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Artificial Intelligence Application in Law: A Scientometric Review

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Abstract: Several topics, problems, and established legal principles are already being challenged using artificial intelligence (AI) in numerous applications. The powers of AI have been snowballing to the point where it is evident that AI applications in law and various economic sectors aid in promoting a good society. However, questions such as who the prolific authors, papers, and institutions are, as well as what the specific and thematic areas of application are, remain unanswered. In the current study, 177 papers on AI applications in law published between 1960 and April 29, 2022, were pulled from Scopus using keywords and analysed scientometrically. We identified the strongest citation bursts, the most prolific authors, countries/regions, and primary research interests, as well as their evolution trends and collaborative relationships over the past 62 years. The analysis also identified co-authorship networks, collaboration networks of countries/regions, co-occurrence networks of keywords, and timeline visualisation of keywords. This study concludes that systematic study and enough attention are still lacking in AI application in law (AIL). The methodical design of the required platforms, as well as the collecting, cleansing, and storage of data, and the collaboration of many stakeholders, researchers, and nations/regions are all problems that AIL must still overcome. Both researchers and industry professionals who are devoted to AIL will find value in the findings.

Keywords: artificial intelligence in law, legal informatics, bibliometric analysis, law informatics, machine learning

1. Introduction

Since its inception, the discipline of law has been recognised for its high level of complexity, which calls for a significant amount of focus on specifics as well as an in-depth familiarity with long-standing legal principles. In recent years, there has been a growing interest among researchers, legal practitioners, and policymakers in the application of artificial intelligence (AI) in legal systems. This has made the topic of AI in legal systems a matter of tremendous importance. There is a possibility that AI will bring about a sea change in the way that the judicial system functions, but the technology also poses several problems that need to be addressed before it can realise its full potential. The purpose of this study is to offer a scientometric evaluation of the previous work done on the uses of AI in legal settings. It provides a comprehensive study of the important players, research interests, and thematic areas of AI use in law, with a focus on identifying gaps and potential for future research. Specifically, it looks at how AI is being applied in criminal law. This paper aims to contribute to the ongoing discussion on the potential for AI to revolutionise the legal system by offering a comprehensive assessment of the current state of the art in AI and law.

In 1956, John McCarthy, also known as the father of AI, introduced "AI" at Dartmouth. AI is considered a field of computer science, which refers to tackling super-complex issues that cannot be tackled by direct computations or arithmetic. AI technology and its subfields (machine learning (ML) and deep learning (DL)) have quickly moved from the laboratory to everyday life (Reed, 2018). Scientists have widely used AI technology to automate several complex operations, such as chess, language translation, and autonomous vehicles, and there are many other applications in the works or the pipeline (Hoeschl & Barcellos, 2004; Nti et al., 2022a, 2022b). The globalisation of the world has recently resulted in the use of technology in every aspect of human life and activity, including law. Subject areas, including legal informatics, legal information, technology law, and other similar names, have a long history with law and technology (Salami, 2017). Several recent studies investigated the use of AI in law (AIL), or AI, as a data mining tool in law enforcement for refining and driving evidence (Hoeschl & Barcellos, 2004; Jordan, 2021; Alzou'bi et al. 2014; Loutsaris & Charalabidis, 2020; Petit, 2018; Salami, 2017). Despite this, few comprehensive high-level overviews of the field exist.

However, this is crucial for the growth of AI research and future trends as a legal tool. Although some studies attempted to summarise AIL's works, all of them employed a systematic literature review (SLR) methodology. Though SLR evaluations are often assumed to capture the domain ontology and flag gaps in the existing literature, even for an expert, analysing a large number of papers might be difficult because specialists are prejudiced and only work in their fields of study (Liu et al., 2019). SLR is also limited

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in finding lexical linkages between study subjects in each field. On the other hand, quantitative methods like citation (bibliometric) analysis and text mining can find semantic links between lots of research in any field. Again, these studies (Ampese et al., 2022; George et al., 2021; Ross, 2012) show that SLR supports or disproves a single point of view and takes a more focused and limited approach. Thus, SLR does not provide a thorough review of the literature on a particular subject. According to Walker et al. (2008), biases such as publication bias, search bias, and selection bias can all be discovered in qualitative evaluations. These biases undermine impartiality in quality iterative analysis since it relies on human judgment and research skills (El Shenawy et al., 2007; Stegenga, 2011).

On the other hand, a literature review that consists simply of an arbitrary selection of material is frequently not reflective of the state of knowledge. For example, sample selection bias occurs when a non-random sample of data is chosen for further investigation in the statistical analysis due to a preference for certain studies (Linnenluecke et al., 2020). The statistical and numerical application of statistical and mathematical methodologies to literature, which includes books, scientific and technological publications, and other kinds of communication, is referred to as bibliometrics (Linnenluecke et al., 2020; Parlina et al., 2020; Royle et al., 2013). It is a tested method for studying and evaluating the literature–research stakeholder relationship.

The conclusion that complete and systematic reviews of the AIL literature have been infrequent during the past 62 years is not difficult to draw. The following issues may arise if the literature review for AIL is not updated. First, because there is no comprehensive study, it is challenging for a beginner in the field to learn about the prolific authors, journals, institutions, and active nations and areas to use as examples. A thorough application profile is required to demonstrate current research accomplishments, including the issues that have been prioritised and the advancements made in the AIL sector. Lastly, researchers who are interested in this topic will need more time to figure out the current state of research, future trends, and research directions if they do not have an overview of how research has changed, what breakthroughs are happening now, and what limits are in place. Furthermore, questions such as who the prolific authors, papers, and institutions are, as well as what the specific and thematic areas of application are, remain unanswered. Consequently, it is essential to conduct a thorough and methodical analysis of the use of AI in law. This study seeks to achieve the following objectives:

1. Identify the prolific researchers, organisations, and nations/ regions involved in AI in law throughout the past 62 years, as well as their cooperative partnerships.
2. List the primary areas of focus for AI research in the legal field throughout the last six decades.
3. Discover the connections between various study topics and their rate of evolution.
4. List the advantages and difficulties of AI in the legal field and suggest exciting new study areas.

The remaining section of this research was organised as follows: Section 2 summarises relevant studies. Sections 3 and 4 provide our research approach, our findings and discussions, and prospects and problems. Finally, the conclusions are discussed in Section 5.

