within administrative procedures. Specifically, the legitimacy of these mechanisms depends on compliance with the general rules of the legal order, since the technical rule programming the algorithm's operation remains a general rule of administrative law. Because of that, it needs to conform to the principles of transparency, reasonableness, and proportionality when applied within an administrative procedure[63].

This also follows from the fact that such a rule is always conceived by humans rather than by the machine, which merely executes it, even if autonomously.

This observation extends the application of the transparency principle to include the right to know who developed the algorithm, the technical process followed in its creation, and the decision-making mechanism designed to reveal the priorities set by developers in assessing data relevant to the decision. Therefore, the path, followed by the machine in reaching a particular outcome[64], is not the only relevant aspect to make knowable.

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[58]Cf. The already cited judgment of the Council of State, Section VI, No. 8472/2019. This centrality is, in any case, also emphasized by statutory provisions, such as Article 42 of the European Charter of Fundamental Rights, which provides that, in cases where an administrative act restricts the subjective legal sphere of the addressee, the administration is bound by the duty of prior adversarial proceedings with the interested party, in addition to the obligation to explain the reasons for adopting such an act. See also Sassi S. (2019), 109, Orsoni G., D'Orlando E. (2019), 593 ff.

[59]The understanding of a rule, even if expressed in a language different from the legal one, must always be ensured for the citizen. In this regard, see Council of State, Section VI, 8 April 2019, No. 2270.

[60]T.A.R. Lazio, Roma, Section III-*bis*, 30 June 2021, n. 7769.

[61]The informatic administrative act is represented by every act adopted with the support of informatic technology, meanwhile the digital act asks for a further requirement to be deemed as such, since it is necessary the usage of an algorithm. See Masucci A. (1997), 221 – 228.

[62]Council of State, Section VI, 13 December 2019, n. 8472; Council of State, Section VI, 18 May 2020, n. 3148.

[63]See, once again, Council of State, Section VI, 08 April 2019, n. 2270.

[64]See Lalli A. (ed.), Carloni E. (2022), 55. Moreover, the Council of State (Council of State, Section VI, 13 December 2019, No. 8742, cited) reiterated the need to regulate automated procedures through a "strengthened" transparency principle, which is manifested in the modes described above. See also Benetazzo C. (2020), 24-35.

Only in this way can the technical rule be regarded as explained, and, as such, legally relevant.

In any event, the algorithmic administrative rule must not allow any discretion in adopting a digital decision; instead, it needs to be programmed to provide a predetermined solution for every possible case submitted to the system[65], even the most unlikely ones, so as to prevent unreasonable or disproportionate results[66].

Consequently, the public administration has to engage in continuous supervision and updating of the algorithm to ensure a proper balancing of the interests at stake. Given the significance of the issue, the Council of State promptly elaborated the minimum principles under which an algorithmic administrative act may be considered lawful.

The judiciary has expressed a favourable view toward the use of automated tools in the exercise of administrative functions, as they facilitate compliance with the principle enshrined in Article 97 of the Constitution. However, efficiency and cost-effectiveness cannot be pursued at the expense of other protected interests. For this reason, the Council of State[67] has clarified that such acts must always be subject to judicial oversight by the administrative courts. Therefore, it is not sufficient merely to guarantee the knowability of all aspects relating to the parties involved, the algorithm's programming, and the resulting decision.

Where these safeguards are ensured, however, the algorithmic tool can significantly enhance administrative action.

In this regard, courts have emphasized that, in carrying out the binding activity of public administration, algorithms can help prevent negligence or misconduct by public officials[68]. This considering the fact that processing large volumes of data not requiring evaluation beyond automatic classification can be performed more efficiently by the algorithm, even without human intervention. Though, eliminating any space for algorithmic discretion is crucial: programmers, as mentioned, must anticipate all possible solutions associated with the exercise of administrative power through the automated tool, preventing the system from making unpredictable choices. Administrative discretion, by contrast, still finds space but it is exercised at the stage of choosing which software to adopt, before the activity is delegated to the algorithm.

Accordingly, the Council of State has identified the essential profiles of legality applicable to the algorithmic rule[69].

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[65]This aspect is what prevents an algorithm-based administrative rule from being fully equated with the general legal rule, which has a general and abstract range of application needed to be suitable for each and every possible hypothesis touched by the provision.

[66]Cf. Torchia L. (2025), 151.

[67]See the mentioned judgement of Council of State, No. 2270/2019: *«An automated administrative decision, adopted through the use of an algorithm, requires that: (a) the algorithm be "knowable", according to a strengthened interpretation of the principle of transparency, which also entails the full knowability of a rule expressed in a language different from the legal one; (b) the algorithmic rule be not only knowable in itself but also fully accessible to, and subject to, the complete scrutiny of the administrative judge»,* on appeal, moreover, from the first-instance judgment of the Regional Administrative Court of Lazio, Rome, No. 12026 of 2016; translation provided by the present writer.

[68]Belisario E., Cassano G., Belisario E., Ricciulli F. (2023), 157 ff.

[69]Simoncini A. (2019), 1149 ff, this refers to a genuine "rule of technology," whereby an automated decision adopted in practice must necessarily correspond to the "abstract algorithmic provision." See also Belisario E., Cassano G., Belisario E., Ricciulli F. (2023), 158. The issue of "algorithmic legality"

A judge called upon to annul an unlawful administrative act must therefore verify the compliance with the principle of "algorithmic legality," as developed in case law.

Among these standards, in addition to the aforementioned duty of constant supervision and updating of the software, stands the "*human in the loop*" [70] principle, of mathematical doctrine origin, which requires that algorithmic decision-making is not entirely detached from human intervention, and that a person is involved as a supervisor in verifying the outcome.

The inclusion of human oversight within the decision-making process is also what, at a pathological stage, enables judicial review to occur. Specifically, this

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does not concern exclusively the machine's compliance with legal requirements in the development of the digital administrative procedure, or the observance of principles outlined by the judiciary, but also the question of whether an electronic administrative act may be adopted only in the presence of a norm that expressly permits such an operation. This clearly relates to the repeatedly expressed need to ensure the application of the law even in the use of digital tools, preventing, indeed, their use as a means to circumvent legal obligations.

In the Italian legal system, there is statutory authorization for the use of digital tools, within Law No. 241 of 7 August 1990, Article 3-*bis*, which highlights the connection between technology and efficiency objectives, alongside Article 12 of the "Codice dell'Amministrazione Digitale". The existence of provisions promoting the digitalization of administrative activity supports the possibility of generalized recourse to algorithmic decision-making, provided it is employed within the limits repeatedly emphasized. In matters of algorithmic legality see Simoncini A. (2019), 1149 ff.; Torchia L. (2025), 114; Civitarese Matteuci S. (2019), 5 ff.; Bateman W. (2020), 520–530; Bent, J. R. (2020), 803–853; Martìn Dalgado I. (2022), 9-30; Panagopoulou F. (2024), 2 ff.

