

Review Article

A Survey on Services Provision and Distribution of Official and Commercial Intellectual Property Platforms

Yang Wang ¹, Haijin Gui,² and Lei Ma ³

¹School of Intellectual Property, Nanjing University of Science and Technology, Nanjing 210094, China

²Wuxi Vocational Institute of Commerce, Wuxi 214153, China

³School of Public Affairs, Nanjing University of Science and Technology, Nanjing 210094, China

Correspondence should be addressed to Lei Ma; maryma208@sina.com

Received 1 May 2020; Revised 1 June 2020; Accepted 18 June 2020; Published 1 August 2020

Academic Editor: Xiaolong Xu

Copyright © 2020 Yang Wang et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Next generation of Information Technologies (IT), such as edging/cloud computing, cybersecurity, and artificial intelligence, has been in a rapid development and therefore concerned wide areas. Management of Intellectual Property Rights (IPR) plays an increasingly important role on knowledge design and engineering, innovation and patent management, intangible assets audition, R&D, and so forth; however, it also meets the challenges from proper platform and service provision, especially when large-scale mobile and distributed requirements become popular. In this paper, Intellectual Property Platforms and corresponding commercial tools have been collected, investigated, and reviewed, involving official platforms in China, USA, EU, and another 6 countries, as well as 12 intellectual property analysis tools commonly used online. Detailed comparison and discussion have been undertaken in order to find potential challenges and opportunities for improved service provision, for example, searching privacy preservation, cloud/edge-based service offloading and efficient distribution, and ontology-based intelligent IPR engineering, which can possibly be commercialised in the near future.

1. Introduction

The powerful advantages of cloud computing technology bring great convenience to the public. With the deepening of technology demand, edge computing also plays a huge role. Edge computing is an open framework, in which data source close to the edge of the network and integrates core functions, such as grid, storage, computing, application, and provides the nearest edge intelligent service according to the main needs of the current digital industry in data optimization, fast connection, privacy security protection, and so forth [1, 2]. However, it cannot be ignored that there are still considerable opportunities and challenges in wireless communication security of edge-cloud computing [3]. In the same network, including the data information, its security and usability are threatened, thus the extension of a series of network security management technology, such as data encryption technology, antivirus technology, firewall technology. The Internet of things further extends the physical

and logical boundaries of the Internet, gradually forming a three-tier service delivery architecture based on the matter-edge-cloud. With the emerging era of 5G network, edge computing can be applied to computing unloading of Internet of things [4–6].

Intellectual Property (IP) refers to invention; literary works are created by the mind, including symbols, names, and images used in business. In law, IP rights are protected by patents, copyrights, trademarks, and so forth, to ensure that people can obtain recognition and their own interests from their own inventions or creations. In order to create and innovate a thriving environment, an IP system should be built to achieve the balance between innovators and wider public interests [7, 8].

There are two types of IP rights:

- (i) Industrial property is composed of industrial design, invention patent, trademark, and geographical indication.

- (ii) Copyright includes literary works, film and television works, art works, and architectural design. For example, the rights of performing artists and producers of works are related to copyright.

Nowadays, industry 4.0 and industry 5.0 have been envisaged, which is likely to bring significant changes to IP and IP information [9–11]. With the rapid development of Internet innovation technology, information resources have become one of the most strategic resources in the current society [12, 13]. The key to global competition in the future is IP competition. It is the general trend to provide the privacy protection methods of blockchain in the network mobile environment, improve the society's awareness of IP protection in the network environment [14–16], and guide the whole society to raise the issue of IP protection to the global development strategy. With the increasing number of published IP rights, what searches the target information quickly, accurately, and securely from the massive data has become one of the most concerned hot issues of the public. At the same time, the retrieval and analysis of this huge knowledge source becomes a complex, detailed, highly interactive, and repetitive task, which requires a lot of professional knowledge with different retrieval strategies. For this reason, the number of analysis platforms issued by relevant domestic and foreign institutions has increased correspondingly to assist in reviewing a great quantity of files. This paper describes the commonly used Intellectual Property (IP) offices in various countries and the main patent search and analysis platforms in China and abroad and summarizes and compares their pros and cons.