2. Related Works

A thorough literature study confirmed that AI is a data mining tool to enhance and lead proof law enforcement (Alzou'bi et al. 2014). The study concluded that AI is important as a supporting technology in policing, reducing crime and cyberattacks, and as a model for upholding the law. Similarly, a summary of AI in law informatics was released to summarise the field into a comprehensible short document (Salami, 2017) using the SLR approach. Likewise, the legal difficulties raised by introducing AI and cognitive robotics technology in law enforcement were examined (Petit, 2018). The challenges of AI in a soft legal setting were explained methodically (Jordan, 2021). An evaluation of legal informatics systems, tools, and taxonomies was conducted based on compatibility (Loutsaris & Charalabidis, 2020). In 1979, a methodological examination of legal issues relating to computer networks was conducted (Steinmüller, 1979). An overview of visual law and legal design was offered, along with some preliminary solutions (Brunschwig, 2021). Finally, Von Bonin & Malhi (2020) proposed the employment of AI in enforcement measures in the future.

Given the large number of AI applications in the legal industry, the significant attention that these techniques have received from professionals and scholars, and the need to gain a better understanding of the state of AIL research on a global scale, it is exciting to carry out a thorough evaluation to evaluate global research efficiency and report on the significant interest in these methods. To attain this goal, we propose that bibliometric methodologies be utilised to quantify the performance of science and technology at countrywide and/or worldwide echelons within a certain subject or literature. Bibliometric approaches rely on quantitative analyses and statistical signals to assess the research production of people, institutions, journals, regions, and nations and are important tools for monitoring and assessing scientific research output. In addition to their tremendous capacity for completing systematic studies, these methodologies may be used to make declarations regarding qualitative indices of scientific endeavours studies (Wamba et al., 2021; Zyoud & Fuchs-Hanusch, 2017). Bibliometric outputs and measures can provide important evidence and facts about the state of research happenings in each subject, which can aid scholars and researchers in finding and pursuing new lines of study. Though few studies (Wamba et al., 2021; Zyoud & Fuchs-Hanusch, 2017) adopted a bibliometrics review in AIL literature, it was not comprehensive. That is, while Zyoud & Fuchs-Hanusch (2017) concentrated on a branch of AI (i.e., DL) application in law, Wamba et al. (2021) focused on how AI research could help people understand and prepare for social changes that AI "good AI society" will bring about.

This analysis has never been undertaken previously, to the best of our knowledge, and is founded on an assessment of the available literature. It is the first of its kind to investigate relative development rates, top countries and areas throughout the world, the most productive journals, institutions, and authors, collaboration patterns, and citation rates in fields of study, including the use of AI approaches in law. This study is driven in part by the fact that AI research encompasses a broad body of literature from a variety of fields. It will give a detailed and new look at the state of research in this important field. It will also help to detect which countries, journals, organisations, or scholars played a significant role in the growth and development of this field of research.

3. Methodology

Bibliometric studies are often conducted using one of four frequently used databases: Web of Science (WoS), Scopus, Google Scholar, or PubMed (Wamba et al., 2021; Zyoud & Fuchs-Hanusch, 2017). We used the Scopus database to find

material on AI applications in law as it is the widest database and indexes the most journals compared to other scientific research databases (Zyoud & Fuchs-Hanusch, 2017). It has over 60 million archives and covers more than 21,500 peer-reviewed publications, making it the biggest abstract and citation catalogue of peer-reviewed literature[1]. Studies claim that the Scopus database provides the utmost flexible perspective of worldwide research production in every area of science (Yataganbaba & Kurtbaş, 2016; Zyoud & Fuchs-Hanusch, 2017). During the data search and collection, all topic categories within the Scopus database were examined.

Figure 1 shows the current study framework. We downloaded all the papers for this study from the Scopus database using our defined keywords. The keywords include privacy, security, legal, informatics, AI, law, law-informatics, and legal-informatics. Our initial search string (string I) was: (TITLE (privacy AND security AND legal AND informatics) OR TITLE (artificial AND intelligence AND law) OR TITLE-ABS-KEY (law-informatics) OR TITLE-ABS-KEY (legal-informatics)) AND PUBYEAR > 1959 AND PUBYEAR < 2023. Our string I resulted in 369 documents; we refined our search string (string II) based on our exclusion criteria phase I (see Table 1). With our string II, the search results yielded 237 papers. String II: *(TITLE (privacy AND security AND legal AND informatics) OR TITLE (artificial AND intelligence AND law) OR TITLE-ABS-KEY (law-informatics) OR TITLE-ABS-KEY (legal-informatics)) AND PUBYEAR > 1959 AND PUBYEAR < 2023 AND (EXCLUDE (DOCTYPE, "cr") OR EXCLUDE (DOCTYPE, "ch") OR EXCLUDE (DOCTYPE, "bk") OR EXCLUDE (DOCTYPE, "ed") OR EXCLUDE (DOCTYPE, "er") OR EXCLUDE (DOCTYPE, "no") OR EXCLUDE (DOCTYPE, "sh")) AND (LIMIT-TO (LANGUAGE, "English")). Finally, we screened the 237 papers based on our exclusion criteria phase II (*see Table 1*). Specifically, we removed papers that were review works and papers published before 2004.* Hence, the final number of papers used in this bibliometric study was 177, as defined in Equation (1).

Figure 1
Study framework

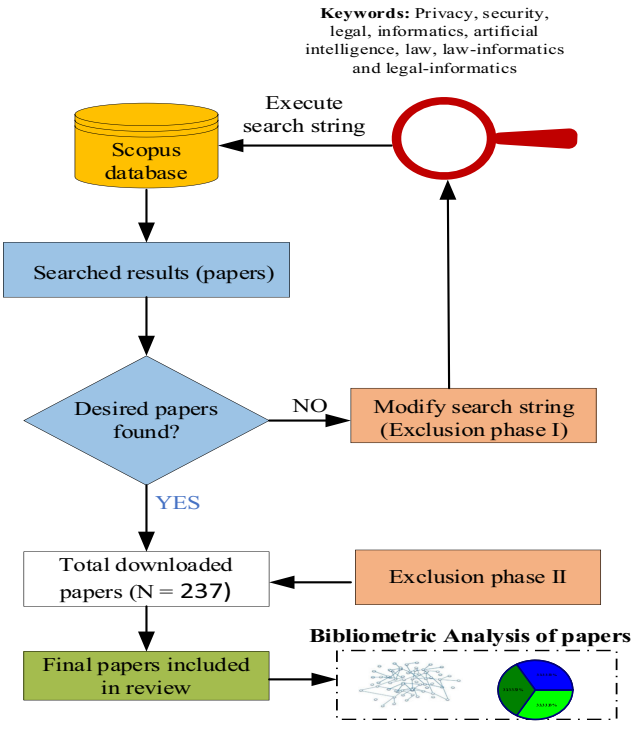


Table 1
Exclusion criteria

Phase I (from 1960 to 2022)	Phase II
	SLR papers on AIL (n = 21)
1. Papers that were:	Papers published before 2004 (n = 39)
i. Conference review (n = 28)	
ii. Book chapter (n = 26)	
i. Books (n = 8)	
ii. Editorial preview (n = 8)	
iii. Erratum (n = 3)	
iv. Note (n = 3)	
v. Short survey (n = 1)	
2. Papers not in English (n = 55)	
Total removed papers = 132	**Total removed papers = 60**

$$UP(177) = TP(369) - PS_1(132) - PS_2(60) \quad (1)$$

where UP = papers used in this study, TP = total papers initial downloaded, PS_1 = phase I screening, and PS_2 = Phase II screening.

