The Proposal of an AI Policy Maturity Model

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***Abstract*— Artificial Intelligence (AI) technologies pose a governance challenge, critical to which is the recent introduction of the Artificial Intelligence Act (AIA) by the European Commission. This research proposes an AI Policy Maturity Model to understand the differences of European Union (EU) Member States approaches. We conducted a review of national AI policy instruments across 26 EU countries, focusing on their alignment with AIA's requirements. The results highlight a heterogeneous landscape within Member States, which our model distinguishes into four groups from Emerging to Leading levels. France and Spain emerge as examples of proactive policy implementation. Our proposed AI Policy Maturity Model offers insights into AI policy within the EU, emphasizing the need for a harmonized regulatory framework and continuous policies that can keep pace with AI advancements and promote European development in AI.**

Keywords— Artificial Intelligence, AI Policy, AI Governance

I. Introduction

As Artificial Intelligence (AI) enters various sectors, its transformative impact intertwines with complex challenges, requiring nuanced governance structures to harness its ethical potential [1], [2], [3]. Given the vast implications of AI, its deployment is not without its ethical and risk challenges [4], [5], [6].

European Union (EU) Member States present different approaches to AI governance, with some just beginning the introduction of domestic policy and others already having established robust AI governance structures[7]. The introduction of the Artificial Intelligence Act (AIA) by the European Commission (EC) signals a paradigmatic shift towards a harmonized regulatory landscape [8]. The AIA, with its risk-based classification of AI systems, detailed stipulations for high-risk AI, and an extensive regulatory ambit, represents an effort to harmonize AI governance across Member States [9]. This legislative framework requires conformity assessments for high-risk AI systems, encompassing rigorous procedures for testing, inspection, and certification, thereby bridging the gap between legal mandates and market entry [9], [10], [11].

Despite the AIA's approach, studies examining existing EU regulatory frameworks such as the General Data Protection Regulation (GDPR)[12] unveil a landscape riddled with inconsistencies, fragmented policies, and disparate enforcement levels across Member States [13], [14]. These conclusions emphasize the reactive nature of prevailing regulations and call into question the adequacy of the Member States policy frameworks to meet the AIA's requirements.

The multifaceted interactions among diverse stakeholders and institutions further intensify the design of governance systems for emergent disruptive technologies like AI. The concept of governance, particularly within high-interaction environments, requires structured interplays between institutional frameworks, clarifying roles and responsibilities across the regulatory domain [15], [16], [17], [18].

The effectiveness of the regulatory framework laid out by the AIA is dependent on the level of enforcement carried out by the Member States. The institutional behaviors, which are influenced by their historical trajectories, play a fundamental role in determining the success of the AIA's implementation. [19], [20], [21], [22].

This research examines such differences, questioning whether the Member States have the necessary governance competencies to fulfill the AIA's requirements. The paper draws on a body of literature, highlighting the multifaceted nature of AI governance that extends beyond technical oversight, encompassing legal, ethical, societal, and economic dimensions[1], [2], [23], [24], [25], [26], [27]. This study proposes an AI Policy Maturity Model [28], comparing the national AI policy instruments implemented across the EU countries. The analysis encompasses a comprehensive review of AI policy instruments, including certification schemes, testing methodologies, and regulatory instruments, reflecting each country's readiness for ethical and effective AIA deployment, gathering national AI strategies, and drawing upon the EC-OECD database of national AI policies, from 26 EU countries.

Through employing the proposed model, the study unveils insights into the state of AI governance within the EU Member States. While some countries demonstrate robust governance structures and AI policy initiatives, others exhibit significant gaps, thus revealing a heterogeneous landscape among EU Member States. Our proposal groups countries into maturity levels—Emerging, Developing, Moderate, and Leading—according to their ability to respond to the AIA based on their national AI policies.

This model may act as a guiding framework for Member States at different stages of AI policy development, aligning them with the AIA's objectives, highlighting areas of strength, and revealing critical gaps that could hinder the effective implementation of the AIA. This understanding is crucial for EU policymakers and stakeholders involved in the development and deployment of AI technologies.