[70]On this point, there are numerous judicial decisions, supported by extensive doctrinal and scientific research, all sharing the common thread that human involvement must not be excluded at any stage of the logical-algorithmic process leading to the adoption of an act that produces legal effects. This ensures that the recipient is guaranteed the possibility of obtaining a decision that is not purely automated. Essentially, a human must be able to supervise, confirm, or override the content of the algorithmic act, meaning that the intended outcome of the act can occur only to the extent that the machine has interacted with a human. This principle is also reflected in Article 22 of the GDPR, except in the cases explicitly listed in paragraph 2, which concern decisions that: *« a) it is necessary for the conclusion or performance of a contract between the data subject and the data controller; b) it is authorized by Union or Member State law to which the data controller is subject, which also specifies appropriate measures to safeguard the rights, freedoms, and legitimate interests of the data subject; c) it is based on the explicit consent of the data subject*». However, the data subject always retains the possibility to express their opinion and challenge the decision, and the data controller remains obliged to implement appropriate safeguards for the rights, freedoms, and legitimate interests of the data subject in the cases referred to in points *a*) and *c*). Cf., *ex multis*, T.A.R. Calabria Catanzaro, Section I, 29 July 2025, n. 1300; Court of Appeal of Rome, Labor Section, Judgement, 03 March 2023, n. 834; Council of State, Section VI, 04 February 2020, n. 881; Council of State, Section VI, 13 December 2020, n. 8474; from a doctrinal point of view, instead, see Kinchin, N. (2024), 23–45; Tschider, C. A. (2024), 324–429; Zheng, E. L., Jin, W., Hamarneh, G., & Lee, S. S.-J. (2024), 84–86; Belisario E., Cassano G., Belisario E., Ricciulli F. (2023), 162; Torchia L. (2025), 129; Sapienza S. (2024), 40. It is worth recalling the already cited Opinion of Advocate General Richard de la Tour delivered on 12 September 2024, by which it was confirmed the setting about art. 22 GDPR, affirming that: «[…] *the prohibition thus laid down does not apply in the cases listed in Article 22(2) of that regulation, to which I shall return below. In its judgment of 7 December 2023, SCHUFA Holding and Others (Scoring), the Court held that Article 22(1) of the GDPR must be interpreted as meaning that the automated establishment, by a credit information agency, of a probability value based on personal data relating to a person and concerning his or her ability to meet payment commitments in the future constitutes 'automated individual decision-making' within the meaning of that provision, where a third party, to which that probability value is transmitted, draws strongly on that probability value to establish, implement or terminate a contractual relationship with that person*».

principle means that, whenever an algorithmic decision affects the subjective sphere of the addressee, the individual has the right to ensure that the production of legal effects does not depend uniquely on an automated process but also on human evaluation[71]. In other words, the machine needs to interact with a human being in order to validly achieve its result[72], whether this happens during the administrative elaboration of the outcome or in front of a court evaluating the digital measure's fairness.

Consequently, following the adoption of an algorithmic act, human intervention has to confirm or remove its content; if even that is not sufficient, then the subject of the illegitimate measure can appeal the judicial remedies.

Although, theoretically, the legal provision embodying this principle appears clear, its practical implementation raises several challenges.

Indeed, EU legislation remains incomplete regarding the use of artificial intelligence in decision-making processes, particularly in two respects relating to the distinction among different automation models.

The first concerns the fact that the requirement of human oversight may not apply to decision-making models that are not fully automated, thereby excluding categories of automation that already incorporate human input during the decision-development stage[73].

The second critical aspect relates to the processing of data referring not to individuals but to groups of people or the wider community, where personal data are anonymized and processed collectively, leading to the inapplicability of GDPR provisions that protect only individual data[74].

The principle of non-discrimination in algorithmic decision-making is the last to consider for completing the algorithmic legality fundamental requirements. This translates into a duty to avoid so-called automation biases[75], preventing outcomes that might be discriminatory toward the addressee of administrative action.

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[71]The algorithm used in the conduct of the administrative procedure must undergo continuous assessment, both before its adoption and throughout its use. This ensures that the interests at stake can be balanced in advance, with the type of reasoned judgment characteristic of human evaluation—whether preventive or subsequent—which the machine itself cannot perform.

[72]Cf. Council of State, section VI, n.881/2020, cited; T.A.R. Lazio Rome, section. IV-*ter*, Judgement., 15 September 2025, n. 16243; T.A.R. Lazio Rome, section III-*bis*, Judgement, 02 February 2026, n.1895.

[73]Sapienza S. (2024), 41.

[74]Attention should also be paid to the Judgment of the Court (Fourth Chamber) of 4 September 2025, which highlighted further critical issues in the EU regulatory framework. In that decision, with reference to the judge's role in cases of unlawful personal data processing, it was emphasized that the GDPR does not directly confer on the data subject the right to obtain an injunction aimed at preventing the recurrence of unlawful data processing by the data controller. Nevertheless, nothing prevents national legislation from providing such a preventive remedy, confirming the importance of judicial oversight in this area

[75]These represent a cognitive factor that conditions the interaction between humans and machines to such an extent that it can cause harm to the data subject through the incorrect processing of personal data, based on mathematical procedures tainted by discriminatory effects against individuals, depending on ethnicity, sex, political opinion, or other factors of similar relevance. See Goddard K, Roudsari A, Wyatt JC (2012); Italian Higher Council of the Judiciary, recommendation 08 October 2025; Guidelines 4/2019 on Article 25. Data Protection by Design and by Default. Version 2.0, of the European Data Protection Board (EDPB).

The difficulty arises from the fact that the accuracy of algorithmic decisions depends on the quality of the data filled into the software[76], coupled with the machine's inherent inability to assess data within their broader context. The objective data processed by the algorithm may thus apply to an individual a rule that is statistically fair and legitimate but, in light of the person's specific circumstances, proves discriminatory in the concrete case[77].

It is even more evident that the intervention of the administrative judge has always to be possible to assess the lawfulness of the algorithmic determination. If the automated measure complies with all the principles outlined above, it will also satisfy the requirements of so-called algorithmic legality.

Concluding Remarks and Criticalities

In conclusion, the exercise of administrative power lends itself to the use of digital technologies, as long as all the legal requirements governing traditional administrative activity are respected.

The use of tools that render the decision-making process opaque— even in the name of greater procedural efficiency—cannot justify any compromise on legitimacy. Consequently, the traditional categories of vices acts must be reconsidered in light of algorithmic decision-making[78].

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[76]A new category of defect in administrative acts could be the 'malfunction' of the algorithm from which an unlawful decision arises. This category seems to encompass all technical circumstances that may negatively affect the accuracy of algorithmic decisions, including through the distortion of reality as perceived by the machine, resulting in the production of an incongruous outcome. Examples may include programming errors, such as mismatches between input and output, or technological deviations, as a consequence of the aforementioned biases or invalid data within the algorithm (see Simeoli D., 2022). However, such a defect also raises questions regarding the applicable liability regime. It is necessary to determine whether there was liability, through intent or negligence, on the part of the administration in the erroneous selection of the software used for exercising administrative power, with potential application of Article 2050 of the Italian Civil Code, concerning liability for hazardous activities (in this case, inherently posing a risk to the recipient), or whether liability might rather lie with the developers who failed to properly train the machine, for the purposes of claiming compensation for the injured party. See Belisario E., Ricciulli F. (2023), 171.