4. Results and Discussions

The VOSviewer platform was used to conduct our bibliometric study; it is a text-mining tool for detecting significant patterns in unstructured data and assessing semantic linkages in scientific publications (Avasthi et al., 2021; Hair & Sarstedt, 2021).

4.1. Breakdown of scientific production trends in AIL

Of the 177 papers that were used in this study, 63.28% were articles from journals, while 36.72% were conference papers. The distribution shows that more authors (AIL) prefer to highlight their findings in journals than at conferences. We analysed the trend of scientific studies on AIL and Google trends on AI and its subfields (ML and DL). Figure 2(A) shows the variation of studies in AIL, while Figure 2(B) shows Google trends on AI, ML, and DL. The aim here was to investigate the relationship between the trends in AIL literature and the search for knowledge in AI and its subfields on Google (ML and DL). We observed that scientific studies in AIL saw a progressive increase from 2015 to 2018 and dropped in 2018. However, they recorded a sharp surge in studies from 2019. Furthermore, from 2015 onwards, we observed a directly proportional relationship between scientific works in AIL and Google trends on AI, ML, and DL (see Figure 2). The upsurge in AIL articles from 2014 onwards may be attributed to the emergence of big data in 2012 and DL in 2015, as well as the success of Google's Alpha Go, which boosted AI research programs and industrial uses dramatically (LeCun et al., 2015; Silver et al., 2016; Wamba et al., 2021; Zhang et al., 2019). During the time of this study, AIL research spanned 19 different topics. The top 10 observed areas, and the number of papers in each study area, are shown in Figure 3. Computer science with

[1]https://www.elsevier.com/solutions/scopus/how-scopus-works/content

Figure 2
Scientific production in AIL development (a); Google trends on AI, ML, and DL (b)

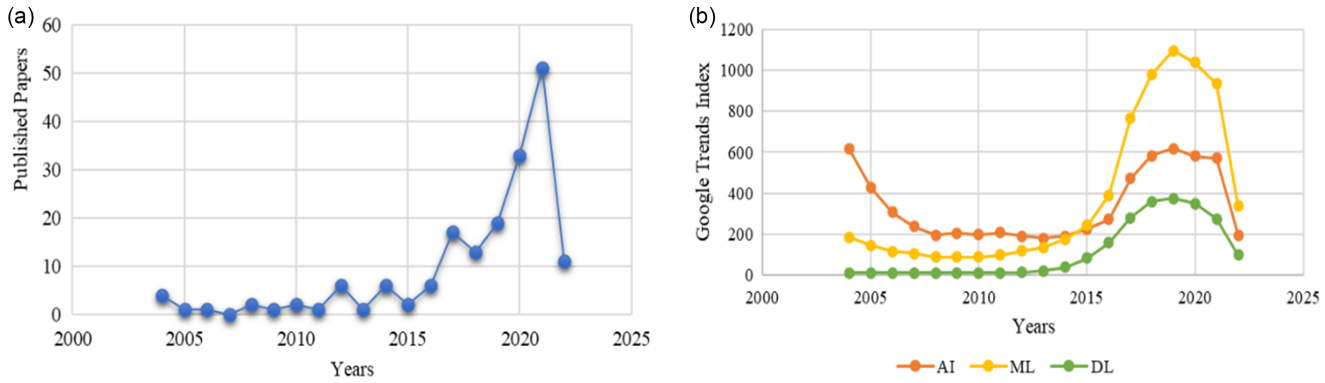
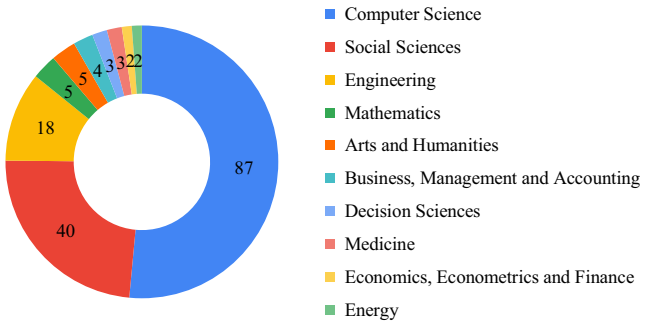


Figure 3
AIL references in different areas (first 11 areas)



87 (49.15%) papers and social science 40 (22.60%) were the two most popular fields.

AI research is conducted in a wide range of fields; some are application sectors, while others contribute to the creation of technologies, models, and algorithms. The results of the research are published in a variety of publications and conferences. To visualise the prolific journals and conferences, the papers assessed in this study were published in 115 journals and conferences. Journals and conferences with at least 3 publications and a minimum of 10 citation counts were chosen. Only six of the 115 journals match these requirements. The 4 most productive and important journals in AIL are shown in Table 2. The publishing sources are sorted by total academic output in AIL and average citation and H-index, which is calculated using citations from AIL articles in the corpus over the period 2004 to April 2022.

4.1.1. Quantum effort (article counts) of authors in AIL studies

In this subsection, we examine the quantum effort or article counts of authors in AIL studies, which is a metric that measures the productivity and research output of individual authors in the field. The most prolific author was Lachmayer[2] with nine papers (e.g. Čyras et al., 2015, 2016; Čyras & Lachmayer, 2020; Lachmayer & Čyras, 2021), followed by Čyras[3] with eight publications in AIL Interestingly, all the papers he co-authored were by Lachmayer. The third position was held by Lettieri[4] and Malandrino[5] with 7 (e.g., Lettieri et al., 2016, 2017, 2018). Alexopoulos[6] was the fourth productive author in AIL literature, with 6 papers, (e.g., Avgerinos Loutsaris et al., 2021; Stavropoulou et al., 2020; Virkar et al., 2020). Of the 336 authors, 7 meet the criteria of a minimum of 4 papers with 6 citations.