II. Literature Review

In the evolving landscape of AI policy, the EU's AIA emerges as a case study, aiming to balance innovation and regulation. In 2021, the EC introduced the AIA, which sets out

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a regulatory framework for AI technologies in the EU [8]. One of the principal aspects of the AIA is its risk-based approach, which categorizes AI systems into different levels of risk: unacceptable, high, limited, and minimal. Based on these classifications, it imposes specific regulatory requirements [8]. This approach ensures public interests and ethical standards are upheld, addressing concerns like fundamental rights, safety, and societal impact of AI[8]. The AIA establishes clear standards for data quality, transparency, and accountability in AI development and usage. Central to this discussion is the interaction between rapid technological progress and policy responses.

The policy process is often lagging due to technological determinism [29], where technology development is seen as an autonomous force that shapes society independent of deliberate human control or policy intervention. This is relevant to AI, where the rapid pace of innovation can surpass the ability of regulatory bodies to understand and govern its implications [18], [21].

The rapid development of emerging technologies that have the potential to disrupt the economy and society poses significant challenges for governance and regulation[30], [31], [32], [33]. These technologies require a more flexible and dynamic regulatory approach that can address the challenges they pose [34]. Traditional policy frameworks often fail to do this, highlighting the need for new and innovative approaches to regulation [30].

Regulatory responses to emerging disruptive technologies are characterized by a combination of incremental changes and critical junctures: incremental changes within existing frameworks, facilitates the gradual integration of new developments, while comprehensive regulatory revisions are necessary at critical junctures [35].

The dynamic nature of emerging disruptive technologies requires a flexible approach to regulation and standard setting [36]. As technologies evolve, so must the regulatory frameworks and standards governing them, requiring continuous reassessment and adaptation. This adaptive approach involves a broad range of stakeholders, including industry experts, regulators, and consumer representatives, to ensure comprehensive and effective policymaking [37].

The EU's diverse regulatory landscape, due to historical policy trajectories, poses challenges in harmonizing regulation policies across Member States[38], [39]. The theory of path dependence suggests that policy decisions are significantly influenced by preceding actions in a particular direction [20], [40]. The aforementioned theory is relevant in the context of the institutional approach to AI governance, as historical precedents within Member States are likely to shape their responses to EU-wide regulations such as the AIA. It is crucial to understand the adaptive processes Member States may undergo when integrating the AIA into their national policies. This perspective, grounded in the influence of historical processes [41], underscores the significance of past decisions in shaping current institutional behavior [19], [20], [42], [43].

Therefore, pre-existing structures and norms within Member States influence the implementation of the AIA. This theoretical framework considers the preparedness of EU Member States to enact new regulations and adapt to policy changes. It encompasses various aspects such as institutional robustness, the capacity for legal enforcement, administrative effectiveness, and the historical trajectory of policy adoption within Member States [19], [20], [51]. In this context, this paper will look at the structural and procedural dimensions of Member States' AI national policies.

III. PROPOSAL FOR AI POLICY MATURITY MODEL

In this section, we propose an AI Policy Maturity Model for assessing the alignment of EU Member States for implementing the AIA. Maturity models, originally developed for improving organizations' capabilities[44], are now fundamental in assessing and guiding policy and governance structures. These models, tracing back to the Capability Maturity Model (CMM) [45], provide structured pathways for improvement across various domains, including policy implementation. In the context of AI, they assess an organization's readiness and capability to harness AI benefits, guiding the enhancement of AI strategies and practices [46], [47], [48]. This approach is particularly relevant for aligning national AI policies with the objectives of the AIA, a regulatory framework proposed by the EC to ensure ethical, secure, and human-centric AI development across the EU.

Our study conducts a detailed examination of 26 EU countries from the EC-OECD database on national AI policies, as compiled by the OECD AI Policy Observatory [49]. This database provides a thorough overview of AI policy frameworks across various countries, emphasizing their approaches and policy instruments in response to AI's transformative impact. We concentrate on two main categories of policy instruments: Governance Policy Instruments, and Guidance and Regulation Policy Instruments (Table I).

Within the Governance Policy Instruments, we analyze a range of policy instruments, that play important roles in ensuring compliance with the AIA and promote the ethical and responsible implementation of AI technologies. Each of these policy instruments has a distinct impact and serves specific functions within the broader framework of AI governance. "*AI coordination and monitoring bodies*" are instrumental in ensuring that national AI initiatives align with AIA requirements. These bodies are important for maintaining compliance and staying up-to-date on ongoing AI developments, in line with AIA principles. "*National strategies, agendas, and plans*" are fundamental for overarching direction and commitment. These strategies form the foundation for aligning national AI initiatives with the principles of the AIA, encompassing aspects such as ethical standards, transparency, and public accountability. "*Public consultations with stakeholders or experts*", though important for inclusiveness, are vital for stakeholder engagement and ensuring a broad-based approach to AI policy development. In addition, we consider the social aspect of "*Regulating labor mobility and incentives*". These regulations promote sustainable integration by guiding the adoption and utilization of AI technologies in the workforce.