[77]See Torchia L. (2025), 143.

[78]Violation of law, lack of competence, and abuse of power remain the reference categories, albeit they must be interpreted so as to encompass the peculiarities of each case. Consider violation of law as the failure to comply with a norm that may exist at both national and supranational levels; the relevant aspect, then, is the development of an algorithm capable of simultaneously observing multiple layers of regulation. Lack of competence, in turn, would arise in any case in which the law itself excludes the development of an automated procedure, or where such a procedure is handled by an entity lacking the competence specifically related to the subject matter of the action. Finally, with regard to abuse of power, additional symptomatic forms of the defect, distinct from traditional ones, have been hypothesized. It is worth mentioning: the so-called uncontrolled delegation, i.e., the generalized conferral of the power to decide on certain matters to the algorithm, without simultaneously providing for adequate human oversight; algorithmic manipulation, understood as the distortion of the outcome through improper use or tampering of the software; lack of transparency, which can likewise be seen as a symptomatic form of algorithmic abuse of power, since in its absence it is impossible to review the content of the decision; and lastly, the 'disproportionate response,' understood as the adoption of a

From this, two main considerations arise: the first concerns the need to adapt the regulation of algorithmic activity to an ever-changing context[79]; the second relates to the importance of upholding the duty to provide the explanation for administrative acts, including algorithmic ones, as required by Article 3 of Law No. 241/1990 and by supranational sources[80].

Just as the statement of reasons plays a crucial role in identifying possible defects in acts adopted through the traditional exercise of administrative functions, so too, in algorithmic decision-making, it represents the cornerstone of citizens' guarantees, since it is through letting the reasons accessible that explainability and explanation take concrete form.

The explicative part of the decision thus constitutes the instrument through which all the principles set out above—those safeguarding transparency and algorithmic legality[81]—enter the automated determination within the administrative procedure, together with the element of human oversight. Only by articulating the underlying reasoning within the statement of reasons can the presence of human judgment in the algorithmic process be ensured, allowing for judicial review or reconsideration by the competent authority.

In the absence of reasoning, or where it is inadequate[82], *ex post* judicial check would be deprived of substance, since even if judges were placed in a position to reconstruct the operations performed by the digital systems, this might not suffice to trace the relationship between the inputs provided and the outputs produced[83]. Indeed, in the use of machine-learning systems, the opacity of inferences is inevitable, given the impossibility of verifying *ex post* which data were processed by the system in order to reach the disputed result.

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decision that is devoid of reasonableness and appropriateness to the specific case. See Belisario E., Ricciulli F. (2023), 171.

[79]The relevant issue is to identify the most appropriate moment to intervene in the regulation of the matter. This critical aspect was already highlighted in the literature as early as the 1980s (cf. Collingridge D. (1980), passim), where it was emphasized that if regulation intervenes too early relative to technological development, there is a risk of failing to provide a framework encompassing all relevant aspects, which would rapidly become obsolete, or of stifling technological progress from the outset. The approach advocated at the time was the so-called 'wait-and-see' approach, whereby the regulator, faced with the existence of a multiplicity of models on the market, should not determine which of them deserve protection, but rather regulate each of their facets. It is evident that such an approach is no longer feasible in a market in which the number of models emerging is so diverse that a single ex-post regulation applicable to all of them is not possible. Cf. Pittelli D. (2025), 43; Torchia L. (2025), 12.

[80]Cf. Art. 296, par. 2, TFUE or the aforementioned Article 41 of the Charter of Fundamental Rights of the European Union. The case law on the subject is extensive, but at the European level, it is worth recalling the judgment of 20 March 1957, *Case 2/6, Die in der "Geitling" Ruhrkohlen-Verkaufsgesellschaft mbH zusammengeschlossenenen Bergwerksgesellschaften v. High Authority*.

[81]The duty to provide adequate reasoning in an administrative act is not only established in Article 3 of Law no. 241/1990 but also serves to justify the decision made by the machine, as it makes the underlying reasoning understandable.

[82]Judgement Court of Justice of the European Union, March 20th, 1959, Case 18/57, I. Nolde v. High Authority.

[83]See Dignum V. (2019), 59 ff.

In such cases, the issue of understanding the logical-legal reasoning is coupled with the problem of ensuring adversarial participation within the procedure, even when the decision is accompanied by reasoning.

The implementation of democratic principles within digital administrative procedures is primarily achieved through the recognition and effective safeguarding of procedural guarantees, notably the right of the addressee to be heard[84], particularly where the contemplated measure is liable to adversely affect his or her legal position[85].

Active participation in administrative proceedings constitutes a fundamental expression of democratic governance and procedural fairness. The exercise of the right to be heard enables individuals to present their observations and arguments, thereby contributing meaningfully to the formation, content, and legal effects of the resulting digital administrative act.

With specific regard to the digital procedure, the requirements of adversarial participation[86] could also be satisfied through the issuance of a preliminary automated decision, with the interested party subsequently allowed to submit observations to a human case handler. In this way, the human official could depart from the potentially detrimental content of the preliminary automated outcome, thereby applying the human-in-the-loop principle, and the final decision would be adopted only after the adversarial phase with the individual concerned.

Nevertheless, under Italian law exist forms of simplified administrative procedure that are legally justified by the binding nature of the administrative outcome[87]. Hence, the use of algorithmic decision-making becomes more acceptable as the degree of administrative discretion decreases and the public action is more tightly constrained.

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[84]Clearly stated by art. 41, par. II, let. *a*), of the EU Charter of Fundamental Rights. This crucial right also appears to be linked to the communication of the initiation of the procedure, disciplined by the mentioned Law. n. 241/1990.

[85]About the right to be heard, see Opinion of Advocate General Darmon delivered on 27 October 1993 and the linked Judgment of the Court of Justice (Fifth Chamber) of 29 June 1994, *Case C-135/92, Fiskano v. Commission*, ECLI:EU:C:1994:267, par. 40. Another element sustaining democracy in digital transitioning procedures may be the right to every person to have access to their files. The latter manifests as a specification of the right to be heard and a consequence to the need of granting the right of defence, also in administrative procedure. In fact, these contexts can also be described as adversarial situations, where the need to have access on the information on which the measure will be adopted is essential in order to tackle a possible negative outcome for the individual. To this matter, see art. 41, par. II, let. *b*) CJUE, and art. 22, Law n. 241/1990, and also Judgment of the Court of First Instance (Second Chamber) of 18 December 1992, *Cimenteries CBR SA, Blue Circle Industries plc, Syndicat Nationale des Fabricants de Ciments et de Chaux and Fédération de l'Industrie Cimentière asbl v Commission of the European Communities*. The access must be granted not only when a digital procedure is begun, but, where needed, even with digital tools rendering easier the obtainment of the files, as established by Council of State, Section I, Judgement of 13 January 2026, n. 61; T.A.R. Lombardia Milan, section I, Judgement, 15 December 2025, n. 4142. Among the many forms in which democracy manifests within the framework of *e-Government*, digital public services are the ones that show the greatest practical impact. One may think of digital healthcare services, or of the importance that access to education services had during the pandemic period, or, again, the chance to express one's vote through digital platforms when far from the designated place. On this topic, see Galetta D.U. (2025), 174 ff.

