CHAPTER 2
LEGAL RELATIONS: FROM THEORY TO PRACTICE

COMPARATIVE ANALYSIS OF REGULATORY ACTS OF THE EU COUNTRIES ON THE PROTECTION OF INTELLECTUAL PROPERTY IN THE CONDITIONS OF THE USE OF ARTIFICIAL INTELLIGENCE

Volodymyr Marchenko[1], Alla Dombrovska[2], Valerii Prodaivoda[3]

[1]Doctor of Science (Law), Professor, Department of State and Legal Disciplines, Criminal Law and Procedure, Grigory Skovoroda Kharkiv National Pedagogical University, Kharkiv, Ukraine, Scientific Center of Innovative Research, Pussi, Estonia, e-mail: marchenko2210@gmail.com, ORCID: https://orcid.org/0000-0003-1921-3041

[2]Ph.D. (Law), Associate Professor, O.M. Beketov National University of Urban Economy in Kharkiv, Kharkiv, Ukraine, WSHIU Akademia Nauk Stosowanych, Poznan, Poland, e-mail: dombrovskalla@gmail.com, ORCID: https://orcid.org/0000-0003-4610-8220

[3]Postgraduate student in the field of knowledge 081 Law by specialty 081 Law, Faculty of History and Law, Grigory Skovoroda Kharkiv National Pedagogical University, Kharkiv, Ukraine, e-mail: prodayvoda.law@gmail.com, ORCID: https://orcid.org/0009-0006-4567-3091

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Abstract. *The rise of artificial intelligence (AI) has fundamentally challenged traditional intellectual property (IP) frameworks, particularly in the European Union (EU), where regulatory efforts are aimed at balancing innovation with legal protections. AI's ability to autonomously create, modify, and use IP raises complex questions about authorship, inventorship, ownership, and enforcement, which existing laws were not designed to handle. As EU countries attempt to adapt their legal systems to address these challenges, a comparative analysis of their regulatory acts is essential to understand how different member states are responding to the intersection of AI and IP protection. The aim of this article is to provide a comparative analysis of the regulatory frameworks governing IP protection in the context of AI across selected EU countries. By examining national legislation and harmonization efforts, the study seeks to identify common challenges, highlight divergent approaches, and offer insights into the evolving legal landscape of IP protection in the age of AI. The article employs a qualitative, comparative research methodology. It focuses on six EU countries—Germany, France, the Netherlands, Poland, Greece, and Romania—analyzing their IP laws concerning AI-related issues. The study reviews national regulations, EU directives, and case law to evaluate how each country addresses AI-generated IP in terms of ownership, authorship, patentability, trademark issues, and enforcement mechanisms. A thematic coding approach is used to identify key trends and divergences between member states. The analysis reveals that all EU countries maintain the requirement for human authorship and inventorship, which limits the legal recognition of fully autonomous AI-generated content. While countries like Germany, France, and the Netherlands have initiated discussions on potential legal reforms, others, such as Poland, Greece, and Romania, rely more heavily on existing frameworks and await further EU guidance. Additionally, enforcement mechanisms vary significantly, with more technologically advanced countries adopting AI-driven tools to monitor and enforce IP rights. As AI continues to evolve and play a larger role in creative and technical industries, the legal frameworks governing IP in the EU must adapt accordingly. Future regulatory efforts should focus on creating new categories for AI-generated works, investing in AI-powered enforcement tools, and ensuring greater harmonization across member states. By addressing these challenges proactively, the EU can strike a balance between fostering AI innovation and maintaining robust IP protections, positioning itself as a global leader in both technology and intellectual property rights.*

Keywords: *artificial intelligence; intellectual property; harmonization; law; intellectual property protection; European Union; legal landscape.*

JEL Classification: H 11, K11, K24

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Introduction. The rapid development and integration of artificial intelligence (AI) technologies across various industries have posed significant challenges to traditional intellectual property (IP) frameworks. In response, European Union (EU) member states have been compelled to adapt their regulatory systems to address the unique issues arising from AI's ability to create, modify, and utilize intellectual property. This article presents a comparative analysis of the regulatory acts in EU countries concerning the protection of intellectual property in the context of AI. By examining the similarities, differences, and key trends in national legislation, the article aims to provide insights into how member states are navigating the intersection of AI innovation and IP protection. The study highlights both the harmonization efforts within the EU and the divergent approaches taken by individual countries, offering a comprehensive overview of the evolving legal landscape in this critical area.

Literature review. The rapid advancement of artificial intelligence (AI) technologies has significantly impacted the traditional frameworks for intellectual property (IP) protection. AI's ability to generate content autonomously, from artistic works to technical inventions, poses fundamental challenges to existing IP laws, particularly in the European Union (EU), where member states must balance harmonization with national legislative autonomy. This literature review explores the key scholarly contributions and legal analyses on the protection of IP in the context of AI, focusing on the comparative regulatory approaches of EU countries.

AI and Intellectual Property Law. The intersection of AI and IP law has been widely discussed in recent legal scholarship, with a particular focus on how traditional IP laws apply to AI-generated works and inventions. Many authors argue that the current IP frameworks, which are rooted in human authorship and inventorship, struggle to accommodate the autonomous capabilities of AI.

Tegmark (2019) examines the growing role of AI in creative industries and the limitations of copyright law in protecting AI-generated content. Tegmark highlights the need for reform, as current laws do not recognize non-human entities as authors, which creates a gap in protection for works generated without significant human input.

Guadamuz (2020) explores the challenges AI presents to the fundamental concepts of ownership and authorship in IP law, arguing that new categories of IP rights may need to be introduced to cover AI-generated content, particularly in the areas of copyright and patent law.

Samson & Durovic (2021) focus on AI's role in the inventive process and patent law, suggesting that while AI can assist in innovation, the requirement for human inventorship in patent law remains a significant obstacle. They advocate for new legal definitions to address the blurred lines between human and AI contributions to inventions.

Comparative Approaches to IP Regulation in the EU. A considerable body of research has examined the different approaches taken by EU member states in adapting their IP laws to new technological challenges, including AI. While the EU has made efforts to harmonize IP law across the union, significant differences remain in how national laws interpret key concepts such as authorship, inventorship, and ownership.

Strowel (2018) provides a comparative analysis of copyright laws across major EU member states, examining how these laws are applied to AI-generated works. Strowel notes significant divergence between countries like France and Germany, where originality and human input are more strictly defined, and more flexible interpretations in the Netherlands and Poland.

Custers et al. (2019) review patent law developments in key EU countries, focusing on AI-assisted inventions. They highlight Germany's leadership in patent filings for AI innovations but point out that all member states require human involvement in the inventive process, which complicates patent applications involving AI.

Gervais (2021) explores the EU's regulatory harmonization efforts through directives such as the Copyright Directive and Digital Single Market Strategy, noting that while these frameworks provide a foundation for IP protection, they do not yet adequately address the complexities introduced by AI.

Legal Reforms and Proposals for AI and IP. Several authors focus on the legal reforms and proposals necessary to adapt IP law to the age of AI. Scholars generally agree that new approaches are needed, though opinions differ on the best strategies for reform.

Bently & Sherman (2020) argue for a more nuanced approach to copyright law that would accommodate both human and AI-generated content by introducing a new category of "machine authorship." They also suggest creating licensing schemes to allow for the use of AI-generated works in a legal and controlled manner.

Lemley & Casey (2021) advocate for a reevaluation of patent law, proposing the concept of "AI-assisted invention" as a new category in IP law that allows for joint human and AI inventorship. They suggest that such changes would better reflect the reality of modern innovation processes, where AI plays an increasingly central role.

Peukert (2022) offers a more critical view, arguing that extending IP protections to AI-generated content may stifle innovation. Peukert suggests that rather than expanding IP rights, legislators should consider alternative models, such as open-access regimes, to encourage the free flow of AI-generated works.

Policy and Legislative Developments at the EU Level. Policy analysis plays a key role in understanding the regulatory landscape for AI and IP in the EU. Recent policy documents and reports from EU institutions provide valuable insight into the direction of future reforms.