Within the scope of Guidance and Regulation Policy Instruments, we analyze various policy instruments. "*Emerging AI-related regulations*" are important for overarching direction and commitment. These regulations are indispensable for establishing a comprehensive regulatory framework, ensuring AI technologies are developed and utilized in alignment with EU standards[50]. "*Regulatory oversight and ethical advisory bodies*" play a vital role in maintaining trust and ethical alignment in AI development and

use, aligning with the core objectives of the AIA. "*Standards and certification for technology development and adoption*", ensures interoperability and safety [51]. These standards and certifications verify that AI technologies meet the safety, interoperability, and reliability standards stipulated by the AIA.

Lastly, the presence of a regulatory governmental body is integral to overseeing AI governance and ensuring compliance with AIA regulations, playing a key role in the broader framework of AI policy development within the EU.

To operationalize the proposed framework, we assign scores to each policy instrument within the governance and guidance and regulation policy groups (Table I). These scores reflect the impact of each instrument on AI policy maturity, with higher points indicating greater significance.

In developing a binary presence (1) or absence (0) approach for evaluating each policy instrument within the Member State. It focuses on the foundational aspect of policy instrumentation - whether a particular policy instrument is in place. The aggregate (1) for each country determines their category, offering a nuanced understanding of their AI policy landscape.

$$Score_i = \Sigma_{j=1}^{n} P_{ij} \quad (1)$$

Where, $Score_i$ represents the total score for country i_i. This score is the sum of points for all the policy instruments assessed for that country. P_{ij} denotes the points assigned to policy instrument j_j for country i_i. These points are indicative of the significance and impact of each policy instrument in the context of the country's maturity and alignment with AIA requirements. Each country will be scored based on the number of policy instruments implemented from each category, n_n is the total number of policy instruments evaluated.

TABLE *I.* AI POLICY INSTRUMENT IMPACT ASSESSMENT

Policy Instruments	**Impact**	**Description**
AI co-ordination and/or monitoring bodies	High Impact (2 points)	These bodies are essential for ensuring that national AI initiatives are in line with AIA requirements, facilitating compliance, and monitoring ongoing AI developments.
AI use in the public sector	High Impact (2 points)	The integration of AI in public sector operations is a key indicator of a country's commitment to implementing AI responsibly and ethically, as advocated by the AIA.
National strategies agendas and plans	Crucial for overarching direction and commitment (3 points)	These strategies are foundational for aligning national AI initiatives with the AIA's principles, including ethical standards, transparency, and public accountability.
Public consultations of stakeholders or experts	Important for inclusiveness but less direct impact (1 point)	While fundamental for inclusiveness and stakeholder engagement, these consultations have a more indirect impact on the concrete implementation of AIA guidelines.
Emerging AI-related regulation	Crucial for overarching direction and commitment (3 points)	Essential for a regulatory framework. The development of AI-specific regulations is critical to meet the compliance requirements of the AIA, ensuring that AI technologies are developed and used in a manner that aligns with EU standards.
Labor mobility regulation and incentives	Important for long-term sustainability but less immediate impact (1 point)	These regulations are important for the sustainable integration of AI into the labor market, a concern addressed by the AIA, but they have a more gradual impact on immediate AI readiness.
Regulatory oversight and ethical advice bodies	High Impact (2 points)	Important for trust and ethical alignment. These bodies play a crucial role in maintaining ethical standards in AI development and use, a core objective of the AIA.
Standards and certification for technology development and adoption	High Impact (2 points)	Critical for interoperability and safety. Standards and certifications ensure that AI technologies meet the safety, interoperability, and reliability standards stipulated by the AIA.
Regulatory governmental body	Crucial for overarching direction and commitment (3 points)	Integral for overseeing AI governance and ensuring compliance with AIA regulations.