The rest of the paper is divided into the following sections: Intellectual Property Platforms have been introduced in Section 2, followed by intellectual property services provision in Section 3. Detailed discussions and perspectives have been proposed in Section 4 with conclusion in Section 5.

2. Intellectual Property Platforms

2.1. Intellectual Property Platforms in China. The China National Intellectual Property Administration (CNIPA) [17] formerly was called the State Intellectual Property Office of China (SIPO), which is supervised by the newly established state administration for market regulation now. It was established in 1980 with the approval of the State Council. CNIPA mainly manages patent, utility model, trademark, and other IP related fields. The patent search and analysis system launched by CNIPA provides rich and comprehensive data resources and professional and high-quality patent search and analysis services. At present, the system has included patent data of 103 countries, regions, and organizations, including abstract data, full-text data, citations, and legal status data.

2.2. Intellectual Property Platforms in USA. The United States Patent and Trademark Office (USPTO) is an agency of the US Department of Commerce that issues patents to inventors and businesses for their inventions [18] and

registers trademarks for the certification of invention products and IP property rights. Through trademark registration, the interests of commercial investment are protected, products and services are promoted, and the rights and interests of consumers are protected. Its main function is to process and disseminate patent and trademark information. The USPTO promotes the development of knowledge technology by issuing patents and provides rewards and compensation for inventions, investors of invention patents, and global public dissemination of new technologies.

2.3. Intellectual Property Platforms in European Union. The examiner of the European Patent Office (EPO) is responsible for studying, examining, and deciding whether to pass the European patent application submitted by the applicant and granting patents to the Contracting States of the European Patent Convention [19]. It is known as the European patent. Although EPO provides a single grant process, the granted patents are a series of national patents. In addition to granting European patents, it is also responsible for the national patent application search report generated on behalf of 13 national patent offices in France, Italy, the Netherlands, Belgium, and so forth. Retrieval and review procedures shall be carried out separately, and application information can be processed in a timely manner. In addition, domestic patent application can be applied for protection by multiple countries at the same time and can enjoy the same effect in any member country, using English, French, and German languages, with freedom of language.

2.4. Intellectual Property Platforms in Other Developed Countries. UK-Intellectual Property Office (UK-IPO) is set up by the British government [20]. Its function is to review and approve relevant legal IP rights (such as patents, designs, trademarks, and copyrights). Besides, coordinating the relevant work of government policy makers, law-enforcing departments and enterprises, jointly deal with criminal acts in the field of IP rights, and ensure the legitimacy of IP rights.

The Japanese Patent Office (JPO) is a government agency responsible for industrial property affairs, which is subordinate to the Ministry of economy and industry of Japan [21]. The Japanese patent office is one of the largest in the world. The main function of Japan's patent office is to manage laws related to patents, utility models, designs and trademarks, so as to promote the growth of Japan's economy and industry. The specific copyright affairs shall be managed by the Cultural Affairs Bureau.

Korea Intellectual Property Office (KIPO) established Korea Intellectual Property Rights Information Service (KIPRIS) centre and provided Internet Patent information retrieval service [22, 23]. Korean patent provided English version of Korean Patent Abstract (KPA) foreign utility model retrieval service. In addition, KIPRIS can provide patent (including patent and utility model) search, design search, trademark search, KPA search, Korean English machine translation and other services.

The German Patent and Trade Mark Office (DPMA) belongs to the jurisdiction of the Federal Ministry of justice

and is the management centre of German industrial property [24]. DPMA is the largest intellectual property office in Europe and the fifth in the World Intellectual Property Office. DPMA's main responsibility is to confer, register, manage, and issue IP related information.

The Canadian Intellectual Property Office (CIPO) is an unusual running institution established by the Ministry of Innovation, Science and Economic Development of Canada [25]. CIPO is mainly responsible for the management of patent, trademark, copyright, industrial design, layout, and other implementation affairs of integrated circuit. Among them, CIPO patent department is responsible for patent application and authorization, and industrial design department is responsible for engineering registration of industrial design.