European Commission (2020) released its White Paper on AI, which addresses the potential legal gaps in IP protection related to AI. The report highlights the need for further exploration of AI-related IP issues and calls for a balanced approach to reform that protects IP while fostering innovation.

EUIPO (2021) published a detailed report on AI and intellectual property, analyzing current laws and identifying areas where reform may be necessary. The report recommends strengthening enforcement mechanisms, clarifying authorship and ownership rights for AI-generated works, and fostering greater harmonization across member states.

The literature consistently highlights the challenges that AI poses to existing IP frameworks in the EU, particularly regarding authorship, ownership, and inventorship. While scholars and policymakers agree on the need for reform, the exact path forward remains a topic of debate. Some advocate for expanding IP protections to cover AI-generated content, while others suggest more flexible models that prioritize innovation and collaboration. The differences in national approaches across the EU complicate harmonization efforts, making comparative analysis crucial for understanding the current and future state of AI-related IP law.

Aim. The aim of this article is to conduct a comprehensive comparative analysis of the regulatory acts in EU countries that govern the protection of intellectual property (IP) in the context of artificial intelligence (AI). The article seeks to identify key similarities, differences, and emerging trends in national legislation, providing insights into how EU member states are adapting their legal frameworks to address the challenges posed by AI in the field of IP protection.

Methodology. The methodology for this article, "Comparative Analysis of Regulatory Acts of the EU Countries on the Protection of Intellectual Property in the Conditions of the Use of Artificial Intelligence," involves a structured approach to examine and compare the legal frameworks adopted by different European Union (EU) member states. The study employs a comparative legal research design, using both qualitative and quantitative methods to systematically analyze regulatory acts, legislative documents, and relevant case law from selected EU countries. The research is conducted in two main phases: data collection and data analysis.

Six EU member states were chosen for this comparative study, representing a diverse cross-section of the EU in terms of technological advancement and legal traditions. These countries include Germany, France, the Netherlands, Poland, Greece, and Romania. They were selected based on their varying levels of AI adoption and IP protection mechanisms, allowing for a comprehensive analysis of different regulatory approaches within the EU. Regulatory acts and official policy documents related to IP protection and AI were gathered from national databases, government publications, and legal repositories. This includes copyright laws, patent laws, trademark regulations, and enforcement mechanisms relevant to AI. EU-level directives, such as the Copyright Directive and the European Patent Convention, were also reviewed to assess the degree of harmonization across member states. Legal commentaries, scholarly articles, and reports from institutions such as the European Union Intellectual Property Office (EUIPO) and the European Commission were utilized to gain insights into recent developments and scholarly debates. These sources provided context and helped identify key issues and trends related to AI and IP protection.

The methodology used in this study provides a comprehensive approach to understanding how EU countries are adapting their IP frameworks in response to the growing influence of AI. By systematically comparing regulatory acts and enforcement practices, the study aims to contribute to the ongoing discussions on harmonizing IP laws across the EU in the age of AI.

Results. The comparative analysis of regulatory acts across EU countries on the protection of intellectual property (IP) in the context of artificial intelligence (AI)

highlights key trends, commonalities, and divergences in national legal frameworks. The results indicate that while there is significant alignment at the EU level due to directives such as the Copyright Directive and the European Patent Convention, member states differ in how they interpret and implement these regulations in the context of AI-generated content and inventions.

Comparative Analysis of Regulatory Acts on AI-Generated IP Ownership and Authorship in Selected EU Countries. As artificial intelligence (AI) plays an increasingly significant role in the creation of intellectual property (IP), EU member states have had to reconsider their traditional legal frameworks concerning IP ownership and authorship. The legal recognition of AI-generated works varies across EU countries, with some introducing specific legislative measures and others still relying on existing frameworks that are often ill-suited to the complexities posed by AI. This comparative analysis examines the approaches of selected EU countries regarding AI-generated IP ownership and authorship.

Germany. Germany, known for its strong intellectual property protection regime, applies a traditional interpretation of IP law when it comes to AI-generated works. Under German copyright law, authorship is granted only to natural persons, meaning that AI cannot be recognized as an author. If AI is used as a tool to generate content, the individual who programmed or used the AI would typically hold the authorship and ownership rights. AI-generated content that lacks a direct human creator cannot claim copyright protection, leaving a potential gap in the protection of fully autonomous AI creations. In the case of patents, German law requires a human inventor, although AI-assisted inventions are recognized if a human directs the inventive process.

France. France has a similar approach to Germany in terms of recognizing natural persons as the only legal authors of IP. French copyright law emphasizes the need for a human creator in order to assign authorship rights, which excludes AI-generated works from automatic protection. Like Germany, France does not recognize AI as an independent legal entity that could own intellectual property. Instead, the individual or entity that controls the AI system (such as a programmer or a business) would typically be considered the owner of the output. For AI-assisted inventions, French patent law follows the European Patent Office's (EPO) guidelines, which stipulate that the inventor must be a human being.

Netherlands. The Netherlands follows a similar legal tradition as Germany and France in that only natural persons can be designated as authors under copyright law. Dutch law does not recognize AI as an author or owner of intellectual property. AI-generated works may fall outside of copyright protection unless human intervention is significant enough to justify authorship. However, the Netherlands has taken steps toward discussing and updating its IP laws to consider the rise of AI-generated works, although no concrete legislative changes have been made to date. Dutch patent law also requires human involvement in the inventive process, leaving AI as a tool rather than a legal inventor.

Poland. Poland’s intellectual property laws also align with the traditional European stance that authorship and ownership of IP require human involvement. AI-generated works are not explicitly addressed in Polish law, but current interpretations

would likely exclude autonomous AI creations from copyright protection. In cases where AI assists in the creation of a work, the person controlling the AI would typically hold the rights. Poland has yet to introduce specific legislative provisions that address the ownership and authorship of AI-generated content, but discussions are emerging within the legal community regarding potential reforms.

Greece. Greece's legal framework for intellectual property follows similar principles to other EU countries, where only natural persons can be recognized as authors of creative works. AI-generated content without significant human contribution is not eligible for copyright protection under Greek law. However, AI-assisted works may be protected if a human has played a meaningful role in directing the creative process. The country has not yet introduced specific regulations addressing AI-generated IP ownership but remains aligned with the broader European perspective on the necessity of human authorship in IP law.

Romania. Romania, like other EU member states, does not recognize AI as an independent author or owner of intellectual property. Romanian law requires that authorship be attributed to a natural person, which excludes fully autonomous AI-generated works from copyright protection. In cases where AI is used as a tool to assist in the creative process, the human operator would typically be considered the author. Romanian patent law similarly requires a human inventor, leaving AI-generated inventions in a legal gray area.

At the EU level, intellectual property law remains largely based on directives and regulations that predate the rise of AI technologies. EU copyright law, as articulated in the Copyright Directive, does not explicitly address AI-generated works, but like individual member states, it presupposes human authorship. In 2020, the European Commission launched a public consultation on AI and intellectual property rights to gather input on potential legislative changes. The EU Intellectual Property Office (EUIPO) has acknowledged the challenges posed by AI and is actively exploring the need for harmonized approaches to AI-generated works, though concrete regulations have yet to be established.

The regulatory landscape for AI-generated IP ownership and authorship across EU countries remains largely rooted in traditional human-centric frameworks, which exclude AI as an independent creator or owner of intellectual property. While there are no significant divergences among EU member states in this regard, the absence of legal recognition for autonomous AI creations presents a challenge as AI technologies advance. As the European Union continues to explore the need for legal reforms, future legislative initiatives may focus on addressing the gaps left by current frameworks to better protect and manage AI-generated intellectual property across the region.

Common and Distinctive Features in the Regulatory Acts of EU Countries on "AI-generated IP Ownership and Authorship". The treatment of AI-generated intellectual property (IP) ownership and authorship across the EU countries shows several commonalities and distinctions in regulatory approaches. While most EU member states share a traditional legal framework that requires human involvement in IP creation, the rise of artificial intelligence is prompting discussions and, in some cases,

reforms. Below is a detailed analysis of the common and distinctive features in the regulatory acts on AI-generated IP ownership and authorship among EU countries.