4.1.2. Prolific papers (citation counts) in AIL studies

Table 3 shows the 5 top prolific papers in AIL literature. We observed that Hacker (2018) paper was the most cited (51). To enforce justice in the digital era, the paper combined the concept of anti-discrimination and data protection legislation. The second is a paper by Liu et al. (2004) with a citation of 34, which suggested algorithms for autonomously creating and refining case examples for felony brief judgments from real-world verdict documents. Next was Robaldo & Sun (2017), a paper with 27 citations proposed combining Jerry R. Hobbs' reification-based approach with input/output logic, a well-known formalism for normative reasoning.

Compared to similar publications, the Field-Weighted Citation Impact (FWCI) measures how well a paper gets cited. A score greater than 1 indicates that the paper has received more citations than expected based on the average. It considers (i) the publication year, (ii) the type of paper used, and (iii) the disciplines linked with the source. Over 3 years, the FWCI is the proportion of citations in a document to the average number of citations in similar publications. Each discipline contributes equally to the statistic, excluding disparities in researcher citation behaviour.

4.1.3. Quantum effort of countries and institutions in AIL research

Figure 4 displays the top 11 countries/territories with the most considerable number of AIL publications in Scopus ranked by total article count from 2004 to April 2022. We selected only countries with at least 6 papers in AIL for the plot. Of the 177 papers analysed in this study, the USA had the highest number of published papers (37; 20.9%) in AIL, followed by Italy with 23 papers (13%), and next was Austria with 16 papers (9%).

[2]https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=24831890400&zone=

[3]https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=36908746100&zone=

[4]https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=55766499900&zone=

[5]https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=7801383595&zone=

[6]https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=56366476900&zone=

Table 2
The four most influential and productive journals and conference proceedings in AIL research (2004–April 2022)

Source	TP	TC	Avg. citations	SJR*	*SC*	SNIP*	H-index	Country
ACM international conference proceeding series	8	29	3.625	0.182 (**Q***)	1.2	0.296	123	USA
Artificial intelligence and law	4	73	18.25	0.856 (**Q1**)	7.5	3.81	34	Netherlands
International review of law, computers, and technology	3	14	4.6667	0.367 (**Q2**)	2.2	1.036	12	United Kingdom
Jusletter IT	14	13	0.9286	0.102 (**Q4**)	0.1	0.019	3	Switzerland

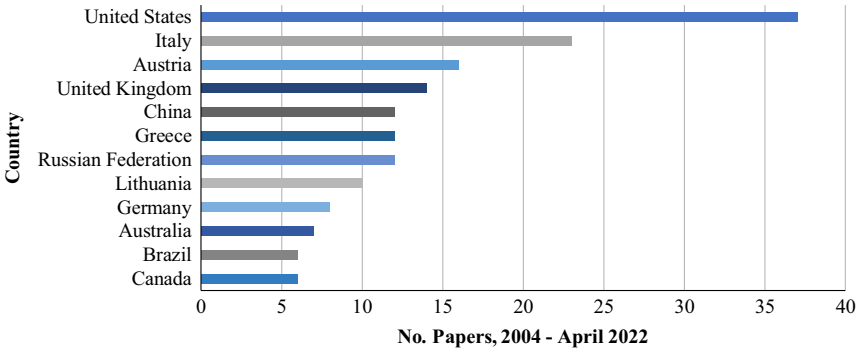
Note: TP = total publication; * = not applicable; SC = Cite Score; SNIP = Source Normalised Impact per Paper; SJR = SCImago Journal Rank; SNIP* = Fig. for 2020 provided by Scopus; SJR* = Fig. for 2020 provided by SCImagoJR; TC = Total Citations counts on AIL publications.

Table 3
Productive papers in AIL literature

		Citations counts						
S/N	Paper (Ref.)	<2019	2019	2020	2021	2022	Total	FWCI*[7]
1.	Hacker (2018)	–	9	15	21	6	51	11
2.	Liu et al. (2004)	9	10	6	7	2	34	0.45
3.	Robaldo and Sun (2017)	4	11	5	7	–	27	2.66
4.	Shih et al. (2008)	20	3	1	–	–	24	2.14
5.	Hamledari and Fischer (2021)			1	14	5	20	15.05

Note: * = Scopus Figs as of May 1, 2022.

Figure 4
Productive countries in AIL research, 2004 to April 2022



The dominance of the USA in this list agrees with the corresponding lists for the Nature Index and Davis report concerning the total article share, article count, and percentage of internationally collaborative articles in AI. However, in contrast with (Savage, 2020) AI index in Dimensions, the current study focused on AI in law and not all AI application fields. As shown in Figure 5, we observed a solid bibliometric coupling between the USA and the United Kingdom and Italy and China. Again, we observed much research collaboration between Austria, Greece, the Russian Federation, and Lithuania in this field. There were 330 institutions/organisations from which the authors of the 177 papers reviewed affiliated with. Figure 6 shows the top eight prolific institutions in AIL research from 2004 to April 2022 regarding publication counts. Though the USA records the most publications in AIL (see Figure 4), the most prolific institution regarding the parties' number of publications was Vilniaus Universitetas[8] from Vilnius, the capital of Lithuania (see Figure 6).

Of the 330 institutions/organisations, only institutions with a minimum of two papers and four citations were visualised. Interestingly, Isfol, Rome, Italy recorded the highest citation count (21) with two publications in AIL. Next was the University of the Aegean, Greece, with 10 citations with 3 papers, Hellenic Parliament, Greece, with 4 citations with 2 papers, and Danube University, Krems, Austria, with 3 citations with 2 papers in AIL. Regarding publication counts, the USA, Italy, Austria, the UK, and China lead AIL research. However, Italy and Greece were prolific in terms of citation counts. Thus, as discussed in earlier bibliometric review studies, high production numbers but low average citations highlight the question of the relative visibility of publications (Wamba et al., 2021).

4.2. Co-occurrence networks

Co-occurrence networks are gaining popularity in scientometric research because they provide a visual representation of the relationships between various terms or phrases in a specific research field. By analysing co-occurrence networks, researchers can identify pertinent terms, research patterns, and connections between different concepts. In the field of AI applications in law, co-occurrence networks are particularly advantageous due to the

