UNVEILING TRENDS IN ARTIFICIAL INTELLIGENCE FOR INTELLECTUAL PROPERTY MANAGEMENT: INSIGHTS FROM PATENT DATA ANALYSIS

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ABSTRACT
This paper investigates the growing intersection of artificial intelligence (AI) and intellectual property (IP) management through an analysis of global patent data from 2014 to 2023. While AI's role in various industries has expanded significantly, research on its application in IP management remains limited. To bridge this gap, this study examines trends in AI-related patent applications specific to IP management. From 2014 to 2021, overall AI patent applications grew nearly eightfold, while AI patents specifically targeting IP management increased sixfold between 2014 and 2019. This research highlights key technological advancements and provides a comprehensive overview of geographical patent filing strategies adopted by leading patent assignees. For instance, IBM, Obeebo Labs Ltd., and Black Hills IP Holdings LLC concentrate their patent filings predominantly on the U.S. market, whereas other entities pursue a more international strategy. Notably, AON Risk Services Inc. holds the largest number of patent families, primarily focusing on IP data and document analysis, and IP landscaping. Entities such as IPwe Inc., Clarivate plc (via Camelot UK Bidco Limited), Strong Force TX Portfolio 2018 LLC, Specifio Inc., Arctic Alliance Limited, and Black Hills IP Holdings LLC demonstrate specialized applications of AI in IP management tools, valuation, transactions, and automation. These findings reveal the competitive landscape, collaboration opportunities, and strategic priorities in this evolving field, providing insights for innovators, IP professionals, policymakers, and investors navigating AI's impact on IP management.
Keywords: Artificial Intelligence, Intellectual Property Management, Patent Data Analysis

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INTRODUCTION

Artificial intelligence (AI) is rapidly integrating into daily life, driving global innovation across various industries. AI is anticipated to significantly transform intellectual property (IP) systems, particularly in the management of patent rights, data ownership, and innovation strategies (WIPO, 2019). IP offices worldwide are increasingly implementing AI-driven initiatives to streamline processes such as search, classification, and translation, thereby boosting productivity (WIPO, 2024). However, existing research provides limited insight into the full scope of AI applications in IP management. This paper addresses this gap by conducting a comprehensive analysis of patent data in this emerging field. It investigates how technology has evolved over the past decade, from 2014 to 2023, while identifying leading patent assignees. Additionally, the study analyzes the geographic distribution of patent applications and the portfolios of major patent holders, highlighting technological advancements, filing strategies, the competitive environment, and opportunities for strategic partnerships. The findings offer valuable insights for a wide range of stakeholders, including inventors and organizations developing products or services in IP management or legal technology, government IP agencies, policymakers, law firms, and IP professionals aiming to enhance their services. Researchers and investors will also find the information valuable, with the study identifying key growth opportunities.

LITERATURE REVIEWS

Intellectual Property Management

Intellectual property (IP) refers to "that class of intangible assets on which legal rights have been conferred by a sovereign state whereby the recipients of those rights possess the authority to exclude others from using, making, selling, distributing, importing, copying or otherwise exploiting those assets without permission" (Willoughby, in Tekic and Willoughby, 2020: 131). IP rights come in different forms, including patents, trademarks, copyrights, design rights, and trade secrets. National IP laws vary, but they generally grant creators specific rights, often for a limited duration, to control how their creations are used (Bogers et al., 2012). IP management involves strategically identifying, protecting, and leveraging IP assets to align with an organization's business goals and maximize their value (Fisher & Oberholzer-Gee, 2013; Saksupapchon & Willoughby, 2021). Effective IP management allows organizations to enhance the economic value of their intellectual assets, and transition from defensive strategies to dynamic approaches that sustain competitive advantage.

Strategies for Filing Patent Applications

Patent applicants typically begin with a domestic application, establishing the "priority date," which serves as the reference for subsequent filings of the same invention. The Paris Convention permits applicants to submit their filings in additional countries or regions within 12 months from this date. The Patent Cooperation Treaty (PCT) extends this timeline to up to 30 months, enabling applicants to determine where to seek international protection through the World Intellectual Property Organization (WIPO). Applicants may choose to file solely in their home country if focused on domestic operations or constrained financially, while those with international business interests or adequate resources may seek broader patent protection abroad (Stevnsborg & van Pottelsberghe, 2007). Firms' decisions on where to file patents are shaped by several key factors, including the size of the market, the technological competitiveness of rivals in specific regions, and the expenses associated with securing and upkeeping patent rights across different areas (Eaton & Kortum, 1996; Henry, 2024).