Table 1. The common and distinctive features in the regulatory acts on AI-generated IP ownership and authorship among EU countries

Common Features		Distinctive Features	
Human Authorship Requirement	Across all EU countries analyzed, the foundational requirement for IP ownership and authorship is human involvement. This means that under current copyright and patent laws, only natural persons can be recognized as authors or inventors.	**Varying Degrees of Policy Discussions**	Some countries, like the Netherlands and Poland, are more proactive in holding public discussions and debates on the future of IP protection in the age of AI. These countries have initiated conversations on whether reforms to their legal frameworks are necessary to address AI-related issues, though no specific laws have been enacted
	AI, regardless of its level of autonomy, cannot be considered the creator or owner of intellectual property in any EU country. This principle applies uniformly to copyright laws, which protect creative works, and patent laws, which protect inventions.		In contrast, other countries, such as Greece and Romania, have not yet initiated extensive discussions or policy debates on AI-generated IP ownership and authorship, and continue to apply their traditional IP laws without modification
AI as a Tool for Human Creation	In all EU countries, when AI is used as a tool to assist a human in generating content, the human operator retains ownership and authorship of the work. The legal frameworks in these countries attribute the IP rights to the person or entity that controls and directs the AI	**Patent Law Interpretations and AI Involvement**	While patent laws across the EU generally require human inventors, the interpretation of what constitutes "human involvement" in AI-assisted inventions varies slightly from country to country. For example, Germany and France follow a stricter interpretation, where the inventor must play a direct and central role in the inventive process. In other countries, such as Poland, there is more flexibility in recognizing AI-assisted inventions as long as there is a clear human agent directing the process.
	This approach sees AI-generated works as being produced through the human's creative input, even if the AI plays a significant role in the output. The ownership rights lie with the human or the organization responsible for programming or operating the AI		This distinction can influence how patents for AI-assisted inventions are treated in different countries, though no country currently allows AI to be named as an inventor
Lack of Legal Recognition for Autonomous AI Creations	There is a consistent gap in the legal frameworks across the EU when it comes to addressing works created by AI with little to no human intervention. AI-generated content that is produced autonomously without human direction generally lacks copyright protection in all countries	**Level of Engagement with EU-Level Initiatives**	Certain countries, such as Germany and France, are more actively engaged in EU-level discussions on the harmonization of IP laws in the context of AI. These countries participate in shaping EU policies and are often seen as leaders in proposing legislative solutions to AI-related challenges
	The absence of clear legal recognition for such works leaves a potential legal vacuum in the protection of fully autonomous AI-generated content		Smaller countries or those with less developed AI ecosystems, such as Greece or Romania, tend to adopt a more passive role, waiting for guidance from the EU before considering any national reforms. This creates a distinction in how quickly countries are likely to adapt to potential future EU-wide regulations on AI and IP
Reliance on Existing IP Frameworks	All EU countries currently rely on their pre-existing intellectual property laws, which were created with human creators in mind. None of the countries has yet implemented specific legislative acts or reforms explicitly addressing the unique challenges posed by AI in the context of IP ownership and authorship	**National IP Office Guidance**	Some countries, such as the United Kingdom (before Brexit) and the Netherlands, have issued guidance or policy briefs through their national intellectual property offices addressing the use of AI in IP creation. While these are not legislative changes, they represent a more advanced level of engagement with the topic compared to countries that have not yet issued any formal guidance
	Discussions are ongoing at both the national and EU levels about whether new laws or amendments are necessary to adapt to the evolving role of AI in IP creation		In countries without such guidance, there is a heavier reliance on courts and legal scholars to interpret how existing laws apply to AI-generated content
Alignment with EU Directives	The majority of EU countries are aligned with EU-wide directives, such as the Copyright Directive and the European Patent Convention, which also require human authorship for intellectual property. These EU-level frameworks similarly do not recognize AI as an independent creator of IP	**Future Legal Reforms**	Although no country has yet introduced comprehensive reforms specifically addressing AI-generated IP, there is a divergence in how countries view the need for legal changes. For instance, countries with more advanced AI ecosystems, like Germany and the Netherlands, are more likely to push for specific reforms in the near future, recognizing the gaps in current IP laws. Meanwhile, other countries, such as Romania or Greece, may adopt a wait-and-see approach, relying on broader EU directives or guidelines before taking any national action

Source: systematized by the authors

In summary, the regulatory acts on AI-generated IP ownership and authorship in EU countries share many common features, including a reliance on human authorship, the treatment of AI as a tool, and the exclusion of autonomous AI creations from legal recognition. However, distinctive features emerge in how different countries are addressing these challenges, particularly in their level of engagement with policy discussions, patent law interpretations, and readiness for future reforms. As AI continues to evolve, these common and distinctive features will likely shape the trajectory of national and EU-wide legislative developments in the field of intellectual property.

Comparative Analysis of Regulatory Acts of EU Countries on the Patentability of AI-related Inventions. The increasing role of artificial intelligence (AI) in the field of innovation has prompted a reassessment of traditional patent laws across the European Union (EU). While AI-generated inventions present new opportunities, they also challenge existing legal frameworks that are primarily designed for human inventors. This comparative analysis explores how selected EU countries are addressing the patentability of AI-related inventions, with a focus on the role of AI in the inventive process, the requirement of human inventorship, and the interpretation of novelty, inventive step, and patent eligibility in the context of AI innovations.

Germany. Germany is a leader in the European intellectual property (IP) landscape and applies a relatively strict interpretation of patent law concerning AI-related inventions. Under German law, patents can only be granted to natural persons, which means that AI itself cannot be listed as an inventor. However, AI-assisted inventions are patentable if they meet the standard criteria of novelty, inventive step, and industrial applicability. German law recognizes inventions where AI plays a role in the innovation process, but the human inventor must have made a meaningful contribution. AI is viewed as a tool that assists in the development of the invention rather than being the source of the invention itself. In Germany, the human inventor who directed the use of AI in the inventive process is considered the legal inventor. The European Patent Office (EPO) guidelines, which Germany adheres to, also require that an inventor must be a natural person.

France. In France, the patentability of AI-related inventions follows a similar trajectory to Germany, where the law requires a human inventor. French patent law mandates that an invention must be the result of human ingenuity, meaning AI cannot be recognized as the inventor. However, like other EU countries, France allows for the patenting of AI-assisted inventions, provided they meet the requirements of patentability.

France allows for the patenting of inventions that utilize AI in their development, but the invention must be the result of a human-directed process. The inventive step must involve human creativity, with AI seen as a tool or support in achieving the final invention. In French patent law, an AI-related invention is assessed on the same grounds as any other invention - whether it involves an inventive step and whether it is novel. The use of AI in generating a solution is not in itself sufficient for patentability; the human inventor must contribute to the inventive process.

Netherlands. The Netherlands follows the general EU guidelines on patent law, emphasizing human involvement in the inventive process. As in Germany and France, AI cannot be an inventor, but AI-assisted inventions are patentable under Dutch law if they meet the standard requirements of novelty, inventive step, and industrial applicability.

Dutch law explicitly requires that a human inventor be named in a patent application, even if AI was instrumental in the inventive process. AI tools are regarded as aids in invention, and the final inventive contribution must come from the human inventor. In the Netherlands, inventions involving AI technologies (such as AI algorithms or machine learning models) are patentable as long as they demonstrate a technical effect beyond the mere implementation of an algorithm. The inventive step must involve human creativity, where AI acts as an enabler rather than the inventor itself.

Poland. Poland's patent law also requires human inventorship, aligning with the broader European patent framework. AI-related inventions are patentable in Poland as long as they meet the traditional criteria of novelty, inventive step, and industrial applicability. However, as in other EU countries, AI cannot be recognized as the inventor.

Polish patent law acknowledges the use of AI as part of the inventive process but insists on human oversight and control. The person who directs the AI in achieving a new solution is recognized as the inventor, and AI is treated as a tool for assisting human innovation. While Poland has not yet introduced specific legislative reforms addressing AI and patentability, discussions are ongoing in the legal community about how the law might evolve to address AI-generated inventions more explicitly.