Policy instruments are scored based on their impact and relevance. The cumulative score places each country within a specific category. This approach offers an evaluation of AI policy implementation across the EU. A scoring system is devised, where each policy instrument is assigned a point value based on its perceived impact.

$$Proportion_i = \frac{Score_i}{MaxScore} \quad (2)$$

Where, $Proportion_i$ represents the proportion of points achieved by country i_i. This is a measure of how much of the potential maximum score a country has attained, providing an indicator of its relative position in terms of AI policy implementation. $Score_i$ the total score for country i_i, as previously calculated by summing the points for all policy instruments evaluated for that country. $MaxScore$ refers to the maximum possible score that a country can achieve, which is based on the full implementation of all policy instruments. This value sets the benchmark against which each country's score is compared.

The proportional scoring system (2) calculates the proportion of total points achieved by each country, providing a relative measure of AI policy implementation, thus allowing for a comparative policy analysis across Member States. This proportional score allows for comparative analysis across Member States, considering the varying levels of policy instrument implementation. It offers a standardized way to assess the position of each country relative to the state of full policy instrument implementation. By using this proportion, we can categorize countries, providing a clear and objective overview of the AI policy landscape in the EU.

This system involves calculating the ratio of achieved to maximum possible points and converting this ratio into a point system, where each level receives assigned points. The resulting coefficient, derived from the points ratio, falls within

a specific interval on the function curve, categorizing Member States into appropriate maturity levels.

Each level is assigned a specific interval on (3). For example, a country with a proportion xx falling within a certain interval range on the curve will be classified into a corresponding level. The exact intervals would be determined based on the distribution of categories, to ensure a fair and meaningful classification across the spectrum from *Emerging* to *Leading* countries.

$$f(x) = e^{ax+b} \quad (3)$$

The assignment system places the cumulative scores within an interval range of respective levels, from *Emerging* (zero) to *Leading* (fourth level) (Table II). To classify areas into appropriate levels, we establish ranges of intervals for classification using (3).

TABLE II. AI POLICY MATURITY MODEL LEVELS

Maturity Level	Point Rage
Emerging	0-5 points
Developing	6-10 points
Moderate	11-15 points
Leading	16- 20 points

This methodology provides a structured, quantifiable approach to assess the AI policy maturity of EU Member States. It enables a clear, objective evaluation of AI governance, aligning with the objectives of the AIA.

The AI Policy Maturity Model underwent a validation process to ensure its reliability and applicability. Initially, the model was evaluated by experts in AI policy, regulation, and governance to affirm its theoretical foundations and practical relevance. Their critical examination led to necessary refinements in the model's design and metrics, aligning it with current policy challenges and governance needs. Moreover, to ensure its data-driven approach, the OECD AI Policy dataset was validated for accuracy, timeliness, and representativeness by cross-referencing it with national databases and policy documents.

IV. OVERVIEW OF NATIONAL AI POLICIES IN EUROPEAN UNION COUNTRIES

The AI Policy Maturity Model allows for comparative analysis across AI policies in EU Member States (Image I).

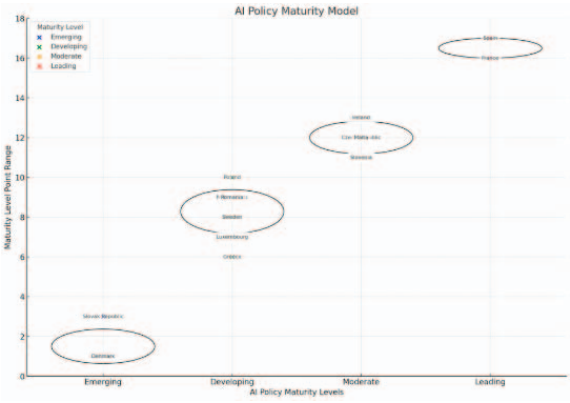

Fig. 1. *AI Policy Matury Model*.

At the Emerging level, countries such as Croatia, Cyprus, Denmark, and the Slovak Republic are characterized by their foundational stage in AI policy strategies. Their engagement with Governance Policy instruments is minimal, indicating early steps toward establishing AI governance structures. The lack of specific AI-related Guidance and Regulations Policy instruments in these countries, presents considerable challenges. This shortfall implies that AI technologies may not be developed or employed following the requisite ethical and legal standards, posing risks to responsible and ethical AI deployment.

Almost half of the EU Countries are at the Developing level, including Austria, Belgium, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Romania, and Sweden, demonstrating a proactive approach to AI policy implementation. These Member States have adopted essential Governance Policy instruments, integrated AI use in the public sector, and established some level of AI-related Guidance and Regulations Policy instruments. They actively engage in "*Public consultations of stakeholders or experts*", reflecting an inclusive approach to AI policymaking.