[7]https://www.scopus.com/
[8]https://www.vu.lt/

Figure 5
Bibliometric coupling between countries

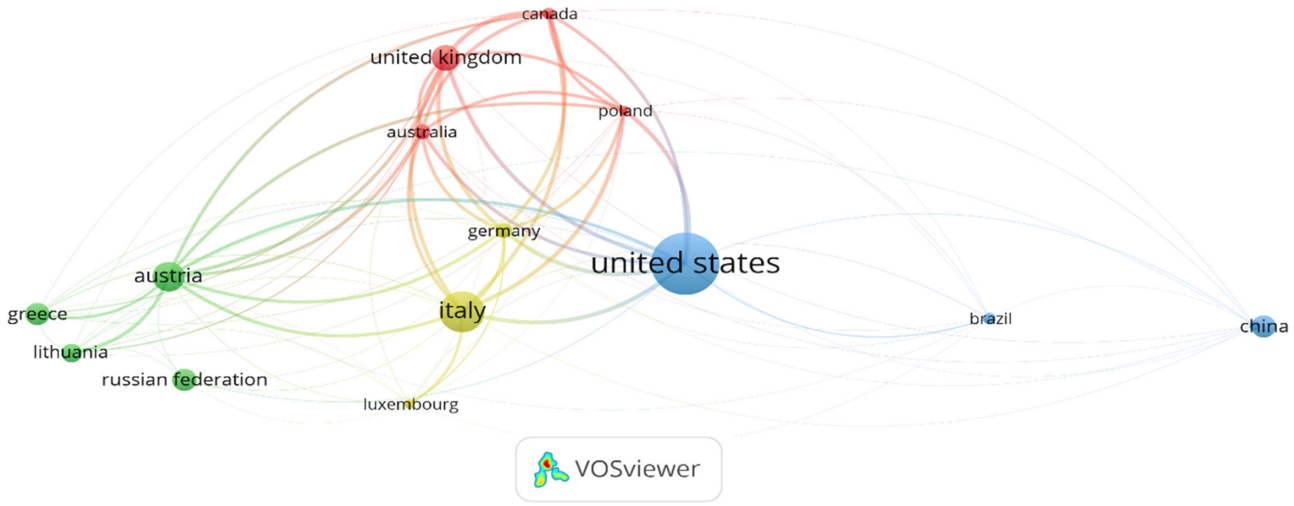
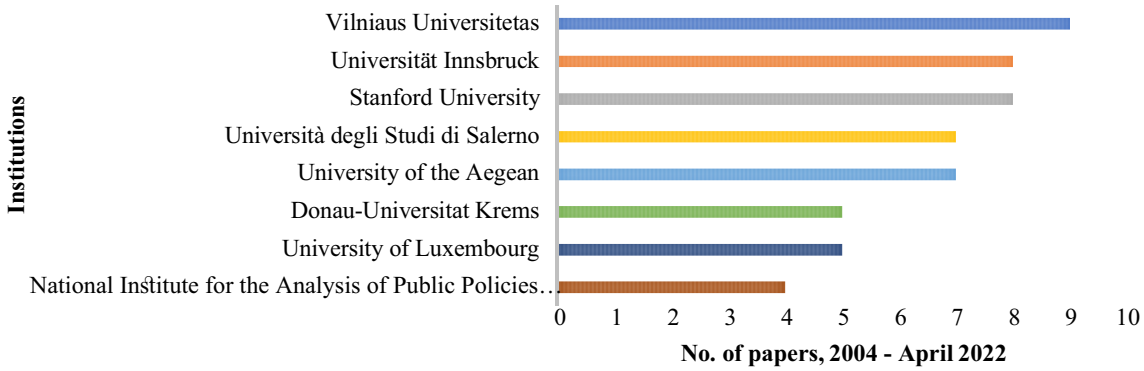


Figure 6
Top 8 prolific institutions in AIL research, 2004 to April 2022



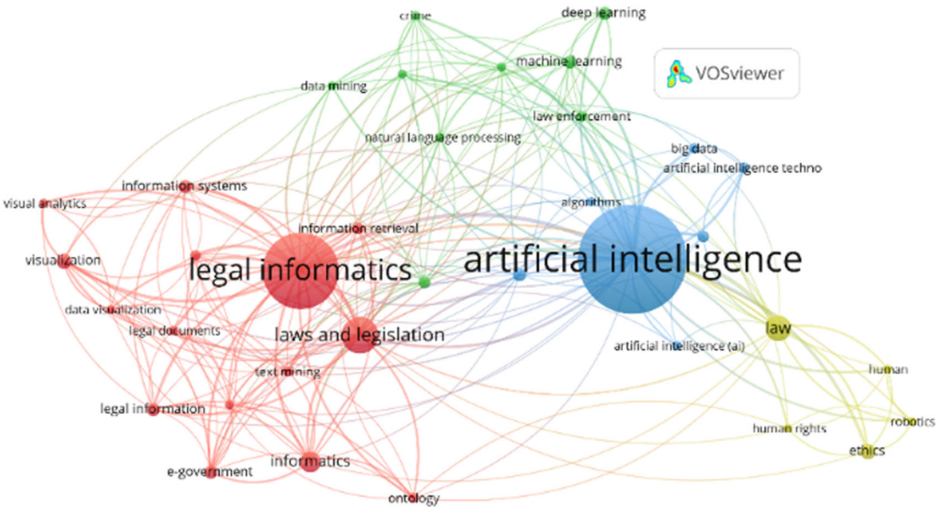
field's swift evolution and the emergence of new concepts and terminology. Co-occurrence networks enable researchers to determine which topics are examined together the most frequently, enabling the identification of emerging trends and research gaps. In addition, co-occurrence networks can help determine which authors and institutions are at the forefront of a field and facilitate collaborations between them. This section describes the observed co-occurrence networks in this study.

4.2.1. Keywords (authors and index)

In visualising the bibliographic map for authors and index keywords (all-keywords) co-occurrence, we set the least number of co-occurrences of each keyword to 5, and out of 1118 keywords, 36 meet the threshold. Figure 7 shows the all-keywords co-occurrence network. It is important to note that generic words like "name of a country" and others that we think are not keywords were removed from the plot. The 36 keywords were clustered into 4 clusters: cluster 1: 15 words, cluster 2: 9 words, cluster 3: 7 words, and cluster 4: 5 words, as shown in Figure 7. AI is thought to have the ability to boost productivity. The AI works on multiple algorithms and is proficient at speeding up document verification and processing activity with the help of the ML algorithm input provided to the app. From Figure 7, it can be inferred that a high percentage of current research work in AI applications in law is focused on:

(i) **Scrutiny and check-ups:** the use of AI to conduct critical scrutiny and unearth circumstantial information and legal mechanisms to assemble data from previous or previous occurrences (legal documents) through data visualisation, information retrieval, semantics, text mining, visual analytics, natural language processing, ontology, and more.
(ii) **Documenting mechanism:** information and data acquisition processes and knowledgeable possession: AI-assisted through decision support systems, learning systems, information science, and other methods, AI can assist lawyers in examining large IP files and extracting meaning from a range of appeals.
(iii) **Ethics and human rights:** privacy protection, access to justice, compliance and ethics monitoring, and ethical decision support are some of the focus areas of AIL for human rights and ethics.
(iv) **Law enforcement and E-government:** scanning crowds or attempting to identify suspects by matching photo or video data with databases, including photos of people who have already had contact with the government or police enforcement.