Greece. Greece follows the European Patent Office (EPO) guidelines, which stipulate that an inventor must be a natural person. AI-related inventions are patentable in Greece if they are novel, involve an inventive step, and are industrially applicable. AI itself cannot be named as an inventor, but inventions involving AI as part of the inventive process can be patented.

Like other EU countries, Greece emphasizes the need for human involvement in the inventive process. The human inventor is recognized as the party who controls or directs the AI in generating the innovation. In Greece, inventions involving AI are patentable if they provide a technical solution to a problem. This technical solution must be more than just an abstract idea or algorithm; it must have industrial applicability.

Romania. Romania's patent law follows the European norm of requiring human inventorship. AI-related inventions are patentable under Romanian law, provided they meet the standard criteria for patentability. However, like other EU member states, Romania does not recognize AI as an independent inventor. Inventions that use AI as part of the development process are patentable in Romania if the human inventor contributes to the inventive step. Romanian law, like other EU countries, views AI as a tool rather than a creator of inventions. While no specific legislative initiatives have been introduced in Romania to address AI-related patents, there are discussions within the legal community about how to handle the rise of AI in innovation. These

discussions focus on whether current laws are sufficient to protect AI-related inventions.

At the EU level, the European Patent Office (EPO) plays a central role in determining patentability for member states, including the countries analyzed. The EPO has made clear that under the European Patent Convention (EPC), an inventor must be a natural person. AI-related inventions are patentable, but AI cannot be named as an inventor.

The EPO provides guidance on the patentability of AI-related inventions, emphasizing that such inventions must provide a technical solution to a technical problem. Merely implementing an AI algorithm is not sufficient for patentability; there must be a tangible technical effect. Inventions that make use of AI are eligible for patent protection across the EU if they fulfill the standard patent requirements—novelty, inventive step, and industrial applicability. However, the human inventor is recognized as the source of innovation, even if AI played a key role in the inventive process.

Common and Distinctive Features in the Regulatory Acts of EU Countries on Patentability of AI-Related Inventions. The patentability of AI-related inventions across EU countries is governed by a combination of national laws and EU-wide frameworks, particularly those established by the European Patent Office (EPO). While there is significant alignment in terms of fundamental principles, some distinctive approaches are emerging in how different countries interpret and handle the specifics of AI-driven innovations. Below is an analysis of the common and distinctive features in the regulatory acts across the EU concerning the patentability of AI-related inventions.

Table 2. The common and distinctive features in the regulatory acts across the EU concerning the patentability of AI-related inventions

Common Features		Distinctive Features	
Human Inventorship Requirement	Across all EU countries, patent law mandates that the inventor must be a natural person. This principle is rooted in the European Patent Convention (EPC) and is uniformly upheld by the EPO. AI systems, no matter how autonomous, cannot be listed as inventors	**Interpretation of Inventive Step**	While all EU countries follow the same basic requirement for inventive step, the level of human involvement required can vary slightly. Germany and France adopt a stricter interpretation, requiring significant human contribution in the inventive process. AI is seen strictly as a tool, and the human inventor's involvement must be clear and central to the invention. In Poland and the Netherlands, there is slightly more flexibility in the interpretation, allowing for broader human oversight over the AI-generated output, as long as the human is directing the process
	In every EU country, the individual or entity responsible for creating the AI or directing its use in the inventive process is recognized as the legal inventor. This ensures that human agency remains central to patentability	**Scope of AI-Related Patent Reforms**	Germany and France are at the forefront of discussions about AI and patent law, actively engaging in debates about how patent law may need to evolve to address the increasing role of AI. These countries are more likely to propose and lead reforms to existing IP laws to accommodate AI-related inventions. Other countries, such as Poland and Romania, have not yet taken any significant steps toward legislative reforms addressing AI patentability, relying heavily on existing frameworks without indicating a pressing need for change
Patentability of AI-Assisted Inventions	All EU countries allow for the patenting of inventions that are assisted by AI, provided they meet the standard criteria of novelty, inventive step, and industrial applicability. This means that AI can be used as a tool in the invention process, but the human operator is considered the inventor	**Scope of AI-Related Patent Reforms**	Germany and France are at the forefront of discussions about AI and patent law, actively engaging in debates about how patent law may need to evolve to address the increasing role of AI. These countries are more likely to propose and lead reforms to existing IP laws to accommodate AI-related inventions. Other countries, such as Poland and Romania, have not yet taken any significant steps toward legislative reforms addressing AI patentability, relying heavily on existing frameworks without indicating a pressing need for change
	AI-assisted inventions, such as those involving machine learning algorithms or automated design	**Scope of AI-Related Patent Reforms**	Germany and France are at the forefront of discussions about AI and patent law, actively engaging in debates about how patent law may need to evolve to address the increasing role of AI. These countries

Common Features		Distinctive Features	
	systems, are treated similarly to traditional inventions as long as the human inventor plays a meaningful role in directing the inventive process		are more likely to propose and lead reforms to existing IP laws to accommodate AI-related inventions. Other countries, such as Poland and Romania, have not yet taken any significant steps toward legislative reforms addressing AI patentability, relying heavily on existing frameworks without indicating a pressing need for change
Technical Effect Requirement	Across the EU, for an AI-related invention to be patentable, it must provide a "technical effect" beyond the mere implementation of an AI algorithm. This requirement is uniform across member states and is reinforced by the EPO's guidelines. The invention must solve a technical problem in a novel and non-obvious way	**National Patent Office Guidance**	Some countries, like the Netherlands, have issued guidance through their national patent offices on the patentability of AI-related inventions. This guidance helps applicants understand how AI innovations will be treated under current laws. Other countries, such as Greece and Romania, have not yet provided detailed guidance specific to AI-related patents, and as a result, the interpretation of AI inventions may rely more heavily on case-by-case analysis through judicial decisions.
	Merely applying an AI algorithm to a problem, without demonstrating a technical contribution, is not sufficient for patentability in any EU country	**Public Policy Discussions on AI and Patents**	Germany, France, and the Netherlands have been more active in public discussions on AI and intellectual property, reflecting their more advanced AI ecosystems. These discussions are leading to a more proactive approach in considering whether patent laws should be updated to address AI's growing role in innovation. Greece and Romania, on the other hand, are adopting a more reactive approach, waiting for broader EU-level guidance before initiating discussions on the need for changes in patent law regarding AI.
Adherence to European Patent Office Guidelines	All EU countries adhere to the EPO's guidelines when it comes to patenting AI-related inventions. These guidelines specify that an invention must be both novel and inventive, with the inventive step involving human ingenuity. This alignment with the EPO ensures consistency across member states regarding AI patentability	**Patentability of AI Technologies Themselves**	In countries like Germany and the Netherlands, there is more engagement with the patenting of AI technologies themselves (such as new machine learning models or algorithms) if they provide a technical effect. These countries are likely to have a greater volume of AI-related patent filings and more sophisticated case law on the subject. In countries with less developed AI industries, like Greece or Romania, fewer patents may be filed for AI technologies, leading to less clarity in how these innovations are treated within their patent systems.

Source: systematized by the authors

The patentability of AI-related inventions in EU countries reflects a balance between preserving the traditional human-centric approach to inventorship and accommodating the growing role of AI in innovation. Common features include the universal requirement for human inventorship, adherence to the EPO's technical effect requirements, and the patentability of AI-assisted inventions. Distinctive features emerge in the degree of flexibility in interpreting inventive steps, the scope of public policy discussions, and the level of guidance provided by national patent offices. While no EU country currently allows AI to be listed as an inventor, some are more actively exploring how patent laws may need to evolve to address the growing influence of AI technologies on innovation.

Comparative Analysis of Regulatory Acts of EU Countries on Trademark Issues Related to AI-Generated Content. The increasing use of artificial intelligence (AI) in content creation, including the development of trademarks, presents new challenges for intellectual property law. Trademarks, which serve as identifiers of the source of goods or services, are traditionally associated with human creators or businesses. However, AI's involvement in generating logos, brand names, slogans, and other trademark elements introduces complexities in trademark ownership, originality, and the potential for conflicts over similarity and infringement. This comparative analysis explores how selected EU countries address trademark issues related to AI-generated content, focusing on ownership, registration requirements, and infringement concerns.