[86]See Torchia L. (2025), 132.

[87]Among all, it can be considered the institution of *tacit consent*, as a typical case of the exercise of administrative power in the absence of the express adoption of an act with positive or negative content for the addressee within the time limits established by law. See, *ex multis*, Lignani P.G. (1999), 978 ff.

In any event, the reasonableness and proportionality of the digital administrative act remain subject to judicial scrutiny. The administrative judge retains full cognizance over the method used to design the software, the way data are entered, the reliability of the data, and the adequacy of their management.

If, therefore, case law over time has demonstrated a certain sensitivity toward this issue—allowing a first form of regulation of digital public administration to emerge through law in action—the legislative path has proven slower and more complex.

The current challenge for the legislator, already anticipated by judicial interpretation, lies in crafting a regulatory framework capable of fostering the use of technological tools that improve the functioning of the administrative system, which remains composed of both human capital[88] and digital resources. The envisaged regulatory intervention is indispensable for the full achievement of the digital transformation process, but it must evolve in step with the rapid progress of information technologies, so as to achieve an algorithmic procedure in which administrative power is exercised with the same degree of transparency as in traditional forms of public action.

This objective may be achieved provided that a comprehensive regulatory framework is properly developed along three principal axes[89].

Firstly, in light of the fact that principles established by case law remain to be fully implemented, regulatory development should focus on enhancing both the transparency and the accessibility of digital administrative decisions, in parallel with ongoing technological advancement. From a legislative standpoint, this entails establishing a coherent set of rules that clearly delineate the duties of public administrations[90], subject to regular updates, and that provide for effective remedies or sanctions in the event of non-compliance. Such measures are essential to ensure that transparency is not merely formal but substantively effective.

Secondly, attention should be given to broadening access to digital tools and the related public services[91]. Regulation must not only keep pace with technological innovation, but also adopt a more meaningful and structured approach to rule-making, as the current framework appears insufficient and rudimentary. By doing so, it would strengthen both the democratic legitimacy of administrative action and the equitable participation of individuals in the digital public sphere.

With regard to specific instances of algorithmic decision-making, a further solution could consist in promoting the training of the system in such a way that the data it processes are fully consistent with the meaning and conceptual framework of legal language.

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[88]Becker Gary S. (1975). Where the economist uses this expression, it refers to the set of skills and abilities of each individual, which determine their value in the labor market, also in relation to the potential positive contribution they can make to societal development

[89]As mentioned, the efficiency in shaping a satisfying regulatory framework is crucial. Scholars (cf. Bandrés Sanchez-Cruzat J. M. (2023), 182) have also theorized a proper individual right to "good regulation", at least from a supernational perspective, which follows through the right to a good administration.

[90]Specifically for digital measures and in addition to the classic principles, as done in the first place through GDPR in 2016. Cf. Fock A., Siller A.S. (2025); Anand, P. (2025).

[91]The National Recovery and Resilience Plan can somehow be intended as a first approach to the matter in this sense, because it sets out the purpose of digitalizing the public administrations.

Accordingly, the use of new technologies, on the one hand, reshapes the manner in which traditional ways of intending democracy are exercised and, on the other hand, gives rise to new categories of rights[92].

Alongside the indispensable *ex ante* regulation governing the proper use of digital instruments, there must be a constant — and subsequent — oversight activity aimed at verifying the continued compliance with the requirements of legality in the exercise of the digital public function.

Indeed, digitalization should be understood as a means to strengthen the democratic paradigm embodied in the *e-Government* model[93], and not as an end in itself that justifies fleeing the democratic nature of the legal order.

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[92]Cf. Sapienza S. (2024), 89, where the author emphasizes that, with the emergence of new categories of rights, there is a corresponding need to define new forms of vulnerability affecting those same rights. The proposed solution lies precisely in the adoption of both regulatory and technological measures aimed at mitigating aspects of "digital" vulnerability (algorithmic discrimination being a case in point).

[93]See Sheridan W., Riley T.B. (2010), 1.

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Socio-Institutional Challenges in Prosecuting Cyber Fraud in Thailand's Online Banking System

*By Anusara Sawangchai**

Thailand's rapid digitization of financial services has created both opportunities for inclusive access to banking and growing vulnerabilities to cyber-enabled financial crime. This conceptual research study examines the direction of justice in cyber fraud cases within Thailand's online banking environment through the lenses of procedural justice theory and institutional theory. Drawing on empirical reports, legal and regulatory documents, and academic literature, the study identifies gaps in victims' experiences, institutional responses of banks, and law enforcement practices and sets research objectives. It proposes a qualitative triangulated study in three phases (victims, bank managers, and police officers) to probe how legal processes, institutional incentives, and perceptions of fairness shape case outcomes and victims' trust. The analysis discusses the implications for theory and practice, proposes actionable interventions, and outlines limitations and directions for future research. Throughout, the study situates the Thai case in global debates about the governance of online financial crime and the legitimacy of justice institutions in the digital age.

Keyword: *cyber fraud, online evidence, admissibility, online banking, access to Justice*

Introduction

Online banking and mobile financial services have become central to everyday economic life in Thailand. The convenience of digital payment channels and fast interbank transfers has substantially expanded access to financial services, but they have also created new attack surfaces for fraudsters and organized scam networks (Taeratanachai & Wiriyakitjar, 2025). Recent governmental and civil society reports indicate that online and digital scams are a significant and growing problem in Thailand, with thousands of incidents reported and aggregate losses running into the billions of baht annually (Nation, 2023). National-level responses, including draft guidelines by the Bank of Thailand (BOT), enforcement actions to freeze accounts suspected of use as mule accounts, and public campaigns, indicate recognition of the problem, but systemic difficulties in prevention, detection, victim redress, and cross-institutional coordination remain salient (Jenweeranon, 2020). Empirical assessments show that scam operators often move stolen funds within minutes, while victims frequently do not realize losses for many hours, which complicates recovery and law enforcement action. These dynamics expose both technical and institutional weaknesses in Thailand's systemic response to financial cybercrime and raise important questions about the direction of justice, including how victims navigate formal legal pathways, how banks can balance regulatory compliance, customer protection, and operational