Artificial Intelligence for Intellectual Property Management

Artificial intelligence (AI) is a multidisciplinary field of computer science dedicated to creating systems that can carry out tasks usually requiring human intelligence, including learning, reasoning, problem-solving, and decision-making (Russell & Norvig, 2021). Over the decades,

AI research has evolved significantly, encompassing subfields such as machine learning, natural language processing, and computer vision. Literature on AI demonstrates diverse applications across industries, including healthcare, finance, and education, while also exploring its ethical implications and societal impact (Nilsson, 2010; Goodfellow et al., 2016). The emergence of AI is transforming various aspects of IP management. While initial discussions focused on the potential of AI to generate patentable inventions, leading to debates about inventorship and ownership (Abbott, 2016), the literature has now broadened to encompass the application of AI in diverse IP-related tasks. This includes AI-powered tools for patent searching and analysis, enabling more efficient prior art searches and identification of patent trends (WIPO, 2019). As AI continues to evolve, its role in enhancing IP management practices and addressing emerging legal challenges remains a focal point of academic inquiry.

RESEARCH METHODOLOGY

This study examines technology trends by analyzing patents with application dates between January 1, 2014, and December 31, 2023. The analysis utilizes data retrieved on November 10, 2024, from the PATENTSCOPE database (https://patentscope.wipo.int), a free resource made available by the World Intellectual Property Organization (WIPO). Petty patents, also known as utility models, are excluded from this study as they cover inventions that may not fulfill the stricter requirements of inventive step or non-obviousness mandated for standard patents. Notably, patent search results are subject to limitations due to the 18-month confidentiality period during which newly filed applications remain unpublished.

Patent data relevant to IP management was retrieved using the Cooperative Patent Classification (CPC) code “G06Q50/184,” which pertains to “information and communication technology specifically adapted for intellectual property management” (USPTO, 2024). This classification is part of the system jointly created by the United States Patent and Trademark Office (USPTO) and the European Patent Office (EPO). The identification of patents related to AI, however, presents challenges due to the absence of a dedicated CPC code and their dispersion across diverse technological domains. According to a study by Leusin et al. (2020), 92.1% of AI-related patents can be identified using the keywords: “artificial intelligence,” “machine intelligence,” “machine learning,” “neural network,” “support vector machine,” “support vector network,” “expert system,” and “fuzzy logic.” In this study, these keywords were combined with the CPC code “G06Q50/184” to specifically identify patents addressing AI applications in IP management.

The search query employed to retrieve patents related to AI for IP management, covering application dates from January 1, 2014, to December 31, 2023, is as follows:

CPC:(G06Q50/184) AND EN_ALL:("artificial intelligence" OR "machine intelligence" OR "machine learning" OR "neural network" OR "support vector machine" OR "support vector network" OR "expert system" OR "fuzzy logic") AND AD:([01.01.2014 TO 31.12.2023]) ANDNOT DTY:(U)

The study utilized a patent landscaping approach to analyze data, uncovering trends, identifying gaps, and mapping the competitive landscape in the field of AI applied to IP management. A comparative assessment was performed to evaluate the leading patent assignees within this technological domain, focusing on their geographic patent filing strategies and the specific IP management inventions highlighted in their patent portfolios. To enhance the reliability of the findings, the results were corroborated with external sources, including corporate websites, reports, industry analyses, and news articles.

RESEARCH RESULTS

Global trends in patent applications for AI, IP management, and AI for IP management

The results of the patent search, illustrated in Figure 1, reveal key trends in patent activity from 2014 to 2023. During this period, a total of 943,376 patent applications (657,009 patent families) were filed in the AI sector, while 5,110 applications (3,777 patent families) were filed in the IP management sector. Additionally, 737 applications (476 patent families) focused on the intersection of AI and IP management. A patent family refers to a set of patent applications associated with the same invention (European Patent Office, n.d.).