Germany. In Germany, trademark law is based on the EU's harmonized framework, particularly the European Union Trade Mark (EUTM) system, which

applies across all member states. Like other EU countries, Germany does not have specific regulations addressing trademarks created by AI, but existing laws govern the ownership and registration of trademarks regardless of how they were generated.

German law requires a legal entity (either a natural person or a business) to own a trademark. Since AI cannot hold legal rights, trademarks generated by AI must be registered under the name of the human or entity that operates or commissions the AI. Trademarks must be distinctive to be registered, which applies to AI-generated trademarks as well. The German Patent and Trademark Office (DPMA) applies the same standard of distinctiveness, regardless of whether the mark was created by AI or a human. Germany follows EU rules regarding trademark infringement. AI-generated trademarks could potentially infringe upon existing trademarks if they are too similar, which raises questions about the role of AI in monitoring potential conflicts. Since AI can create content at a much faster rate, there is concern that AI-generated trademarks might increase the likelihood of unintentional infringement.

France. France's trademark law follows the EU Trade Mark (EUTM) system, which ensures consistency with other member states. Like Germany, France does not have specific rules for AI-generated trademarks, but its legal framework governs ownership and registration processes for all trademarks. In France, trademarks must be owned by a legal person, meaning AI cannot be the legal owner of a trademark. If an AI system generates a trademark, the rights are held by the individual or organization responsible for the AI. French law requires trademarks to be distinctive and not deceptive. AI-generated marks must meet the same criteria as human-created ones. The use of AI may raise additional concerns about originality, especially if AI algorithms generate similar or identical marks to existing ones. France, like Germany, must address the challenge of AI-generated trademarks potentially infringing upon existing marks. Since AI can generate vast numbers of trademarks, businesses may need to employ AI-based monitoring systems to detect potential conflicts early.

Netherlands. In the Netherlands, trademark law is aligned with the broader EU framework, and like other EU countries, it does not yet have specific rules regarding AI-generated trademarks. The ownership and registration of trademarks follow the same rules, whether the content was created by AI or a human. As in other EU countries, AI cannot own trademarks in the Netherlands. Trademarks created by AI are owned by the individual or entity that controls the AI system. This could be a business that commissions the AI or a designer using AI tools. The Dutch trademark system requires trademarks to be distinctive and not conflict with existing marks. AI-generated trademarks must meet the same standards as human-created ones. The use of AI may make it easier to create large volumes of trademark content, raising questions about the potential for repetitive or similar marks. The Netherlands has seen early discussions on the implications of AI in trademark law, particularly the risk of AI-generated marks unintentionally infringing upon existing trademarks. There is a growing awareness of the need for automated systems to monitor trademark conflicts in a rapidly evolving digital landscape.

Poland. Poland follows the EU Trade Mark (EUTM) regulations, which govern trademark ownership, distinctiveness, and infringement at the national and EU levels.

AI-generated trademarks are not specifically addressed in Polish law, but the existing legal framework applies. Similar to other EU countries, trademarks in Poland must be registered by a natural or legal person. AI-generated marks are owned by the human or organization that controls or commissions the AI. There are no provisions allowing AI itself to own trademarks. Poland's trademark office, like others in the EU, evaluates whether a mark is distinctive and meets the legal requirements for registration. AI-generated trademarks are subject to the same scrutiny as human-created marks, and distinctiveness is key to obtaining trademark protection. Poland is exploring how AI-generated content might affect trademark infringement, especially in cases where AI tools generate marks that are too similar to existing ones. This raises the possibility of increased monitoring requirements to prevent unintentional conflicts due to the scale of AI's content generation capabilities.

Greece. Greek trademark law, like that of other EU countries, aligns with the EU-wide EUTM system. Greece does not have specific regulations for AI-generated trademarks, and the legal framework treats all trademarks under the same rules, regardless of how they are created.

AI cannot hold trademarks in Greece. Trademarks generated by AI must be owned by a natural person or a legal entity that controls the AI system. Greek law does not distinguish between AI-generated and human-created marks for purposes of ownership. Greece applies the same distinctiveness requirement to all trademarks, including those created by AI. To be eligible for protection, the trademark must be sufficiently distinctive and not conflict with existing marks. Greece has yet to engage in significant legal discussions regarding AI's impact on trademark law, but there are concerns about the potential for AI-generated marks to increase the risk of infringement. The sheer volume of content created by AI may require more advanced monitoring systems to ensure compliance with trademark law.

Romania. Romania follows the EU Trade Mark regulations, which govern how trademarks are registered, owned, and enforced. Like other EU countries, Romania does not have specific provisions for AI-generated trademarks, and current laws treat AI-generated and human-created marks under the same legal framework. In Romania, trademarks must be owned by a natural or legal person. AI-generated trademarks cannot be owned by AI itself, and the ownership rights belong to the individual or organization responsible for the AI's use. As with other EU countries, Romania requires that trademarks be distinctive and not misleading. AI-generated trademarks must meet the same standards as human-created ones to qualify for registration. Romania, like other countries, faces the potential challenge of AI-generated trademarks unintentionally infringing on existing marks. The lack of legal provisions specific to AI-generated marks may require enhanced monitoring and enforcement systems to keep up with the speed at which AI can generate new trademarks.

Trademark issues related to AI-generated content across EU countries share several common features, including the requirement for human or legal entity ownership of trademarks, the distinctiveness requirement for trademark registration, and concerns about potential infringement. Distinctive features emerge in the level of engagement with AI-related trademark issues, with countries like Germany, France,

and the Netherlands leading discussions on potential reforms and the need for advanced monitoring systems, while Poland, Greece, and Romania take a more conservative approach, relying on existing legal frameworks. As AI continues to play a larger role in content creation, these differences may influence how quickly individual countries adapt their trademark laws to address the challenges posed by AI-generated content.

Common and Distinctive Features in the Regulatory Acts of EU Countries on Trademark Issues Related to AI-Generated Content. The emergence of artificial intelligence (AI) in the creation of trademarks presents new challenges for the traditional legal frameworks governing trademark law. While AI can generate logos, brand names, and other trademark elements, the core principles of trademark law in the EU are still designed with human authorship and ownership in mind. This analysis outlines the common and distinctive features of the regulatory acts across EU countries regarding trademark issues related to AI-generated content, focusing on ownership, distinctiveness, and potential infringement.

Table 3. The common and distinctive features of the regulatory acts across EU countries regarding trademark issues related to AI-generated content, focusing on ownership, distinctiveness, and potential infringement