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constraints, and how police interpret and implement legal rules in the digital environment (Stefan, 2025). Recent policy interventions by the Bank of Thailand and related authorities signify a shifting landscape, but scholarly understanding of the interplay among victims' experiences, bank institutional behaviour, and law enforcement practices in Thailand's online banking environment remains limited and fragmented (Thongmeensuk, 2025). Existing documentation and reporting provide robust descriptive accounts of the scale and patterns of online fraud in Thailand, as well as policy responses such as draft online fraud management guidelines and account-freezing operations. However, essential gaps remain in scholarly and policy-oriented research. First, much reporting is aggregative and statistical, offering limited insight into victims' lived experiences with reporting, bank remediation, and justice outcomes (such as restitution, criminal prosecution, or administrative relief). Second, although literature on procedural justice and institutional theory offers powerful frameworks for understanding perceptions of legitimacy and organizational behavior, these frameworks have not been systematically applied in the Thai online-fraud context to integrate micro-level perceptions (victims), meso-level institutional practices (banks), and macro-level legal structures (law enforcement and regulators). Third, there is limited qualitative research that triangulates perspectives across victims, banking professionals, and police officers within a single research design to illuminate procedural bottlenecks, institutional incentives, and normative expectations that shape justice trajectories in cyber fraud cases. Finally, the legal and administrative reforms that Thailand has introduced in recent years (including central bank guidelines and tactical enforcement measures against mule accounts) raise novel institutional dynamics and compliance pressures that require empirical investigation to evaluate their effect on procedural fairness and institutional isomorphism in the financial sector. Addressing these gaps is necessary to generate evidence-based reforms that strengthen both the effectiveness and legitimacy of justice processes for online-fraud victims (Tilleke & Gibbins, 2025).

This study sets out to conceptualize how justice is directed in cyber fraud cases in Thailand's online banking environment by synthesizing the literature on procedural justice and institutional theory. Secondly, to identify institutional and legal features that shape victims' experiences and case outcomes. Third, to propose a robust qualitative, triangulated research design to probe victims, bank managers, and police officers empirically. Fourth, to derive theoretical and practical recommendations for improving justice direction, meaning the allocation, accessibility, and perceived fairness of remedial, investigative, and prosecutorial responses to online financial crime.

Literature Review

Online Banking and Cyber Frauds Worldwide

Recent global literature emphasizes that fraud in digital payments, online banking, and related financial technologies has been rising and that institutions are responding with technological, regulatory, and behavioural measures (Laxman et al., 2024). A prominent recent work in the global domain explained by Vanini et al. (2023), this study analyzes transaction data spanning three years, proposing a combined framework of machine learning-based detection, economic optimization of machine learning

decisions, and a risk model that considers countermeasures. The study shows that their machine learning model alone reduces expected and unexpected losses by about 15%, and when combined with optimization and risk modeling, up to 52%, while maintaining very low false positive rates (0.4%). This reflects how more sophisticated detection methods are necessary to manage fraudulent behavior in the digital banking (Vanini et al., 2023). Also relevant study is the explored by Aschi et al., (2022), which discusses the limitations of classical rule-based systems and describes how AI/machine learning based systems are increasingly used to detect risky transactions in real-time, with streaming architectures, data preprocessing, and continuously updated models. This work underscores that even small improvements in fraud detection rates can generate significant savings, given the scale of digital transactions (Chiarella & Borgese, 2025). This review synthesizes three aspects: (a) empirical and policy research on cyber fraud and digital financial crime in Thailand; (b) procedural justice and legitimacy in policing and regulatory contexts; and (c) institutional theory as it applies to organizational responses in regulated environments, such as banks and police forces. Further, the objectives of this study are to map and analyze the procedural steps followed by Thai banks when customers report cyber fraud, including reporting, freezing, investigation, decision, and appeal processes.

Cyber Fraud and Digital Banking in Thailand: Patterns, Impacts, and Institutional Responses

Thailand has experienced an acceleration of online financial crime in line with global trends of increased online financial transactions. Studies and financial reports document a wide spectrum of fraudulent modalities, including online purchase scams, investment frauds, fake job and call-center scams, and account takeovers that exploit both technological vulnerabilities and social-engineering tactics to trick victims into transferring funds (Ingkathawornwong, 2020). Literature on Thailand's perspective indicates significant psychological and social effects on victims, including shame, financial loss, and reduced trust in formal institutions. At the systemic level, the speed with which scammers launder funds through mule accounts and quickly move money across accounts complicates recovery and prosecution (Chayanon et al., 2025). The Bank of Thailand and related agencies have recognized the scale of the problem; in recent years, they have published guidelines and executed large-scale interventions to close suspect mule accounts and propose new online fraud management frameworks for financial institutions. These interventions have included technical measures, regulatory guidance, and operational collaboration with law enforcement, but their effectiveness depends on timely detection, information-sharing, and the willingness of banks to freeze and reverse transactions under legal and reputational constraints (Bank of Thailand, 2023). Academic and practitioner reports stress that prevention and victim recovery require coordination across banks, regulators, and police, but empirical evidence on how these actors actually coordinate and how victims experience those processes is limited (Lertsatitpirote & Kanyajit, 2023).

Several documents highlight the urgency and scale of the problem, including investigative reporting and NGOs' daily reports of hundreds of online fraud incidents, bank supervisory reports note the prevalence of mule accounts and deliberate

laundering conduits, and the BOT has circulated draft guidelines for digital fraud management aimed at harmonizing banks' prevention and response protocols. Nonetheless, statistics also reveal a troubling time-lag problem. Scam operators often complete fund transfers within minutes, while victims may take many hours to detect fraudulent transactions. The asymmetry between attacker speed and institutional response time underscores structural obstacles to recovery and prosecution (Titus & Gover, 2001). The literature, therefore, frames cyber-fraud challenges not only as technical or criminological issues but as institutional coordination problems requiring legal clarity, operational capacity, and procedural fairness to maintain public trust (Zayas, 2023).

Bank Liability Limits and Barriers to Admissibility of Digital Evidence in Thai Courts

Financial institution liability limits in Thailand show a shifting legal landscape where banks are increasingly held responsible for fraud losses, notably in electronic transactions; recent court rulings have placed the burden of proof on financial institutions to demonstrate that the contested transaction was legitimately authorised by the bank, rather than by the customer, marking a substantial shift in the liability balance (Sirawongphatsara et al., 2024). Existing investigations into regulatory frameworks reveal that the Thai authorities (including the Bank of Thailand) are introducing shared-responsibility standards for fraud prevention, requiring banks to identify and limit suspicious digital transfers and to be involved in loss-mitigation measures under a new decree on fraud-prevention (Sirawongphatsara et al., 2023). As for admissibility of digital evidence in Thai courtrooms, legal academics highlight several challenges where the validity of digital evidence must adhere to stringent authenticity and integrity requirements, and the extent to which it is accepted is decided as a function of judicial discretion and technological standards, which adds to the complexity of legal proceedings with respect to cybercrime. In the Thailand context, digital forensic standards and procedures are also still emerging, which poses a challenge in the time needed to collect reliable evidence as well as how the digital information can be admitted into the courtroom. There are significant gaps in the documentation and technology to facilitate liability determination and the evidentiary use of digital records for cyber fraud litigation (Bawornchai et al., 2025).