3. Intellectual Property Services Provision

3.1. Intellectual Property Searching and Retrieval Services. Intellectual property search and acquisition services are mainly for the search and acquisition of patents, trademarks, copyrights, and so forth. In the era of science and technology, information and data are growing explosively, and increasing Intellectual Property Rights are included in major patent offices around the world. In order to provide rapid and accurate screening for the public and facilitate institutions and groups, relevant institutions or enterprises in each country are trying to develop search tools for IP information and link to IP databases in different countries through the platform. And the search methods and functions applied to the platform are more and more mature [26, 27]. From the perspective of patent search, this paper introduces the commonly used IP search websites at home and abroad. The details are as follows.

The main page of the website of the SIPO has the function of patent search, as shown in Figure 1, which contains all patent information since the first patent application, including description items, abstracts, specifications and design graphics. There are three retrieval methods: simple retrieval, advanced retrieval, and PC classified retrieval. In addition, some Chinese search websites provide search services, such as China Patent Database, Wanfang Data Knowledge Service Platform, SooPAT Patent Search Engine, Patent Star Search Platform, Patent Information Service Platform, National Key Industry Service Platform, Hong Kong Intellectual Property Office, and Macao Economic Services.

The USPTO allows the user to retrieve all US authorized patents from 1790 to 1975 from two search portals, the patent number and the US patent classification number. At this stage, however, only full-text image pages are available. Since 1976, in addition to full-text image, all kinds of authorized patent documents in the USA can be retrieved from 31 search portals, including searchable basic description items, abstracts, and full-text patents, as shown in Figure 2.

The European Patent Office provides patent searchers with raw data from 70 countries and 40 patent offices, namely, bibliographic data in Figure 3. Its patent information service provides the translated version of the patent

and provides legal consultation and prompt services throughout the patent application process. Patent retrieval is mainly completed by EPO Espacenet database. Other patent retrieval data can also be retrieved through Espacenet database, including patent family information, legal status information, citations, and other Asian patent retrieval data, which provides also a relatively unique function compared with other patent retrieval systems, that is, the search function option of Cooperative Patent Classification (CPC); Espacenet provides a more comprehensive tool and function for a better patent search structure.

The UK Patent Office has a variety of collection channels, mainly providing six patent retrieval channels, namely, online patent document information service system (Ipsum), patent document publication retrieval, European Patent Office retrieval, Supplementary Protection Certificate (SPC) retrieval, patent classification retrieval, and patent review report retrieval, as shown in Figure 4.

Patent application data submitted by Japan is included in JPO database. The INPIT platform collects and stores global industrial property information and provides data consultation. In addition, Japan Patent Office (in Figure 5), and the patent related reference materials are retrieved from Japan Patent Information Platform (J-PlatPat), which is managed by INPIT. J-PlatPat allows access to patent map guidance (PMGs) and other tools and searches information from Patent Abstracts of Japan (PAJ) by keywords. It is worth mentioning that Japan Industrial Property Information Training Centre provides industrial property information particularly.

KIPRIS Retrieval System collects the patent and new use data published in Korea since 1948 and provides public applications and patents registering more than 2 million. It provides English search page and registered and unregistered users. Page navigation provides IP information (patent, design, trademark, and kpa) retrieval database connection, as shown in Figure 6, with the translation of Korean patent summary tools. The retrieval method has the functions of basic retrieval, intelligent retrieval, advanced retrieval, and the display of results.

DPMA, by publishing and search services DPMA register and DEPATISnet, enables the public to quickly learn about effective IP rights seen in Figure 7. DEPATISnet database is an online service offered by the GPTO. The underlying database applied is the DEPATIS information system database of the GPTO, which is also a retrieval database used internally by the GPTO. In this database, patent documents published by many countries and organizations can be retrieved and the full text of patent specification in PDF format can be browsed. In addition to the primary search, the German database also provides expert search and monitoring search.