Figures 2-4 depict global trends in patent applications for AI, IP management, and AI for IP management. AI patent filings surged nearly eightfold, from 21,158 in 2014 to a peak of 164,858 in 2021, before stabilizing in 2022 and decreasing to 135,624 in 2023. Patents in IP management tripled, rising from 279 in 2014 to 791 in 2020, but declined to 417 by 2023. Similarly, AI applications specific to IP management increased sixfold, from 26 in 2014 to 143 in 2019, then dropped to 83 in 2023. In 2019, approximately 20% of IP management patents were AI-driven. Notably, the 2023 decline may partly reflect unpublished patents due to the 18-month confidentiality period.

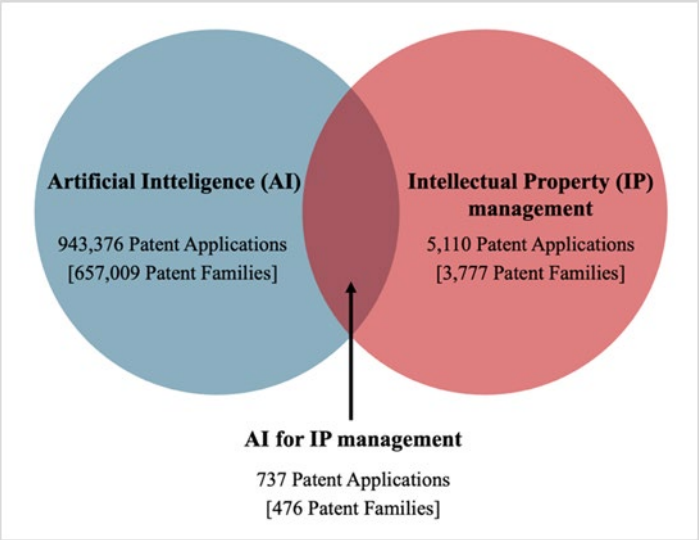

Figure 1 Numbers of patent applications and patent families in AI, IP management, and AI for IP management