Moving to the Moderate level, Chez Republic, Estonia, Finland, Germany, Portugal, and Slovenia showcase significant advancement in AI policy maturity. They have not only adopted most Governance Policy instruments but also enacted comprehensive AI-related regulations. This dual approach reflects a robust commitment to overseeing AI responsible development and deployment. These Member States have established "*National Strategies Agendas and Plans*" that guide their AI initiatives, ensuring ethical standards and accountability.

The Leading countries, France, and Spain, demonstrate the highest degree of AI policy maturity within the EU, integrating a comprehensive and proactive approach to AI policy development. These countries have instituted robust "*AI Coordination and Monitoring Bodies"*, integrated AI into public sector operations, and provided a clear roadmap for alignment with ethical standards and public accountability.

Spain's comprehensive approach to AI governance is marked by several strategic initiatives and structures, particularly important for establishing a National Supervisory Authority for AI. The Spanish Agency for Artificial Intelligence (AEI) is a regulatory body that monitors AI development and ensures compliance with ethical norms. The agency's establishment highlights Spain's proactive stance in integrating ethics into its AI trajectory, fostering a robust framework within which AI-driven innovations must operate.

While certain EU Member States like France and Spain have exhibited comprehensive readiness and proactive implementation of AI policies, others remain at the emerging stages, with significant developments needed to establish complete and effective AI policy frameworks. The disparities in AI policy maturity across the EU underscore the need for a unified and integrated approach to AI governance. For countries at the Emerging and Developing levels, there is a clear imperative to enhance their AI Governance Policy instruments, ensuring the ethical deployment of AI technologies.

Therefore, Leading and Moderate countries are well-positioned to assume the AIA's regulatory responsibilities, others may struggle due to less strategic focus on AI policy formulation. This harmonization is not merely about consolidating various policies but also formalizing governance infrastructures that will facilitate the rigorous testing and validation of AI technologies, ensuring their alignment with future ethical and operational standards indicated in AIA.

Moreover, as the upcoming EU regulation on the use of AI systems is complex and stipulates many demanding obligations, preparing organizations for regulatory requirements is inevitable [8], [43]. Taking a proactive role, like in Spain, building the required competencies and formalized governance structure early on, and establishing a strong AI policy framework can not only ensure legal compliance but also generate business value.

The EU, as a collective, stands with disparities in readiness presenting potential obstacles to the unified implementation of the AIA. To navigate this, there will need to be a concerted effort at the EU level to strengthen the governance capacities of less-prepared Member States and foster greater harmonization in regulatory approaches. This is essential to ensure that the transformative potential of responsible and ethical AI is utilized throughout the EU.

V. CONCLUSION

Drawing from the literature, it is evident that the rapid evolution of AI technologies requires a governance framework that is both adaptive and comprehensive. However, the AI Policy Maturity Model highlighted significant disparities in AI national policies across the EU. While countries like France and Spain demonstrate advanced stages of AI policy maturity, others show limited progress. The current EU landscape, reveals a certain degree of fragmentation among the policies implemented, suggesting that while individual efforts are commendable, there is a discernible lack of a unified approach.

This fragmentation among Member States precipitates a fragmented digital marketplace, creating barriers to entry for AI enterprises. This heterogeneity can lead to significant disparities in how AI technologies are developed, deployed, and regulated, creating uneven competitive conditions, and impacting the overall efficiency and innovation capacity of the EU. A fragmented landscape may result in supply chain inefficiencies, as companies navigate variable regulatory compliance requirements across borders, thereby hindering the global competitiveness of EU-based AI firms.

Understanding the economic implications of a fragmented landscape of AI policies and varying levels of AIA enforcement across the European Digital Market is fundamental. Future research can identify specific areas where policy fragmentation is most detrimental to the economic growth and competitiveness of the EU. Through addressing the economic implications of fragmented AI policies and varying AIA enforcement levels, the EU can better position itself, fostering an environment that promotes innovation, economic growth, and sustainable development within its AI sector.

The AI Policy Maturity Model proposed here can provide a structured framework for understanding the state of AI governance within the EU. Given the continuous evolution of AI and its increasing integration across various sectors, the importance of robust, well-harmonized AI governance frameworks is paramount.

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