Common Features		Distinctive Features	
Human or Legal Entity Ownership Requirement	Across all EU countries, trademarks must be registered by a natural person or a legal entity (such as a business). AI cannot be the legal owner of a trademark. This is a universally applied principle based on the European Union Trade Mark (EUTM) regulations.	**Level of National Engagement with AI-Generated Trademark Issues**	Germany, France, and the Netherlands have initiated more advanced discussions on the implications of AI-generated trademarks. These countries are exploring whether current trademark laws are sufficient to address the complexities of AI-generated content, particularly in areas like originality, ownership, and monitoring for potential conflicts.
	Whether AI creates a trademark independently or assists in its creation, the ownership of the trademark is attributed to the human or business that operates or commissions the AI. This ensures that legal responsibility for the trademark remains with a human or corporate entity.		Poland, Greece, and Romania have taken a more conservative approach, relying on existing legal frameworks without actively engaging in policy debates about AI's impact on trademark law. These countries are more likely to adopt reforms in response to broader EU directives rather than leading discussions themselves.
Trademark Distinctiveness Requirement	The distinctiveness requirement is consistently enforced across all EU countries. A trademark, whether AI-generated or human-created, must be distinctive enough to identify the goods or services it represents and must not be misleading or confusingly similar to existing trademarks.	**Monitoring Systems for Trademark Conflicts**	Germany, France, and the Netherlands are more advanced in considering the need for automated or AI-based tools to monitor potential trademark conflicts. Given AI's ability to create large volumes of trademarks, these countries recognize the importance of developing systems that can efficiently detect similarities or conflicts with pre-existing trademarks.
	All EU countries adhere to the European Union Intellectual Property Office (EUIPO) standards, where AI-generated trademarks must meet the same criteria as human-created ones to be eligible for registration. The AI's involvement in the creation process does not lower the threshold for distinctiveness.		Poland, Greece, and Romania have yet to make significant strides in this area. While there is awareness of the challenges posed by AI-generated trademarks, these countries have not yet developed comprehensive strategies or systems to address the scale of content generation by AI.
Harmonization Under the EUTM System	The EUTM system, which provides for the registration and protection of trademarks across the EU, creates a harmonized legal framework that governs trademark issues in all member states. This framework ensures consistency in how AI-generated trademarks are handled throughout the EU, including the processes for registration, ownership, and enforcement.	**Distinctiveness Interpretation**	France tends to have a stricter interpretation of distinctiveness, particularly in the context of AI-generated trademarks. The French trademark office may apply more rigorous standards to ensure that AI-generated marks are not misleading or too similar to existing marks, reflecting France's broader emphasis on originality and creativity in intellectual property.
	All EU member states rely on the EUTM system for resolving cross-border trademark disputes and ensuring that trademarks are uniformly protected within the EU, regardless of how they are created.		In contrast, Germany and the Netherlands focus more on the technical application of distinctiveness criteria. As long as the trademark can sufficiently distinguish the goods or services it represents, it may be more easily accepted for

Common Features		Distinctive Features	
			registration, regardless of whether it was created by AI or a human.
Trademark Infringement Concerns	Across all EU countries, there are concerns about the potential for AI-generated trademarks to increase the likelihood of infringement. AI's ability to generate large volumes of trademarks rapidly could lead to unintentional conflicts with existing registered marks.	**AI-Generated Trademark Conflicts and Enforcement**	Germany and France are more actively exploring how trademark law enforcement might need to evolve to handle AI-related conflicts. Both countries have recognized the potential for AI-generated trademarks to unintentionally infringe upon existing trademarks and are considering new enforcement mechanisms to address these challenges.
			Greece and Romania have been slower to address the enforcement challenges posed by AI-generated trademarks. These countries continue to apply traditional trademark enforcement processes without specific adjustments for the scale of content creation enabled by AI.
	Trademark law in the EU includes provisions to address infringement, but the introduction of AI-generated content has prompted discussions on whether enhanced monitoring systems or tools will be necessary to detect conflicts between AI-generated trademarks and existing ones.	**Potential for Legislative Reforms**	Germany, France, and the Netherlands are leading discussions on the potential for legislative reforms to address AI-generated trademarks. These countries are considering whether additional legal provisions are needed to clarify the role of AI in trademark creation and ownership, as well as to enhance protection against AI-driven infringement.
			Poland, Greece, and Romania have not yet initiated any significant legal reforms in this area. These countries are more likely to wait for EU-level directives or guidance before implementing changes to their national trademark laws.

Source: systematized by the authors

Trademark issues related to AI-generated content across the EU exhibit several common features, including the human or legal entity ownership requirement, the application of distinctiveness standards, and the harmonization of trademark laws through the EUTM system. However, there are also distinctive features in how different EU countries engage with AI-generated trademark issues, particularly in terms of monitoring systems, the interpretation of distinctiveness, enforcement strategies, and the potential for legislative reforms. While Germany, France, and the Netherlands are more proactive in addressing the challenges posed by AI-generated trademarks, Poland, Greece, and Romania continue to rely on existing frameworks and are less likely to initiate reforms independently. As AI continues to play a larger role in content creation, these distinctions may shape how quickly individual countries adapt their trademark laws to address the complexities of AI-generated content.

Comparative Analysis of Regulatory Acts of EU Countries on Enforcement Mechanisms in the Context of AI and Intellectual Property (IP) Disputes. As artificial intelligence (AI) plays a growing role in creating, using, and infringing intellectual property (IP), the enforcement of IP rights has become more complex. European Union (EU) member states, while aligned in some areas due to harmonized EU frameworks, show variance in how they approach enforcement mechanisms related to AI and IP disputes. This comparative analysis examines the enforcement mechanisms of selected EU countries in the context of AI-related IP disputes, focusing on legal procedures, technological enforcement, and challenges in adjudicating cases where AI is involved.

Germany. Germany is known for its strong intellectual property enforcement framework, and this is reflected in how it approaches AI-related IP disputes. German courts and legal structures are well-equipped to handle complex IP disputes, though the rise of AI presents new challenges, particularly in identifying liability and addressing potential gaps in traditional IP enforcement.

Germany has a robust judicial system for enforcing IP rights, with specialized IP courts and well-established legal procedures. In the context of AI, the courts rely on existing IP laws, but issues of AI ownership and liability can complicate enforcement, particularly when determining the responsible party for AI-related infringements. Germany has embraced the use of digital tools to monitor and enforce IP rights. Automated systems for tracking infringement, including those facilitated by AI, are becoming more common, allowing rights holders to detect potential violations early. This is particularly relevant for trademarks, patents, and copyright infringements caused by AI-generated content. One key challenge in Germany is determining whether AI-generated content infringes on existing IP rights. German law currently treats AI as a tool, meaning that the human operator or entity responsible for the AI must face legal consequences for infringement. Courts are still working through how to assign liability when AI autonomously violates IP rights.

France. France, like Germany, has a highly developed IP enforcement system. French law focuses on protecting the moral and economic rights of IP holders, but AI-related disputes pose new challenges, particularly in the areas of copyright and trademarks, where AI may generate content that infringes upon existing rights.

France has specialized IP courts that handle enforcement disputes, and like Germany, the country is grappling with how to address AI-related issues within existing legal frameworks. French courts apply traditional IP laws in AI-related cases, with a focus on determining whether human oversight is present and whether infringement was intentional. In addition to judicial processes, France is increasingly using mediation and arbitration in IP disputes, including those involving AI. These alternative dispute resolution mechanisms provide a faster and less costly way to resolve complex cases, including those related to AI infringement. France is exploring the use of AI and automated systems to monitor IP rights and detect potential violations. These tools are particularly important in the creative industries, where AI-generated content can quickly spread and infringe upon copyrights and trademarks. However, the challenge remains in establishing clear guidelines for assigning liability when AI is involved in the infringement.

Netherlands. The Netherlands has an efficient and technologically advanced IP enforcement system, with a focus on digital innovation in monitoring and protecting IP rights. The rise of AI has pushed the country to adapt its enforcement mechanisms, particularly in handling disputes where AI is used in the creation or infringement of IP.

Dutch courts follow the general principles of IP law but are increasingly involved in cases where AI plays a central role. The Netherlands emphasizes quick and efficient enforcement of IP rights, with specialized courts able to handle complex disputes involving AI. The Netherlands is a leader in implementing AI and machine learning tools to enforce IP rights. These tools help rights holders identify infringements, particularly in the digital space, where AI can generate vast amounts of content. These technologies allow for early detection and resolution of IP disputes before they escalate into costly litigation. Like other countries, the Netherlands faces challenges in determining liability in AI-related IP disputes. Courts are still working through whether

the human operator of the AI, the developer, or another entity is responsible for infringements caused by autonomous AI systems.

Poland. Poland's IP enforcement system is less developed compared to Germany, France, and the Netherlands, but the country is making strides in modernizing its legal and technological infrastructure to handle AI-related IP disputes. Poland's approach to enforcement is primarily judicial, with growing use of digital tools to support IP monitoring.

In Poland, IP disputes, including those related to AI, are resolved through traditional court systems. While there are no specific regulations addressing AI in IP enforcement, courts rely on existing legal principles to resolve cases. One area of focus is identifying who is legally responsible for AI-generated content that infringes IP rights. Poland is beginning to explore AI-based tools for detecting IP infringements, though these systems are less advanced compared to other EU countries. The country is investing in automated monitoring systems to help track violations, particularly in industries where AI is commonly used, such as media and technology. As in other countries, Poland faces the challenge of assigning liability in cases where AI autonomously infringes on IP rights. Polish courts have so far treated AI as a tool, holding the operator or developer responsible for the infringement. However, as AI systems become more autonomous, this approach may face legal challenges.