The CIPO is in charge of the introduction of five kinds of IP rights, among which retrieval function includes patent, patent database, Patent Reexamination Board, industrial design, and industrial design database, to help users understand various IP-related laws, rules, application process, related costs, and other information, as shown in Figure 8.

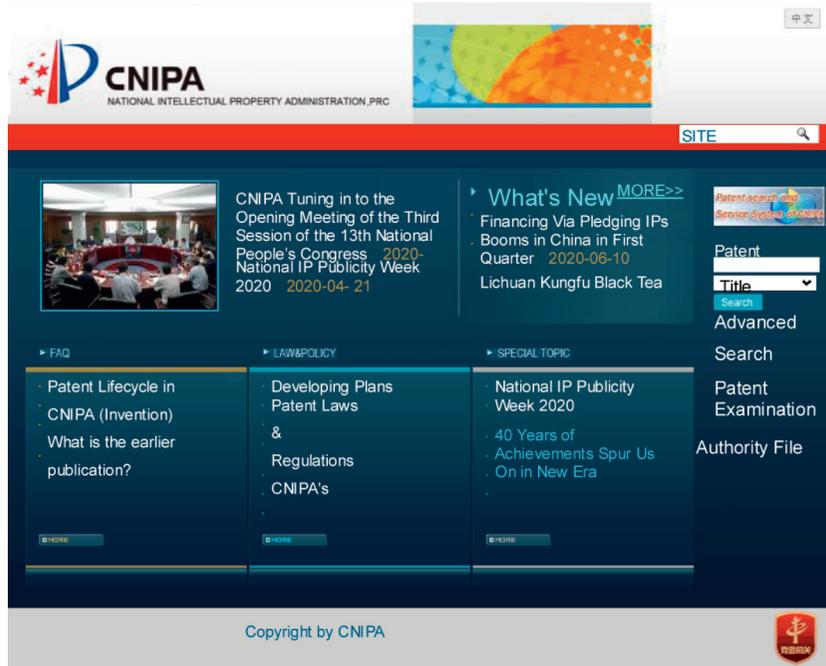


FIGURE 1: Intellectual property information search page of CNIPA [17].

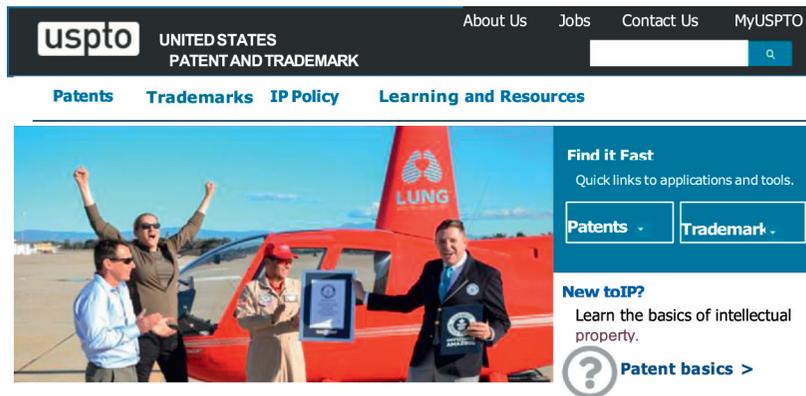


FIGURE 2: Intellectual property information search page of USPTO [18].