Figure 7
Authors and index keywords' co-occurrence plot



The plot shows that legal informatics, ML, AI, law, and legislation have appeared in most keywords. For instance, AI is available to assist judges and attorneys in rechecking or evaluating their work, processes, and verdicts.

Figure 8 shows the keywords' co-occurrence based on 177 paper titles and abstracts. For this plot, the minimum keyword co-occurrence was 10, and of the 4055 terms, 63 met the threshold. A relevance score was calculated for each of the 63 terms using the VOSviewer software. Sixty percent (38) of the most relevant terms were selected for the plot (see Figure 7). We sought to verify the correlation between authors and index keywords with the titles and abstracts of papers. From Figure 8, there is a degree of coupling with Figure 7, i.e., it suggests a high correlation between the authors' keywords and the abstracts of their papers in the field. This result shows that one can accurately depend on the keyword of a published paper to have a fair idea of the study area of the paper. Figures 7 and 8 depict the intellectual framework of AIL research knowledge.

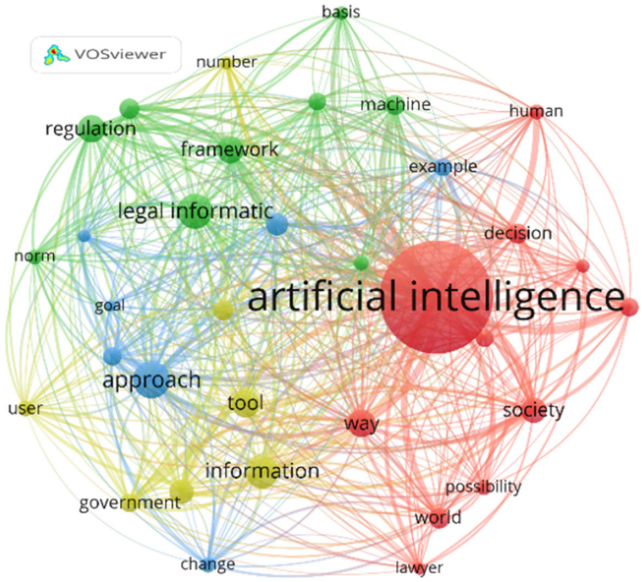
4.3. Opportunities, challenges, and future prospects

Though AI application in law has not been entirely accepted in most countries, especially in the developing world, this work can affirm that research on AI and law has been going on since the 1970s, but with varying emphasis, as noted by Nissan (2017). An AI research platform can help lawyers become better advisors to their clients. It can stabilise legal research expenses while preserving a constant level of quality. AI can increase the efficiency of attorneys, judges, and law enforcement agencies like the police.

4.3.1. Opportunities

1) **Litigation prediction:** A field where AI researchers may collaborate with domain experts such as attorneys and judges to construct ML models that predict the outcomes of ongoing cases. They can help law firms organise their litigation strategy ahead of time, streamline settlement discussions, as well as limiting the number of cases that will proceed to trial.

Figure 8
Co-occurrence of keywords in both the title and abstract



2) **Contract analytics:** To an alarming degree, businesses operate in the dark concerning their contractual obligations. NLP-based solutions can extract and contextualise crucial information from a firm's complete body of contracts. This will simplify the understanding of all parties of the firm's commercial commitments.
3) **Agreement appraisal:** Agreements are essential to our economy's survival; without them, no commercial dealings can occur. However, negotiating and finalising an agreement are now time-consuming[9].

[9]https://www.forbes.com/sites/robtoews/2019/12/19/ai-will-transform-the-field-of-law/?sh=9e21cd17f01e

4.3.2. Challenges

1) **Professionals in the legal field do not accept it totally** (Shikhar, 2021): In most middle- and low-income countries, AI in law is however in its initial stages. Solicitors are cautious about accepting this technology because they feel AI would harm their career prospects. Most senior lawyers prefer to remain in an old-fashioned way, with no AI.
2) **The legal nature of AI has yet to be established:** The legal personality of AI is not expressly established anywhere in modern law. As a result, there will be confusion until the privileges and duties of AI-driven gadgets and paraphernalia are defined. In most countries, the existing legal system does not hold a robot accountable for its deeds.
3) **Inadequate systems and data**: One of the most significant challenges to implementing AI in developing nations is obsolete technology and equipment. Data are usually inadequate, and the machine cannot operate effectively until a substantial amount of reliable data has been given to it by society at large.
4) **Personal data privacy and protection**: AI-driven robots must be invented to guard and secure the parties' confidential data. Because ML and DL deal with enormous volumes of data, the legal framework must guarantee that the data are not exploited, that secrecy is preserved, that a lawful process is observed, and that a safekeeping layer to avoid confidentiality breaches is established.
5) **Costly:** An AI machine is an advanced machine system that can learn and respond independently, requiring considerable financial investment. Because most AI-driven machines are made in developed countries, small- and medium-sized law firms will not be able to buy them; only big law firms will be able to buy them.

4.3.3. Future prospects

The future of AI applications in law is extremely promising, as AI has already begun to significantly transform the legal industry. AI can assist solicitors with a variety of duties, such as document review, legal research, contract analysis, and even case outcome prediction. It can also aid in expediting legal procedures, reducing costs, and enhancing productivity. AI systems will become more sophisticated and capable of handling more complex tasks as technology advances. There may be an increase in the use of AI-powered chatbots for legal services, as well as the development of more sophisticated ML algorithms that can analyse enormous quantities of legal data and provide previously difficult or impossible insights. It is essential to observe, however, that AI cannot replace human solicitors. While AI can assist with many tasks, such as document review and research, tasks that require a more nuanced understanding of the law and legal processes will still require human attorneys. The most effective application of AI in the legal industry will entail a combination of AI-powered tools and human expertise.

5. Conclusions

The field of law has always been complex, demanding a scrupulous focus on details and a comprehensive understanding of established legal principles. However, over the past few years, there was a growing interest in the use of AI in the legal domain among academics, practitioners, and policymakers. The study examined the existing studies on AI application in law, its associated benefits, and challenges. An analysis of 177 AIL research articles indexed in Scopus from 2004 to April 2022 was conducted to achieve the following objectives: (1) to identify the most prolific researchers, organisations, and nations/regions involved in AI in law over the past 62 years and their collaborative partnerships; (2) to list the primary areas of focus for AI research in the legal field during the last six decades; (3) to discover the relationships between different research topics and their rate of evolution; and (4) to identify the benefits and challenges of AI in the legal field and suggest promising new research areas. The study concluded that although AI had the potential to significantly improve the efficiency of legal professionals and organisations, its integration required a comprehensive legal framework to regulate its behaviour and mitigate the risks associated with it. Thus, a balanced approach was needed to ensure the safe and beneficial integration of AI in the legal industry.