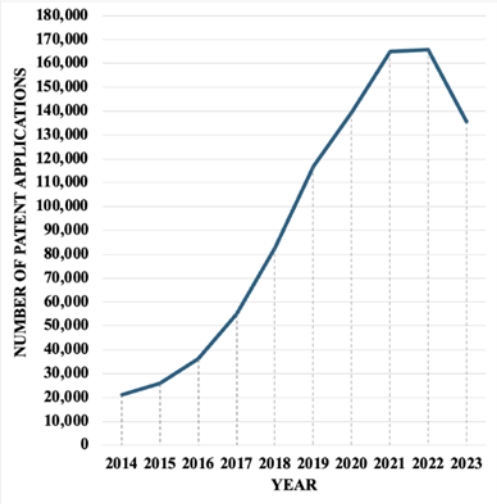

Figure 2 Trend of patent applications in AI

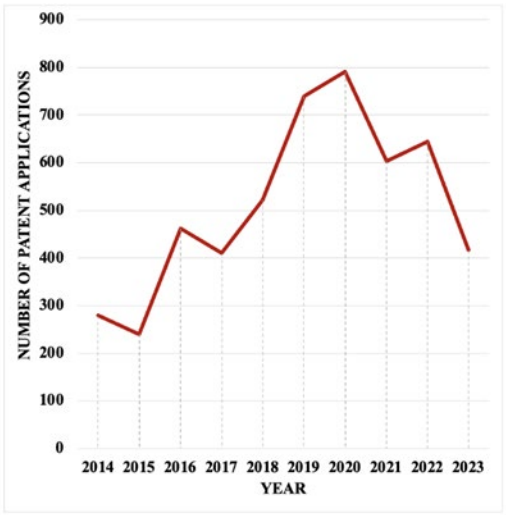

Figure 3 Trend of patent applications in IP management

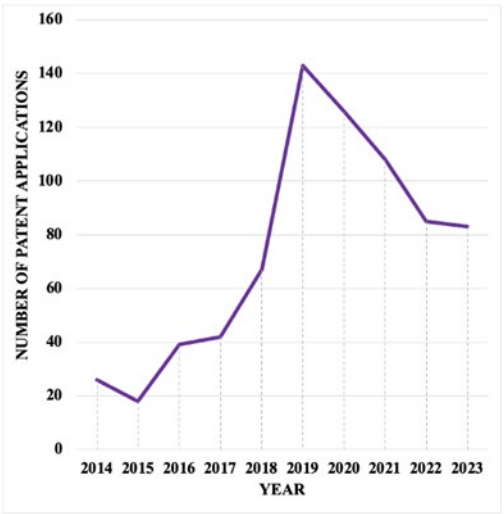

Figure 4 Trend of patent applications in AI for IP management

Leading Patent Assignees in AI for IP Management: Filing Jurisdictions and Patent Family Insights

The patent landscape of AI for IP management reveals diverse filing strategies among the top ten patent assignees, as detailed in Table 1. The top three entities are AON Risk Services Inc. of Maryland, IPwe Inc., and Camelot UK Bidco Limited. While International Business Machines Corporation (IBM), Obeebo Labs Ltd., and Black Hills IP Holdings LLC have exclusively focused their filings within the United States (US), others demonstrate more varied approaches. IPwe Inc. and Google LLC have prioritized the US, with additional filings at the World Intellectual Property Organization (WO). AON Risk Services Inc., and Camelot UK Bidco Limited have primarily targeted the US, with supplementary filings at WO and the Canadian Intellectual Property Office (CA). Audible Magic Corporation has concentrated on the US and the European Patent Office (EP), whereas Shenzhen Winstrong Information Technology Ltd. has focused on WO and China (CN). Strong Force TX Portfolio 2018 LLC has employed a broader strategy, primarily targeting the US and extending its filings to WO, CA, and Australia (AU). Specifio Inc. mirrors this wide-ranging approach, adding the EP to its portfolio. Arctic Alliance Limited, meanwhile, has focused on the United Kingdom (UK) while also filing in the US, EP, and WO. This data underscores the strategic jurisdictional preferences

of major players in AI-driven IP management. Note that unlike other organizations, the patent applications associated with IPwe were assigned to individuals, led by Erich Lawson Spangenberg, rather than being filed under the company's name.

Table 1 Top Patent Assignees in AI for IP management and Filing Jurisdictions

No.	Patent Assignees	Rank by Number of Patent Families	Number of Patent Families	Number of Patent Applications in Different Jurisdictions *							
				Total Number of Patent Applications	WO	US	CA	EP	AU	GB	CN
1	AON Risk Services Inc. of Maryland	1st	**26**	**38**	5	32	1	0	0	0	0
2	Individuals associated with IPwe Inc. (Erich Lawson Spangenberg et al.) **	2nd	**23**	**36**	4	32	0	0	0	0	0
3	Camelot UK Bidco Limited	3rd	**7**	**9**	3	5	1	0	0	0	0
4	International Business Machines Corporation (IBM)	4th	**6**	**6**	0	6	0	0	0	0	0
5	Strong Force TX Portfolio 2018 LLC	5th	**5**	**85**	4	74	3	0	4	0	0
6	Audible Magic Corporation	5th	**5**	**8**	0	5	0	3	0	0	0
7	Google LLC	5th	**5**	**6**	1	5	0	0	0	0	0
8	Obeebo Labs Ltd.	5th	**5**	**5**	0	5	0	0	0	0	0
9	Shenzhen Winstrong Information Technology Ltd.	5th	**5**	**5**	4	0	0	0	0	0	1
10	Specifio Inc.	10th	**4**	**9**	1	5	1	1	1	0	0
11	Arctic Alliance Limited	10th	**4**	**8**	1	2	0	2	0	3	0
12	Black Hills IP Holdings LLC	10th	**4**	**4**	0	4	0	0	0	0	0

* The codes for country or regional patent offices: WO (World Intellectual Property Organization), US (United States Patent and Trademark Office; USPTO), CA (Canadian Intellectual Property Office; CIPO), EP (European Patent Office; EPO), AU (IP Australia), GB (United Kingdom Intellectual Property Office; UKIPO), and CN (China National Intellectual Property Administration; CNIPA)