Cyber-Fraud Complaint Handling Issues in Thailand

Thailand-specific studies confirm these general patterns while adding local institutional detail. Qualitative work involving Thai police investigators and victims found that common fraud types (sale scams, account takeovers via social messaging platforms, and romance and investment scams) are widespread, and that victims' inexperience, over-optimism, and acquisitiveness were repeatedly identified as drivers of victimization. Importantly, interviews with officers revealed they perceive resource and technical gaps when managing high volumes of online fraud complaints, a situation that contributes to victim dissatisfaction and discourages reporting (Lertsatitpirote & Kanyajit, 2023).

From the policing side, international policing literature emphasizes two interrelated problems affecting complaint handling: (1) organizational capacity (skills, digital forensics, case backlog) and (2) procedural legitimacy (how victims experience police response). The study shows that when police lack cyber expertise or show procedural indifference, victim satisfaction falls and future reporting declines, creating feedback that weakens official statistics and hampers prevention efforts (Stephan, 2025). These findings explain why victims in Thailand, facing similarly strained cyber units, may opt for bank dispute channels or third-party recovery efforts rather than lodging police complaints (Curtis & Oxburgh, 2023). Banks in Thailand have responded with a mix of detection/monitoring technologies, customer-notification systems, and coordination protocols with law enforcement and central authorities, such as the anti-online scam operation center and central fraud registry initiatives. Industry and government reports show banks improving automated transaction monitoring and customer outreach. However, academic analyses note tensions between rapid fraud containment, such as account freezes and transaction holds, and consumer rights, including mistaken freezes and delays in customer redress, which damage trust and prompt formal complaints to both regulators and, in some cases, the police. This operational friction the bank's dual role as gatekeeper and service provider shapes how and whether customers escalate incidents to police (Tilleke & Gibbins, 2025).

Theoretical Background

This study integrates procedural justice theory and institutional theory as complementary lenses for understanding the direction of justice in cyber fraud cases. Procedural justice provides the micro-level account of how victims perceive fairness and legitimacy in the handling of their cases. Institutional theory provides meso- and macro-level explanations for why banks and police organizations adopt particular policies and procedures and how coercive, mimetic, and normative forces shape these.

Procedural Justice Theory: Fairness, Legitimacy, and Cooperation

Procedural justice theory argues that individuals' perceptions of the fairness of processes used by authorities, rather than instrumental assessments of outcomes or deterrence, substantially influence their acceptance of decisions, willingness to cooperate with authority, and compliance with rules. Classic contributions from Sunshine & Tyler, (2003) show that when citizens perceive authorities (police, courts, regulators) as procedurally fair through respectful treatment, neutrality, voice, and trustworthy motives, they are more likely to view the institutions as legitimate and to cooperate voluntarily with legal processes (e.g., reporting crimes, providing information, complying with requests) even if outcomes are unfavorable.

Procedural fairness matters in policing because legitimacy can substitute for costly enforcement and fosters trust and information-sharing, which are crucial in complex investigations. In the context of cyber fraud, procedural justice suggests that victims' willingness to report incidents, engage with bank investigation teams, and cooperate with police may be strongly conditioned by how fairly they are treated

during complaint intake, the transparency and timeliness of investigation updates, and perceptions of whether institutions prioritize victim welfare. Conversely, experiences of bureaucratic indifference, blame, or opaque processes can erode trust and discourage cooperation, reducing the likelihood of successful investigation and restitution. Thus, understanding victims' perceptions of fairness and legitimacy is essential to explain case trajectories and designing reforms that incentivize cooperative behavior (Tyler et al., 2015). Applied to the Thai context, procedural injustice can exacerbate underreporting, impede cross-institutional coordination, and hinder asset recovery, producing both social harms (loss of trust) and operational inefficiencies. Empirical work on procedural justice in policing and regulatory interactions emphasizes the causally significant role of perceived fairness. This emphasis transfers readily to digital-fraud contexts where cooperation is crucial to tracing funds across accounts and jurisdictions (Sroeurn & Kohsuwan, 2025).

Institutional Theory: Coercive, Mimetic, and Normative Pressures

Institutional theory explains organizational behavior as a response not merely to efficiency considerations but to pressures for legitimacy and survival in an institutional field. Applied to banks and policing organizations, institutional theory explains why financial institutions might adopt similar compliance and fraud-risk management practices in response to central bank guidance, peer practices, or professional norms among risk managers. It also explains how law enforcement agencies may converge on investigative models due to resource constraints, the diffusion of training programs, or national policy directives. In the digital fraud domain, coercive pressure from regulators, mimetic pressure arising from peer banks' implementation of advanced transaction monitoring, and normative pressure from legal-professional communities can produce isomorphic responses that shape the availability and quality of victim remediation. However, institutional theory also warns that such isomorphic convergence does not guarantee substantive effectiveness. Organizations may adopt similar rituals to signal compliance or legitimacy without materially improving outcomes (Chiarella and Borgese,2025). In Thailand, institutional theory helps analyze how banks and police might align their practices with regulatory templates while facing resource, technical, and legal constraints that blunt effective action. It further illuminates potential conflicts such as banks' risk-avoidance incentives versus customer-protection duties and the legitimacy consequences of formal compliance that do not translate into victims' perceived fairness (DiMaggio & Powell, 1983).

Procedural Justice Theory Applied to Cyber Fraud

Procedural justice theory foregrounds four core elements of fair process: voice (opportunity to be heard), neutrality (impartiality in decision-making), respect (dignified treatment), and trustworthy motives (perception that authorities act with benevolent intentions) (Sunshine & Tyler, 2003). In cyber-fraud cases, victims' access to timely information (voice) during complaint intake and investigation, consistency in bank and police procedures (neutrality), respectful communication by bank officers and police investigators, and the perception that institutions prioritize victim welfare

over institutional convenience shape whether victims report incidents, persist with investigations, and cooperate with evidence collection. Procedural justice affects both subjective outcomes (victims' trust, satisfaction) and objective outcomes (cooperation necessary for investigations). Applied to the Thai context, procedural injustice can exacerbate underreporting, impede cross-institutional coordination, and hinder asset recovery, producing both social harms (loss of trust) and operational inefficiencies. Empirical work on procedural justice in policing and regulatory interactions emphasizes the causally significant role of perceived fairness. This emphasis transfers readily to digital-fraud contexts where cooperation is crucial to tracing funds across accounts and jurisdictions (Sroeurn & Kohsuwan, 2025).

From these theories, the study derives several integrative practices to guide empirical inquiry. First, higher perceived procedural fairness in bank and police interactions predicts greater victim cooperation and higher rates of case escalation to formal investigation. Second, coercive regulatory pressure without adequate resources or clear operational protocols produces isomorphic but superficial compliance among banks, which may not translate to improved victim outcomes. Third, discrepancies between institutional narratives of compliance and victims' experiences would predict reduced trust in both banks and law enforcement and lower reporting rates, thereby creating a negative feedback loop that impedes effective justice.