The following are recommendations:

1) It is necessary to build a sound policy structure that specifies the legal liability of this intelligent machine.
2) To regulate its conduct, the topic of responsibility must be considered.
3) More stringent data protection measures are essential to protect privacy. Nevertheless, the best thing to do is embrace innovative technology and use AI to our advantage by setting up suitable regulations to shield users' rights.

Bibliometric analyses could give evidence-based descriptions, contrasts, and representations of research outputs and may produce a data-driven view of scientific research efforts across diverse research fields. Notwithstanding their widespread use in research assessment, they are confined to publications in indexed journals and exclude unreported research, published research in non-indexed journals, unpublished papers, theses, and other types of study. This results in the exclusion of certain important works on the subject. Thus, some restrictions are inescapable, as in most other bibliometric assessments. To begin with, our investigation only looked at publications designated as journal articles or conference papers. Other sorts of documents (such as books, book chapters, and brief surveys) may have been excluded, resulting in the omission of some valuable contributions to the area or pertinent research. Second, the review was limited to Scopus-only articles, potentially excluding significant papers from pertinent catalogues such as WoS, Google Scholar, and PubMed. A third constraint is the citation count obtained solely from the Scopus database. Dissimilar research catalogues often provide varying numbers of citations. Despite this, the Scopus database remains a critical leading master search database for analysing, comparing, and monitoring citations (Yataganbaba & Kurtbaş, 2016; Zyoud & Fuchs-Hanusch, 2017).

Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

The data that support the findings of this study are openly available at https://www.scopus.com.

References

Alzou'bi, S., Alshibl, H., & Al-Ma'aitah, M. (2014). Artificial intelligence in law enforcement, a review. *International Journal of Advanced Information Technology*, *4*(4), 1–9. http://dx.doi.org/10.5121/ijait.2014.4401

Ampese, L. C., Sganzerla, W. G., Ziero, H. D. D., Mudhoo, A., Martins, G., & Forster-Carneiro, T. (2022). Research progress, trends, and updates on anaerobic digestion technology: A bibliometric analysis. *Journal of Cleaner Production*, *331*. https://doi.org/10.1016/j.jclepro.2021.130004

Avasthi, S., Chauhan, R., & Acharjya, D. P. (2021). Techniques, applications, and issues in mining large-scale text databases. In *Advances in Information Communication Technology and Computing: Proceedings of AICTC 2019*, 385–396. https://doi.org/10.1007/978-981-15-5421-6_39

Avgerinos Loutsaris, M., Lachana, Z., Alexopoulos, C., & Charalabidis, Y. (2021). Legal text processing: Combing two legal ontological approaches through text mining. In *DG.O2021: The 22nd Annual International Conference on Digital Government Research*, 522–532. https://doi.org/10.1145/3463677.3463730

Brunschwig, C. R. (2021). Visual law and legal design: Questions and tentative answers. *Jusletter IT*, 179–230. https://doi.org/10.38023/8b70bb88-de0c-4034-a54c-68409bb9549e

Čyras, V., & Lachmayer, F. (2020). Analogical Methods in Legal Informatics. *Jusletter IT*, 397–404. https://doi.org/10.38023/20364b7c-275e-4c9a-bf29-9728cf26f9b7

Čyras, V., Lachmayer, F., & Lapin, K. (2015). Structural legal visualization. *Informatica*, *26*(2), 199–219. https://doi.org/10.15388/Informatica.2015.45

Čyras, V., Lachmayer, F., & Schweighofer, E. (2016). Views to legal information systems and legal sublevels. In G. Dregvaite & R. Damasevicius (Eds.), *Information and Software Technologies* (pp. 18–29). Springer Cham. https://doi.org/10.1007/978-3-319-46254-7_2

El Shenawy, E., Baker, T., & Lemak, D. J. (2007). A meta-analysis of the effect of TQM on competitive advantage. *International Journal of Quality & Reliability Management*, *24*(5), 442–471. https://doi.org/10.1108/02656710710748349

George, T. T., Obilana, A. O., Oyenihi, A. B., & Rautenbach, F. G. (2021). Moringa oleifera through the years: A bibliometric analysis of scientific research (2000-2020). *South African Journal of Botany*, *141*, 12–24. https://doi.org/10.1016/j.sajb.2021.04.025

Hacker, P. (2018). Teaching fairness to artificial intelligence: Existing and novel strategies against algorithmic discrimination under EU law. *Common Market Law Review*, *55*(4), 1143–1185.

Hair, J. F., & Sarstedt, M. (2021). Data, measurement, and causal inferences in machine learning: Opportunities and challenges for marketing. *Journal of Marketing Theory and Practice*, *29*(1), 65–77. https://doi.org/10.1080/10696679.2020.1860683

Hamledari, H., & Fischer, M. (2021). Role of Blockchain-Enabled Smart Contracts in Automating Construction Progress Payments. *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, *13*(1). https://doi.org/10.1061/(ASCE)LA.1943-4170.0000442

Hoeschl, H. C., & Barcellos, V. (2004). Artificial intelligence and law. In K. Rannenberg (Ed.), *IFIP Advances in Information and Communication Technology* (pp. 25–34). Springer. https://doi.org/10.1007/1-4020-8151-0_3

Jordan, S. R. (2021). Challenges of artificial intelligence review in a soft law environment. *IEEE Technology and Society Magazine*, *40*(4), 57–67. https://doi.org/10.1109/MTS.2021.3123743

Lachmayer, F., & Čyras, V. (2021). Visualization of legal informatics. *Frontiers in Artificial Intelligence and Applications*. Netherlands: IOS Press. https://doi.org/10.3233/FAIA210310

LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *Nature*, *521*(7553), 436–444. https://doi.org/10.1038/nature14539

Lettieri, N., Altamura, A., Faggiano, A., & Malandrino, D. (2016). A computational approach for the experimental study of EU case law: Analysis and implementation. *Social Network Analysis and Mining*, *6*, 1–17. https://doi.org/10.1007/s13278-016-0365-6

Lettieri, N., Altamura, A., Giugno, R., Guarino, A., Malandrino, D., Pulvirenti, A., . . . , & Zaccagnino, R. (2018). Ex machina: Analytical platforms, law and the challenges of computational legal science. *Future Internet*, *10*(5), 37. https://doi.org/10.3390/fi10050037

Lettieri, N., Altamura, A., & Malandrino, D. (2017). The legal macroscope: Experimenting with visual legal analytics. *Information Visualization*, *16*(4), 332–345. https://doi.org/10.1177/1473871616681374

Linnenluecke, M. K., Marrone, M., & Singh, A. K. (2020). Conducting systematic literature reviews and bibliometric analyses. *Australian Journal of Management*, *45*(2), 175–194. https://doi.org/10.1177/0312896219877678

Liu, C. L., Chang, C. T., & Ho, J. H. (2004). Case instance generation and refinement for case-based criminal summary judgments in Chinese. *Journal of Information Science and Engineering*, *20*(4), 783–800.