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Table 2 presents an overview of the patent families associated with leading patent assignees in the field of AI for IP management. AON Risk Services Inc. of Maryland, a subsidiary of the global insurance and consulting giant AON plc, holds the largest number of patent families or inventions in this domain, with a total of 26 distinct patent families. Headquartered in the United States, AON specializes in risk management, insurance brokerage, and human capital solutions. AON provides IP solutions to help businesses evaluate their assets, manage risks, and align them with strategic growth objectives (Aon, 2021). The delineation of its patent families covers various areas, including IP data analysis, IP landscaping platforms, document or claim analysis, digital property authentication management, IP liability or insurance, and trademark distinctiveness modeling. These patent families showcase Aon's significant role in advancing AI-driven IP management tools.

Several companies primarily focused on the IP sector are included among the patent assignees, such as IPwe Inc., Camelot UK Bidco Limited, Strong Force TX Portfolio 2018 LLC, Specifio Inc., Arctic Alliance Limited, and Black Hills IP Holdings LLC. IPwe Inc., founded in 2018 by Erich Spangenberg, was a technology-driven company based in the United States that utilized blockchain and AI to streamline patent analysis, management, monetization, and transactions (Crunchbase, 2024). Despite its innovation, IPwe faced financial difficulties and filed for bankruptcy in early 2024, resulting in liquidation and closure (Inforuptcy, 2024). The company's patent portfolio encompassed various inventions related to IP valuation and financing, patent management platform, IP ownership and title assurance, defensive patent

aggregation and freedom to operate (FTO) compliance, and technology transfer platform, all of which were powered by blockchain and AI technologies.