Integrative Observations and Need for Triangulated Qualitative Research

The literature above converges on several analytical points. First, victims' perceptions of procedural fairness are central to whether they seek and persist with formal justice channels. Second, institutional responses are shaped by regulatory pressure, peer imitation, and professional norms, which may lead to formalized yet uneven practices. Third, the rapid pace of technological change in digital banking creates timing and evidentiary challenges that complicate both institutional responses and perceptions of fairness. A triangulated, phase-based qualitative approach is therefore necessary to illuminate the micro–meso–macro dynamics that determine the direction of justice in cyber fraud cases. The following theoretical framing and proposed methodology respond directly to this need (Lertsatitpirote & Kanyajit, 2023).

Methodology

This study proposes a qualitative, triangulated research design to generate in-depth, contextualized knowledge about how justice is administered in cyber fraud cases. A qualitative approach is suited to exploring perceptions, meanings, and institutional logics that quantitative methods may not capture. The research goal is exploratory and interpretive, seeking to understand how procedural fairness is experienced and enacted and how institutional pressures shape organizational responses. Semi-structured interviews allow open-ended exploration while maintaining comparability across respondents. Document analysis of bank policies, BOT guidelines, and police manuals complements interviews by providing background to stated practices and revealing formal institutional frames. The study aims to use thematic analysis to code interview

transcripts and documents, iteratively developing categories that reflect procedural-justice dimensions (voice, neutrality, respect, trustworthiness) and institutional-theory constructs (coercive, mimetic, and normative pressures). The design foregrounds purposive sampling, semi-structured interviews, document analysis, and thematic content analysis across three phases corresponding to the study's core populations, which are victims, bank managers/staff, and police officers. The research employs a multi-phase, qualitative case study design that triangulates data from three distinct but interconnected stakeholder groups. The number of respondents would depend on the saturation point achievement in the data. Collection process and study objectives.

Phase 1 involves in-depth interviews with victims of digital banking fraud to capture experiences of victimization, reporting decisions, interactions with banks and police, satisfaction with processes, and perceived barriers to justice. The respondents would be selected for interviews from 20 to 25 victims of cyber fraud in Thailand. Phase 2 engages bank managers and frontline staff to elicit institutional policies, decision rationales, perceived legal constraints, and inter-organizational coordination practices. Data would be collected through interviews with 10 to 15 bank officers from major commercial banks in Thailand, based on role and experience. Phase 3 interviews police officers assigned to cybercrime and economic crime units to explore investigative practices, legal interpretations, evidentiary challenges, and perspectives on cooperation with banks and victims. The respondents are 10 to 15 police officers specializing in cyber fraud in Thailand. Each phase includes purposive sampling to ensure diversity of experiences across urban and provincial sites, bank types (large commercial banks and regional banks), and law-enforcement units. The interview would be conducted face-to-face to avoid ambiguity, and it is expected to last 30 to 40 minutes with each interviewee. Firstly, to identify the actual victims, the screening questionnaire will be distributed to the interviewees. Secondly, before data collection, the bank's managers and police officers will be asked to provide the meeting time. Triangulation across stakeholder groups enables the study to identify convergent and divergent accounts, procedural bottlenecks, and institutional incentives shaping case trajectories.

Data Collection Methods

Semi-structured interviews will be conducted in Thai or the participant's preferred language by trained interviewers. Interview guides will be tailored to each population. Still, they will include core modules aligning with the theoretical framework, perceptions of fairness (voice, neutrality, respect, trust), procedural experiences (reporting, timelines, information flows), institutional responsibilities and constraints (legal duties, resource limitations), inter-organizational coordination, and suggestions for reform. Interviews will be audio-recorded (with consent), transcribed verbatim, and anonymized for analysis. Document analysis will include both guidelines and public statements from the Bank of Thailand, internal bank policy documents (where accessible), police procedural manuals, and relevant legal statutes governing money transfers, bank secrecy, and cybercrime procedures. Where possible, observation of complaint-intake processes at bank branches or call centers will be conducted to cross-validate self-reports.

Analytical Strategy

Transcripts and documents will be coded using NVivo software for qualitative analysis, following an iterative coding procedure. Initial codes will derive from theory (procedural-justice elements and institutional pressures), while inductive coding will allow emergent themes (e.g., time lags, technical evidentiary constraints, and fear of reputational harm). Cross-case matrices will be constructed to identify patterns across victims, banks, and police. Special attention will be paid to temporal sequences (when victims report relative to transaction timing), information asymmetries (what banks and police can access and share), and institutional narratives that justify certain practices. The analytic objective is to map the causal pathways by which institutional structures and perceived fairness produce particular justice trajectories ranging from successful recovery and prosecution to stalled investigations and victimization. Further, validity will be enhanced through triangulation, reliability through transparent coding schemes and inter-coder checks, and reflexivity through the documentation of researchers' positionality. Participants will be informed of the study purpose, use of data, and their right to withdraw.

Discussion Based on Documented Literature

The proposed triangulated qualitative study promises to yield a nuanced picture of how justice is directed in Thailand's cyber-fraud cases. Several likely themes emerge from integrating existing literature, policy documents, and the study's conceptual understanding advanced here.

Timing and Evidence Asymmetry: A Cross-Sector Challenge

One pervasive theme is the temporal asymmetry between attacker speed and institutional response. Scammers often move funds within minutes, victims commonly detect loss hours later, banks and police must then act in a compressed time window to freeze and trace funds. This timing challenge creates an asymmetry in evidence. Perpetrators exploit speed and use mule accounts or cross-jurisdictional transfers that fragment transaction trails. Victims and investigators face an uphill battle to produce timely, actionable information. Institutional reforms such as BOT guidelines on digital fraud management and system-level controls on rapid transfers seek to mitigate this but face implementation and legal hurdles (e.g., privacy and transaction confidentiality). The literature and policy reports underscore that without tighter technical and operational coordination and clearer legal channels for rapid data-sharing, many cases will remain unresolved (Zayas, 2023).

Procedural Fairness as an Operational Asset, Not Only a Normative Ideal

Applying procedural justice theory reframes customer service and victim outreach as instrumental to effective investigations. When victims are given a voice, transparent timelines, and respectful communication, they are more likely to provide

corroborating information (multiple device logs, conversations, and screenshots) and to remain engaged throughout lengthy investigations. Conversely, bureaucratic indifference or blaming victims for carelessness can lead to underreporting, withdrawal, and loss of evidentiary leads. These dynamics suggest that improving procedural fairness is not merely normative but operationally productive. It increases cooperation, which in turn raises the probability of successful tracing and recovery. This insight supports investments in victim-facing processes (fraud hotlines, dedicated case managers) as part of the broader anti-fraud architecture. The procedural justice literature supports this causal channel between fairness, legitimacy, and cooperation (Tyler et al., 2015).