Liu, G., Nzige, J. H., & Li, K. (2019). Trending topics and themes in off site construction (OSC) research: The application of topic modeling. *Construction Innovation*, *19*(3), 343–366. https://doi.org/10.1108/CI-03-2018-0013

Loutsaris, M. A., & Charalabidis, Y. (2020). Legal informatics from the aspect of interoperability: A review of systems, tools and ontologies. In *Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance*, 731–737. https://doi.org/10.1145/3428502.3428611

Nissan, E. (2017). Digital technologies and artificial intelligence's present and foreseeable impact on lawyering, judging, policing and law enforcement. *AI & Society*, *32*, 441–464. https://doi.org/10.1007/s00146-015-0596-5

Nti, I. K., Adekoya, A. F., Weyori, B. A., & Nyarko-Boateng, O. (2022a). Applications of artificial intelligence in engineering and manufacturing: A systematic review. *Journal of Intelligent Manufacturing*, *33*(6), 1581–1601. https://doi.org/10.1007/s10845-021-01771-6

Nti, I. K., Quarcoo, J. A., Aning, J., & Fosu, G. K. (2022b). A mini-review of machine learning in big data analytics: Applications, challenges, and prospects. *Big Data Mining and Analytics*, *5*(2), 81–97. https://doi.org/10.26599/BDMA.2021.9020028

Parlina, A., Ramli, K., & Murfi, H. (2020). Theme mapping and bibliometrics analysis of one decade of big data research in the Scopus database. *Information*, *11*(2), 69. https://doi.org/10.3390/info11020069

Petit, N. (2018). Artificial Intelligence and Automated Law Enforcement: A Review Paper. *SSRN*. http://dx.doi.org/10.2139/ssrn.3145133

Reed, C. (2018). How should we regulate artificial intelligence? *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *376*(2128), 1–12. https://doi.org/10.1098/rsta.2017.0360

Robaldo, L., & Sun, X. (2017). Reified input/output logic: Combining input/output logic and reification to represent norms coming from existing legislation. *Journal of Logic and Computation*, *27*(8), 2471–2503. https://doi.org/10.1093/logcom/exx009

Ross, T. (2012). *A Survival Guide for Health Research Methods*. UK: McGraw-Hill Education.

Royle, P., Kandala, N. B., Barnard, K., & Waugh, N. (2013). Bibliometrics of systematic reviews: Analysis of citation rates and journal impact factors. *Systematic Reviews*, *2*, 1–11. https://doi.org/10.1186/2046-4053-2-74

Salami, E. (2017). A Brief Overview of Legal Informatics.. *SSRN*. http://dx.doi.org/10.2139/ssrn.2966201

Savage, N. (2020). Learning the algorithms of power. *Nature*. *588*(7837), S102–S104. https://doi.org/10.1038/d41586-020-03409-8

Shih, J. Y., Chang, Y. J., & Chen, W. H. (2008). Using GHSOM to construct legal maps for Taiwan's securities and futures markets. *Expert Systems With Applications*, *34*(2), 850–858. https://doi.org/10.1016/j.eswa.2006.10.031

Shikhar, S. (2021). *Role of artificial intelligence in law*. Retrieved from: https://blog.ipleaders.in/role-of-artificial-intelligence-in-law/

Silver, D., Huang, A., Maddison, C. J., Guez, A., Sifre, L., van den Driessche, G., . . . , & Hassabis, D. (2016). Mastering the game of go with deep neural networks and tree search. *Nature*, *529*(7587), 484–489. https://doi.org/10.1038/nature16961

Stavropoulou, S., Romas, I., Tsekeridou, S., Loutsaris, M. A., Lampoltshammer, T., Thurnay, L., . . . , & Charalambidis, Y. (2020). Architecting an innovative big open legal data analytics, search and retrieval platform. In *Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance*, 723–730. https://doi.org/10.1145/3428502.3428610

Stegenga, J. (2011). Is meta-analysis the platinum standard of evidence? *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences*, *42*(4), 497–507. https://doi.org/10.1016/j.shpsc.2011.07.003

Steinmüller, W. (1979). Legal problems of computer networks: A methodological survey. *Computer Networks (1976)*, *3*(3), 187–198. https://doi.org/10.1016/0376-5075(79)90040-0

Virkar, S., Alexopoulos, C., Stavropoulou, S., Tsekeridou, S., & Novak, A. S. (2020). User-centric decision support system design in legal informatics: A typology of users. In *Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance*, 711–722. https://doi.org/10.1145/3428502.3428609

Von Bonin, A., & Malhi, S. (2020). The use of artificial intelligence in the future of competition law enforcement. *Journal of European Competition Law and Practice*, *11*(8), 468–471. https://doi.org/10.1093/jeclap/lpaa077

Walker, E., Hernandez, A. V., & Kattan, M. W. (2008). Meta-analysis: Its strengths and limitations. *Cleveland Clinic Journal of Medicine*, *75*(6), 431–439. https://doi.org/10.3949/ccjm.75.6.431

Wamba, S. F., Bawack, R. E., Guthrie, C., Queiroz, M. M., & Carillo, K. D. A. (2021). Are we preparing for a good AI society? A bibliometric review and research agenda. *Technological Forecasting and Social Change*, *164*. https://doi.org/10.1016/j.techfore.2020.120482

Yataganbaba, A., & Kurtbaş, İ. (2016). A scientific approach with bibliometric analysis related to brick and tile drying: A review. *Renewable and Sustainable Energy Reviews*, *59*, 206–224. https://doi.org/10.1016/j.rser.2015.12.357

Zhang, Y., Huang, Y., Porter, A. L., Zhang, G., & Lu, J. (2019). Discovering and forecasting interactions in big data research: A learning-enhanced bibliometric study. *Technological Forecasting and Social Change*, *146*, 795–807. https://doi.org/10.1016/j.techfore.2018.06.007

Zyoud, S. H., & Fuchs-Hanusch, D. (2017). A bibliometric-based survey on AHP and TOPSIS techniques. *Expert Systems with Applications*, *78*, 158–181. https://doi.org/10.1016/j.eswa.2017.02.016

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