Table 2 Top Patent Assignees in AI for IP management and Patent Family Analysis

No.	Organization Name	Organization Description	Business Sector	Country of Headquarters	Number of Patent Families Related to AI for IP Management	Delineation of Patent Families Related to AI for IP Management
1	AON Risk Services Inc. of Maryland	AON Risk Services Inc., a subsidiary of Aon plc, offers services including risk management, insurance brokerage, and consulting focused on human capital solutions.	Risk Management, Insurance and Consulting	USA	26	• IP Data Analysis (Products/Services) (6 patent families) • IP Analysis/Landscaping Platforms (5 patent families) • Document/Claim Analysis (Linguistic/Automated) (5 patent families) • Digital Property Authentication/Management (5 patent families) • IP Liability/Insurance (3 patent families) • Dataset/Trademark Distinctiveness Modeling (2 patent families)
2	IPwe Inc.	IPwe Inc., established by Erich Spangenberg, uses blockchain and AI to create an advanced platform for managing, monetizing, and analyzing patents and IP.	Intellectual Property and Technology	USA	23	[Inventions powered by blockchain and AI] • IP Valuation & Financing (9 patent families) • Patent Management Platforms (6 patent families) • IP Ownership & Title Assurance (4 patent families) • Defensive patent aggregation and freedom to operate(FTO)compliance to reduce IP risks (3 patent families) • Technology Transfer Platforms (1 patent family)
3	Camelot UK Bidco Limited	Camelot UK Bidco Limited is part of Clarivate plc, supporting its financial and corporate activities, including acquisitions. Clarivate is a global leader in information services and analytics, specializing in research, innovation and intellectual property management.	Information Services and Analytics (Research, Innovation and Intellectual Property)	UK	7	• Trademark Similarity/Analysis (3 patent families) • Trademark Monitoring/Evidence Gathering (1 patent family) • IP Transaction Facilitation (1 patent family) • Identifier Record Strength/Analysis (1 patent family) • In-Browser Content Analysis and Markup (1 patent family)
4	International Business Machines Corporation (IBM)	IBM is a global leader in technology, providing hardware, software, and cloud computing solutions to businesses worldwide.	Technology and Consulting	USA	6	• IP/Patent Evaluation and Valuation (2 patent families) • Software Licensing & Usage Management (2 patent families) • IP Data Ownership Assessment (1 patent family) • Mobile Geo-Location IP Protection (1 patent family)
5	Strong Force TX Portfolio 2018 LLC	Strong Force TX Portfolio 2018 LLC, part of the Strong Force group, specializes in developing and managing patent portfolios across multiple technological sectors.	Intellectual Property and Technology	USA	5	• IP Marketplace and Transactions (2 patent families) • Digital Knowledge Rights Management, Tokenization and Smart Contract (2 patent families) • Asset Tokenization Platform (1 patent family)
6	Audible Magic Corporation	Audible Magic Corporation is recognized for its automatic content recognition (ACR) technology, offering services such as copyright compliance, audio and video fingerprinting, and rights management.	Technology and Media	USA	5	• Media Rights Management (3 patent families) • Media identification and Classification (2 patent families)
7	Google LLC	Google LLC is a global technology leader known for its innovations in search engines, online advertising, cloud services, and a wide range of hardware and software products.	Technology and Internet	USA	5	• Content Ownership Representation (2 patent families) • Social Interaction-Based Policies for Digital Media (2 patent families) • Rights Management of Embedded Sound Recordings (1 patent family)
8	Obeebo Labs Ltd.	Obeebo Labs Ltd. is a pioneer in advanced music technology, specializing in AI-based systems that support music generation, mood analysis, and sound classification.	Technology and Music	Canada	5	• Musical Catalog Amplification (2 patent families) • Mood Labeling in Music (1 patent family) • Computer-Generated Note Sequences (1 patent family) • Computer-Generated Musical Compositions (1 patent family)
9	Shenzhen Winstrong Information Technology Ltd.	Shenzhen Winstrong Information Technology Ltd. focuses on creating innovative systems and solutions that combine big data and AI, with a particular emphasis on IP management and urban safety monitoring.	IT Services and Data Solutions	China	5	• Evaluation of Trademark Registration Possibilities (4 patent families) • Technical Confidentiality Assessment (1 patent family)
10	Specifio Inc.	Specifio Inc. leverages AI to automate the creation of patent drafts, transforming basic claim drafts into fully detailed applications, including figures and formalities.	Intellectual Property and Technology	USA	4	• Automated Patent Drafting (3 patent families) • Patent Document Template Extraction (1 patent family)
11	Arctic Alliance Limited	Operating under the brand name "Aalbun," Arctic Alliance Limited offers a cutting-edge online legal technology platform focused on IP services.	Intellectual Property and Technology	UK	4	• Patent/IP Management Tools (3 patent families) • Secure Patent Data Management (1 patent family)
12	Black Hills IP Holdings LLC	Black Hills IP Holdings LLC specializes in IP services, offering docketing, paralegal support, and data analytics, with a focus on integrating AI to improve automation.	Intellectual Property and Technology	USA	4	• Patent/IP Management Tools (2 patent families) • Patent Landscape and Citation Tools (1 patent family) • Docketing Automation (1 patent family)

Camelot UK Bidco Limited, based in the UK, operates as a subsidiary of Clarivate plc, a leading global provider of information services and analytics (SEC, 2022). Founded in 2016 and headquartered in the United States, Clarivate specializes in delivering comprehensive

solutions across research, innovation, and IP management (Clarivate, 2024). The company's diverse patent family portfolio covers key areas such as trademark similarity analysis, trademark monitoring and evidence gathering, IP transaction facilitation, identifier record strength analysis, and in-browser content analysis and markup. Strong Force TX Portfolio 2018 LLC, part of the Strong Force group, operates in the United States and specializes in the development and management of patent portfolios across various technological sectors (Strong Force, 2024). The company's patent families encompass a wide range of IP services, including IP marketplace transactions, digital knowledge rights management, tokenization and smart contracts, as well as asset tokenization platforms. Specifio Inc., founded in 2017 and based in the United States, was acquired by Paximal, Inc. (Tracxn, 2024). The company utilizes AI to automate the process of drafting patent applications. Its patent families are focused on automated patent drafting and patent document template extraction. Arctic Alliance Limited, founded in 2014 and trading under the name 'Aalbun,' is a UK-based company offering a state-of-the-art online legal technology platform that provides IP services (Aalbun, 2024). Its patent families concentrate on patent management tools and secure patent data management. Black Hills IP Holdings LLC, founded in 2011 and headquartered in the United States, provides IP services, including docketing, paralegal support, and data analytics, with a focus on leveraging AI to enhance automation (Black Hills AI, 2024). Its patent families cover IP management tools, patent landscape and citation tools, as well as docketing automation.