Greece. Greece's IP enforcement mechanisms are primarily judicial, and the country has not yet fully developed the technological infrastructure to handle AI-related IP disputes. As AI becomes more integrated into various industries, Greece is facing new challenges in enforcing IP rights, particularly in the context of AI-generated content.

Greece's IP enforcement is conducted primarily through its court system. While the courts are capable of handling complex IP disputes, the country has not yet developed specific legal frameworks for addressing AI-related IP cases. Judges must apply existing IP laws, which can be difficult when AI is involved in creating or infringing content. Greece has yet to adopt advanced technological enforcement tools like AI-driven monitoring systems. As a result, enforcement in AI-related cases is less proactive, relying more on traditional methods of detecting and resolving IP disputes. One of the key challenges in Greece is determining the extent of human involvement in AI-generated content. Courts are still figuring out how to assign liability, especially in cases where the AI operates autonomously or with minimal human input.

Romania. Romania is in the early stages of adapting its IP enforcement mechanisms to the challenges posed by AI. Like Greece, Romania relies primarily on judicial processes for resolving IP disputes, but it is beginning to explore how digital tools can be used to support enforcement in AI-related cases.

Romanian courts handle IP disputes using traditional legal principles, and there are no specific regulations addressing AI in this context. Courts must determine whether the human operator, the developer, or another party is responsible for AI-generated IP infringements. Romania is starting to invest in digital tools to support IP enforcement, though it lags behind more advanced EU countries. These tools are particularly relevant in industries where AI-generated content is growing, such as

technology and creative industries. As in other EU countries, Romania's legal system struggles with how to assign liability in cases where AI autonomously creates content that infringes on IP rights. Romanian courts are likely to hold the human operator responsible, but as AI becomes more autonomous, this may become increasingly difficult to enforce.

Enforcement mechanisms in the context of AI and IP disputes across EU countries share several common features, including reliance on judicial enforcement, the use of existing IP laws, and challenges in assigning liability for AI actions. However, there are notable distinctive features in how countries like Germany, France, and the Netherlands are more proactive in adopting technological enforcement tools and exploring legal reforms, while countries like Poland, Greece, and Romania are still in the early stages of adapting their enforcement mechanisms to the challenges posed by AI. As AI continues to play a larger role in content creation and IP disputes, these differences may shape how quickly and effectively individual countries adapt their enforcement systems to address the complexities of AI-driven innovation.

Common and Distinctive Features in the Regulatory Acts of EU Countries on Enforcement Mechanisms in the Context of AI and Intellectual Property (IP) Disputes. As artificial intelligence (AI) becomes more prominent in intellectual property (IP) creation, use, and potential infringement, EU countries are adapting their enforcement mechanisms to address these new challenges. The enforcement of IP rights, traditionally designed for human-driven creations, now faces complexities introduced by AI's involvement. This analysis outlines the **common** and **distinctive** features in the regulatory frameworks of EU countries regarding the enforcement mechanisms for AI-related IP disputes (Table 4).

Table 4. The common and distinctive features in the regulatory frameworks of EU countries regarding the enforcement mechanisms for AI-related IP disputes

Common Features		**Distinctive Features**	
Judicial Enforcement as the Primary Mechanism:	Across all EU countries, judicial systems remain the primary method for resolving IP disputes, including those involving AI-generated content or AI-driven IP infringement. Courts are the main venues for adjudicating issues such as ownership, infringement, and liability.	**Adoption of Technology-Driven Enforcement Tools:**	Germany, France, and the Netherlands have advanced significantly in adopting digital and AI-driven tools to monitor and enforce IP rights. These countries use sophisticated software systems to detect IP infringement, often leveraging AI to help identify violations more efficiently. These systems are crucial in dealing with the scale of content that AI can generate, especially in industries such as media, technology, and design.
	No EU country has implemented specific legal frameworks for AI-related IP disputes, meaning existing IP laws are applied to AI-related cases. Courts typically rely on established principles of IP law to handle disputes, which can create challenges when dealing with AI's autonomous actions.		In contrast, countries like Poland, Greece, and Romania have been slower to implement such technological tools. While these countries are beginning to explore digital enforcement methods, they primarily rely on more traditional, manual processes for detecting and addressing IP violations, which may be less effective in handling AI-related disputes.
Liability Assigned to Human Operators or Legal Entities:	In all EU countries, AI is treated as a tool, not an independent entity. Therefore, when AI is involved in IP infringement or creation, the liability falls on the human or legal entity responsible for the AI's operation, use, or programming.	**Alternative Dispute Resolution (ADR) Mechanisms:**	France and the Netherlands have taken significant steps in promoting alternative dispute resolution (ADR) mechanisms, such as arbitration and mediation, to resolve complex IP disputes, including those involving AI. These ADR processes offer faster and more cost-effective resolutions, particularly for cases where AI's role complicates traditional litigation.
	Courts uniformly hold that the operator, developer, or controller of the AI system must face legal consequences for AI-related IP disputes. This approach ensures that there is always a legal entity accountable, even in cases where AI autonomously generates content that infringes on existing IP rights.		Other countries, such as Germany and Poland, use ADR mechanisms but still place greater emphasis on court-based resolutions for AI-related IP disputes. Greece and Romania rely heavily on their court systems and have yet to adopt widespread use of ADR in IP enforcement.

Common Features		Distinctive Features	
Harmonization Under EU IP Directives:	All EU countries are aligned under broader EU IP regulations, including directives like the Copyright Directive and the Trademark Directive, which provide a harmonized framework for resolving IP disputes. These EU-level regulations are applied uniformly to AI-related IP cases, ensuring consistency in enforcement across member states.	**Engagement with Legal Reforms and AI-Specific Guidelines:**	Germany, France, and the Netherlands are leading discussions on potential legal reforms to address the challenges posed by AI in IP disputes. These countries are actively exploring how IP law may need to evolve to deal with AI's growing autonomy, and there is ongoing debate about whether new regulations are needed to clarify liability and ownership in AI-related cases.
	The European Union Intellectual Property Office (EUIPO) provides guidelines and frameworks that all EU countries follow, meaning that the foundational legal approach to AI and IP enforcement is similar across jurisdictions.		Poland, Greece, and Romania are less engaged in these legal reform discussions. These countries tend to take a more reactive approach, waiting for EU-level directives or broader international guidelines before making significant changes to their national legal frameworks for AI and IP enforcement.
Emerging Challenges in Assigning Liability for AI Actions:	Across the EU, there is a growing recognition that assigning liability in AI-related IP disputes can be complex, especially as AI systems become more autonomous. Courts in all countries must grapple with questions such as whether the developer, operator, or end user should be held responsible when AI infringes on IP rights.	**Judicial Expertise and Specialized Courts:**	Germany and France have highly specialized IP courts with expert judges who are well-versed in handling complex IP disputes, including those involving AI. These courts are better equipped to address the nuanced technical and legal issues that arise in AI-related cases.
	As AI systems become more sophisticated, the challenge of assigning liability becomes more difficult, as the level of human control or oversight may diminish in AI-driven actions.		In countries like Poland and Romania, IP cases are handled by general courts, which may not have the same level of expertise in addressing the specific challenges posed by AI-driven IP disputes. As a result, enforcement in these jurisdictions may be slower or less predictable when AI is involved.
Lack of Specific AI Regulations for IP Enforcement:	No EU country has introduced specific regulations addressing AI's role in IP enforcement. Instead, existing IP laws are being adapted to cover AI-related disputes. While discussions on legal reforms are ongoing, all countries currently rely on their traditional IP frameworks to address AI issues.	**Monitoring and Enforcement Systems for AI-Generated Content:**	Germany, France, and the Netherlands have invested in automated systems that use AI to monitor for IP infringements, particularly in sectors where AI-generated content is prevalent. These systems allow for early detection of potential violations, helping rights holders prevent and address infringements more effectively.
			Greece, Poland, and Romania have not yet developed comprehensive AI-based monitoring systems for IP enforcement. These countries still rely on traditional monitoring methods, which may be insufficient to keep up with the volume and complexity of AI-generated content.