Institutional Isomorphism and the Risk of Ritual Compliance

Institutional theory warns that banks and law-enforcement agencies may adopt similar anti-fraud measures in response to regulatory pressure or peer imitation without necessarily solving root problems. For instance, banks may publicize state-of-the-art monitoring tools to signal compliance while failing to integrate processes across customer-facing units and law-enforcement liaison offices. Similarly, police units may adopt cybercrime rhetoric and create specialized units without sufficient training or interagency data-sharing protocols in place. Such ritual compliance can create the appearance of activity while victims continue to experience procedural unfairness and poor outcomes. This critique suggests that regulators and policy-makers should emphasize substantive performance metrics (timeliness of freeze actions, proportion of funds recovered, and victim satisfaction) rather than mere adoption of standard operating procedures (DiMaggio & Powell, 1983).

Legal and Regulatory Complexity: Privacy, Liability, and the Need for Clear Protocols

Legal frameworks governing bank secrecy, personal data protection, and evidence rules can create friction between the need for rapid data sharing and obligations to protect privacy. Banks may be reluctant to release logs without explicit legal authorization. Police may be uncertain about the admissibility of certain digital traces, and victims may be deterred from cooperating due to stigma or fear of retribution. BOT draft guidelines and recent policy measures indicate awareness of these legal tensions, translating guidance into operational protocols requires explicit legal clarifications (e.g., emergency data disclosure mechanisms under judicial or administrative fiat) and safe harbors for banks that share data in good faith with authorized investigators. Without clear legal instruments that balance privacy and investigatory needs, interinstitutional cooperation will remain ad hoc and inconsistent (Tilleke & Gibbins, 2025).

Organizational Incentives and Victim-Centered Metrics

Banks' incentives rooted in reputational risk, operational efficiency, and regulatory compliance can sometimes conflict with victim-centered practices that demand time-consuming case management. For example, immediate freezing of accounts can reduce short-term transaction volumes and lead to customer complaints in wrongful-freeze cases. Conversely, delaying freezes to obtain higher surety can reduce the chances of recovery. Designing incentives that align institutional self-interest with victim outcomes is therefore crucial. Possible mechanisms include regulator-mandated victim-recovery KPIs, supervised central registries to expedite tracing, and liability frameworks that protect banks acting in good faith to freeze funds. The institutional literature implies that coercive regulation (clear rules), normative professionalization (training and standards), and mimetic diffusion (sharing examples of effective models) can jointly encourage substantive improvements rather than token compliance (DiMaggio & Powell, 1991).

Information Asymmetry and the Role of Trust

Trust emerges as a cross-cutting factor. Victims need to trust banks and police to report and cooperate; banks need to trust that sharing data with police will not create regulatory or reputational liabilities; police need to trust that banks' technical traces are reliable and timely. Building inter-institutional trust may require formal mechanisms memoranda of understanding, joint task forces, and legal frameworks that create predictable pathways for collaboration. Procedural fairness contributes to trust by making processes transparent and accountable; institutional reforms can anchor trust by specifying roles and liabilities. Together, these mechanisms can shorten response times, increase cooperation, and improve justice trajectories.

Implications and Contribution of the Study

This study proposes several theoretical contributions. By integrating procedural justice and institutional theory in the context of digital financial crime, the research extends procedural justice scholarship beyond traditional policing and court settings to financial institutions and hybrid regulatory environments. It demonstrates that perceptions of procedural fairness apply equally to corporate actors (banks) when they act as gatekeepers to legal redress. The study also expands institutional theory by showing how rapid technological change interacts with institutional isomorphism. Under uncertainty, mimetic pressures may favor the adoption of similar technical solutions (e.g., transaction-monitoring algorithms) even while organizational routines, customer service, police liaison, and legal disclosure remain heterogeneous. Finally, by emphasizing the temporal dimension (attacker speed vs. institutional response speed), the study adds a dynamic element to both theories, including procedural justice and institutional isomorphism, which must be understood in their temporal contexts, where timing affects both legitimacy and the efficacy of isomorphic practices.

The research suggests several practical recommendations for policymakers, banks, and law enforcement. Establish legally authorized rapid-data pathways and

emergency disclosure mechanisms that balance privacy with investigatory needs. Clear statutory instruments or emergency administrative orders can reduce banks' fear of liability when sharing transaction logs with authorized investigators. Further, institutionalize victim-centered complaint processes within banks, such as dedicated fraud case managers and standardized communication protocols that operationalize procedural-justice principles (voice, respect, neutrality, and transparent motives). Empirical evidence suggests that procedural fairness increases victim cooperation, which is operationally critical. More, develop inter-organizational performance metrics focused on substantive outcomes (time to freeze, proportion of funds recovered, victim satisfaction), and publish aggregated performance indicators to create accountability and drive improvement beyond superficial compliance. Another recommendation is to create joint task forces or liaison units with clear roles and standard operating procedures between banks and police to reduce time lags and evidentiary frictions. These units should include technical specialists who can translate bank logs into usable investigative leads. Further, to provide targeted training for police and bank staff on digital evidence, conversational interviewing of victims (trauma-informed methods), and legal frameworks to reduce procedural injustice arising from victim-blaming and misinformation. The other recommendation is to encourage the central bank to continue and refine its digital-fraud guidance through stakeholder consultation, emphasizing both technical measures and victim-protection obligations, and to consider a central fraud registry to expedite tracing and pattern detection measures, consistent with BOT draft initiatives already in circulation.

Implementing these recommendations requires coherent governance and political will. However, combining legal clarifications, procedural reforms, and institutional incentives increases the probability that victims will experience timely, fair, and effective justice.

Limitations and Future Research Directions

This conceptual study proposes a qualitative, triangulated empirical design but also acknowledges limitations that future research should address. First, the proposed qualitative design emphasizes depth over breadth, and findings would be richly contextual yet not statistically generalizable. Complementary quantitative studies, large-scale victim surveys, administrative data analyses of complaint outcomes, and cross-bank performance benchmarking would strengthen external validity and enable causal inference about the effectiveness of specific reforms. Second, access constraints may limit the availability of internal bank documents or in-depth police case studies due to confidentiality and reputational concerns. Building partnerships with banks and law-enforcement agencies, including data-sharing agreements that protect privacy while enabling research access, will be necessary. Third, the rapidly evolving nature of technology and criminal tactics means that any empirical snapshot may quickly become dated. Longitudinal research that tracks changes over time, particularly following policy interventions such as BOT guidelines or legislative reform, would provide stronger evidence on reform efficacy. Fourth, cross-jurisdictional dynamics (offshore mule-account networks, international money movements) are increasingly central to digital fraud. Future research should incorporate comparative and transnational perspectives, including regional flows and cooperation with foreign law enforcement.

Finally, while this study focuses on Thailand, comparative work across jurisdictions with different legal traditions and banking sectors would illuminate how institutional configurations shape the direction of justice in varied contexts, thereby refining theoretical generalizations.

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