IBM and Google LLC, two leading global technology firms, have made significant contributions to the integration of AI and IP management. IBM's patents include innovations in IP evaluation and valuation, software licensing and usage management, IP data ownership assessment, and mobile geo-location IP protection. On the other hand, Google's patents focus on content ownership representation, social interaction-based policies for digital media, and rights management of embedded sound recordings.

Audible Magic Corporation, founded in 1999 and based in the United States, is renowned for its advanced automatic content recognition (ACR) technology, offering services such as copyright compliance, audio and video fingerprinting, and rights management (Audible Magic, 2023). Its patent families emphasize media identification, classification, and rights management. Obeebo Labs Ltd., incorporated in 2019 and based in Canada, excels in AI-driven music technology, providing cutting-edge systems for music generation, mood analysis, and sound classification (IPQwery, 2024a). The company's patent portfolio highlights advancements in musical catalog amplification, mood-based labeling, and computer-generated note sequences and compositions. Meanwhile, Shenzhen Winstrong Information Technology Ltd., based in China, focuses on integrating big data and AI to develop systems for urban safety monitoring and IP management (IPQwery, 2024b). Its patent families addressing trademark registration evaluation and technical confidentiality assessment. The patent families of these organizations showcase the broad and innovative applications of AI in advancing IP management across various areas, underscoring the increasing impact of technology in reshaping the way intellectual property is managed.

DISCUSSION & CONCLUSION

The analysis of patent data presented in this study highlights a significant evolution in the intersection of AI and IP management over the past decade, from 2014 to 2023. The number of AI-related patent applications surged nearly eightfold from 2014 to 2021, underscoring AI's exponential expansion across various industries. While patents in IP management also grew, the intersection of AI and IP management, though smaller, experienced a sixfold increase between 2014 and 2019, reflecting the growing integration of AI into this specialized area. Overall, the data shows the rising significance of AI in IP management, highlighting its transformative potential in reshaping IP processes. The trajectory indicates that AI is

increasingly becoming an essential tool for IP professionals in this evolving field. However, a decline in patent filings across all three categories was observed in 2023, which may be partially attributed to the 18-month confidentiality period for unpublished patents. This trend warrants further investigation in future research to ascertain whether it represents a temporary fluctuation or a shift in innovation focus.

The analysis of leading patent assignees revealed diverse filing strategies and specializations within the AI for IP management landscape. While some entities, such as IBM, Obeebo Labs Ltd., and Black Hills IP Holdings LLC, concentrated their filings within the United States, their headquarters country, others adopted more geographically diverse strategies, including filings with the World Intellectual Property Organization, the European Patent Office, and other national patent offices. This highlights the global nature of innovation in this field and the strategic considerations of different organizations.

AON Risk Services Inc. held the largest number of patent families, showcasing its substantial investment in AI-driven IP management tools across various areas, including IP data analysis, landscaping platforms, claim evaluation, digital property authentication, IP liability and insurance, as well as trademark distinctiveness modeling. Notably, several IP-focused companies, such as IPwe Inc. (despite its subsequent bankruptcy), Clarivate plc (through its subsidiary Camelot UK Bidco Limited), Strong Force TX Portfolio 2018 LLC, Specifio Inc., Arctic Alliance Limited, and Black Hills IP Holdings LLC, demonstrated specialized applications of AI in areas such as IP valuation, transaction facilitation, automated patent drafting, and docketing automation. The contributions of major technology firms like IBM and Google, as well as specialized companies like Audible Magic Corporation and Obeebo Labs Ltd., further underscore the breadth and depth of AI's impact on IP management across diverse sectors. These findings provide valuable insights into the competitive landscape, technological advancements, and strategic priorities of key players in this rapidly evolving field, offering valuable information for stakeholders ranging from inventors and IP professionals to law firms, tech companies, government agencies, researchers, and investors.

Future research should explore the impact of AI tools on IP management, especially regarding efficiency and decision-making. It should also examine the ethical and legal challenges, including IP ownership, accountability, and transparency in AI decisions. Addressing these issues will enhance understanding of the relationship between technology, law, and innovation.

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