Source: systematized by the authors

In summary, EU countries share several common features in their enforcement mechanisms for AI-related IP disputes, including reliance on judicial enforcement, the assignment of liability to human operators or legal entities, and the application of harmonized EU-level IP frameworks. However, there are also significant distinctive features among EU member states. Germany, France, and the Netherlands are more advanced in adopting technology-driven enforcement tools, promoting ADR mechanisms, and engaging in discussions about legal reforms to address AI's growing role in IP disputes. In contrast, Poland, Greece, and Romania are slower in adopting these changes and tend to rely more on traditional IP enforcement methods, with less emphasis on advanced technological solutions or reform initiatives.

As AI continues to play an increasing role in IP creation and infringement, these differences in enforcement mechanisms may shape how effectively individual EU countries can address the complex legal challenges posed by AI-driven innovation and IP disputes.

Discussion. The increasing integration of artificial intelligence (AI) into the fields of intellectual property (IP) creation and management has raised significant questions for European Union (EU) countries regarding how best to regulate and protect IP rights in this new technological landscape. The comparative analysis of regulatory acts on IP protection in the context of AI across EU member states reveals both common

approaches influenced by EU-wide harmonization efforts and distinct national-level interpretations shaped by each country's legal traditions and economic priorities.

Common Challenges Across the EU. The most prominent common challenge faced by EU countries is that traditional IP frameworks, designed for human creators and inventors, struggle to accommodate the role of AI. The foundational requirement for human authorship and inventorship is present across all member states, as EU directives and national laws emphasize that only natural persons or legal entities can be recognized as authors or inventors. This creates a legal gap for fully autonomous AI-generated works and inventions.

AI's ability to autonomously generate content—whether in the form of artistic works, musical compositions, or technical inventions—raises difficult questions about ownership and liability. Across the EU, there is consensus that AI cannot be considered the legal author or inventor, but countries differ in their responses to the role AI plays in the creative process. For example, in copyright law, if an AI-generated work lacks sufficient human input, it falls outside of the scope of protection, leaving such works without legal recognition. Patent law presents similar difficulties, as AI systems increasingly contribute to the inventive process, yet the requirement for human inventorship remains a significant hurdle.

Furthermore, all EU countries share concerns about how to monitor and enforce IP rights in a landscape where AI-generated content can be produced at unprecedented scales. This challenge underscores the need for new technological tools and legal strategies to effectively detect and manage potential infringements. EU member states are investing in AI-driven enforcement systems, though the extent of these efforts varies.

Divergent National Approaches. While EU directives such as the Copyright Directive and the European Patent Convention provide a common framework for IP protection, significant national variations remain, especially regarding how individual countries interpret key legal concepts such as originality, inventorship, and ownership in the context of AI.

Germany and France are at the forefront of addressing the regulatory challenges posed by AI. These countries are heavily invested in AI technologies and have initiated discussions about reforming IP laws to better accommodate AI's role in creation and innovation. Germany, with its strong tradition of patent law, has emphasized the need for clear human involvement in the inventive process, while France's focus on the originality requirement in copyright law has led to more restrictive interpretations of AI-generated works.

The Netherlands has adopted a more flexible approach, allowing for broader interpretations of how AI can assist in the creation of IP without necessarily requiring substantial human involvement in every case. However, like other member states, it stops short of granting AI itself the status of creator or inventor.

Poland, Greece, and Romania have been slower to address the specific challenges posed by AI in IP law, relying more heavily on existing frameworks and waiting for broader EU guidance. These countries are generally more reactive, adopting changes once EU directives or landmark court cases provide further clarity.

The variations in national approaches also extend to enforcement mechanisms. Germany and the Netherlands have led the way in adopting AI-driven tools to monitor and enforce IP rights, while countries such as Poland and Romaniaare still in the early stages of implementing such technologies. This disparity in technological infrastructure could create gaps in enforcement capabilities across the EU, particularly as AI-generated content proliferates.

Legal and Policy Implications for Harmonization. The EU has made significant strides in harmonizing IP law through directives such as the Copyright Directive and the Digital Single Market Strategy. However, the challenges posed by AI highlight the limits of these harmonization efforts. The complexity of AI-generated works and inventions requires more nuanced and flexible regulatory frameworks than what is currently provided by existing EU directives.

Several policy proposals have emerged to address these gaps. One option under consideration is to introduce new categories of IP rights specifically for AI-generated content, which would recognize the role of AI in the creative and inventive process without undermining the human-centered nature of traditional IP rights. Another proposal focuses on joint authorship and inventorship, where AI is seen as an "assistant" in the creative process, allowing humans to retain legal recognition while acknowledging AI's contribution.

At the EU level, there is also a growing recognition that IP enforcement will require more sophisticated AI-based monitoring tools to handle the sheer volume of content generated by AI systems. The European Commission has already begun exploring how such tools can be integrated into IP enforcement mechanisms to ensure that rights holders can effectively protect their IP in a rapidly changing digital landscape.

Moving Forward: Policy Recommendations. Given the complexities that AI introduces into IP law, a multi-faceted approach is necessary to ensure effective protection and enforcement of intellectual property across the EU:

- *Legal Reforms:* EU member states need to explore potential legal reforms that would recognize the role of AI in the creative and inventive process without granting AI full authorship or inventorship rights. One possible solution is the introduction of AI-assisted IP rights that reflect the collaborative nature of AI and human creators.
- *Technological Enforcement: All* EU member states should invest in AI-driven enforcement tools that can detect and monitor IP infringement on a larger scale. These systems would help mitigate the challenges posed by the high volume of AI-generated content, particularly in the fields of copyright and trademark.
- *Harmonization Efforts:* The EU should continue to push for further harmonization of IP laws in the context of AI, particularly by introducing new directives or regulations that address the specific legal gaps identified by member states. Greater clarity on the concepts of authorship, inventorship, and ownership in relation to AI is essential for ensuring consistent application across the EU.
- *Cross-Border Cooperation:* Given the cross-border nature of AI-generated content, EU countries should work more closely on joint enforcement strategies and share

best practices for handling AI-related IP disputes. This would help address discrepancies in enforcement capabilities and ensure a more consistent approach to protecting IP rights within the EU.

Conclusion. The comparative analysis of the regulatory acts across EU countries on the protection of intellectual property (IP) in the context of artificial intelligence (AI) highlights both the challenges and opportunities that AI presents to traditional IP frameworks. While the EU has made significant progress in harmonizing IP laws through directives like the Copyright Directive and the European Patent Convention, AI's autonomous capabilities introduce complexities that existing laws are not fully equipped to address.

The analysis reveals that all EU countries maintain the requirement for human authorship and inventorship, making it difficult for fully autonomous AI-generated works and inventions to be recognized under current IP regimes. This gap underscores the need for legal reform, as AI continues to advance and play a larger role in the creation of creative and technical content.

At the same time, significant national differences remain in how EU member states interpret and apply key legal concepts such as originality, ownership, and liability in the context of AI. Countries like Germany, France, and the Netherlandshave taken proactive steps to adapt their regulatory frameworks, investing in AI-driven enforcement tools and exploring potential reforms. Meanwhile, countries such as Poland, Greece, and Romania have been slower to address these challenges, largely waiting for broader EU-level guidance.

Moving forward, the EU faces a critical need to further harmonize its approach to AI and IP, ensuring that its legal frameworks remain fit for purpose in the digital age. This includes the potential introduction of new legal categories for AI-generated content, investment in AI-powered enforcement systems, and continued collaboration between member states to share best practices and jointly address the unique challenges posed by AI.

Ultimately, the balance between fostering AI innovation and protecting IP rights will be crucial for ensuring that Europe remains a leader in both technological development and intellectual property protection in the years to come.

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