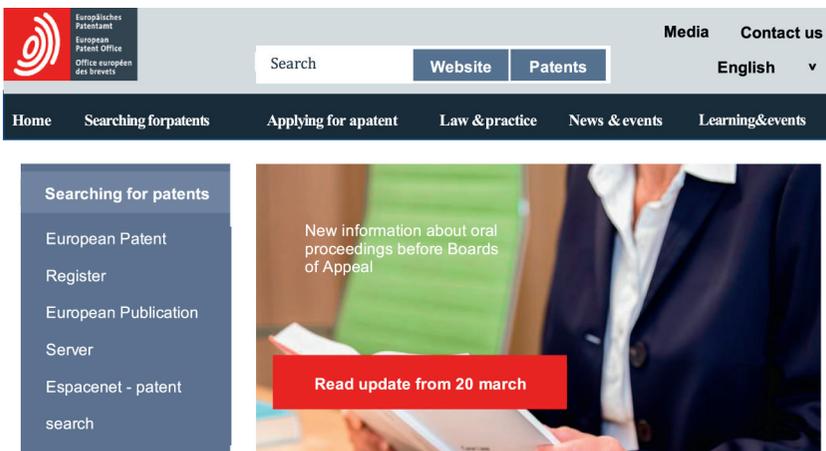


FIGURE 3: Intellectual property information search page of EPO [19].



FIGURE 4: Intellectual property information search page of UK-IPO [20].

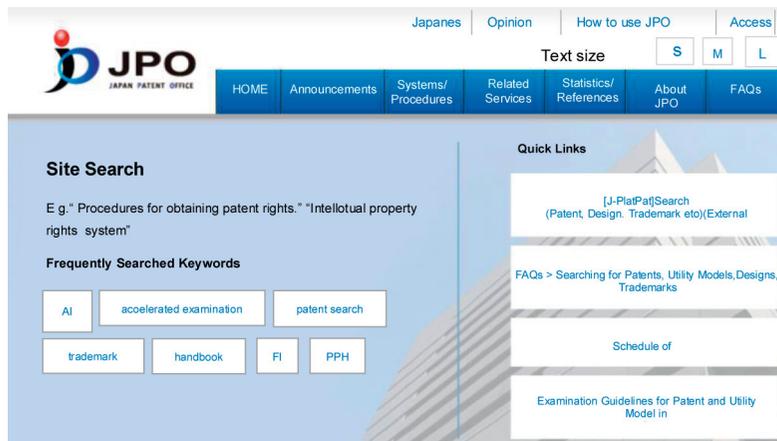


FIGURE 5: Intellectual property information search page of JPO [21].

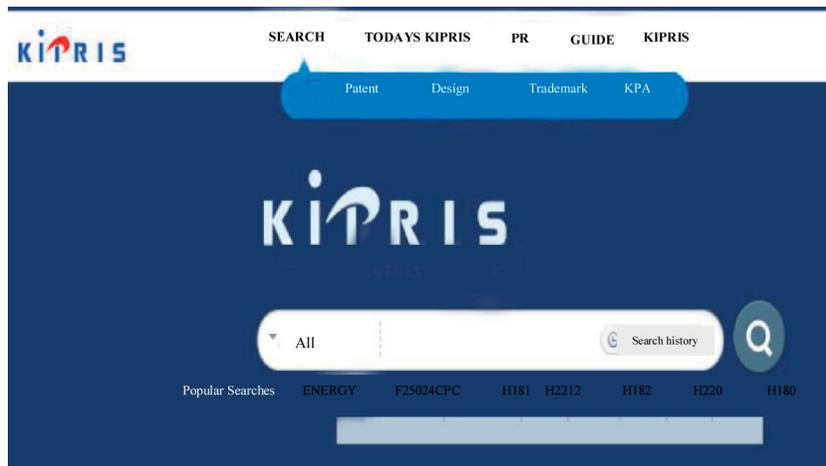


FIGURE 6: Search page of KIPRIS [23].

3.2. *Intellectual Property Data Retrieval and Analysis Services.* Nowadays, software development of various industries has been integrated into social life and developed rapidly, there are more and more advanced patent websites on the Internet [28], and more and more patent knowledge intelligent services. Some members of the public can use different platforms to obtain patent full text for free, skillfully use patent websites and conduct objective, in-depth, and

comprehensive patent analysis. Patent analysis is to use data mining and information metrology to make statistics, comparison, and analysis of patent information and transform patent information into competitive intelligence with prediction function [29]. Based on a great quantity of patent information collected from intellectual property offices of various countries, the following summarizes the characteristics of commonly used patent analysis tools at

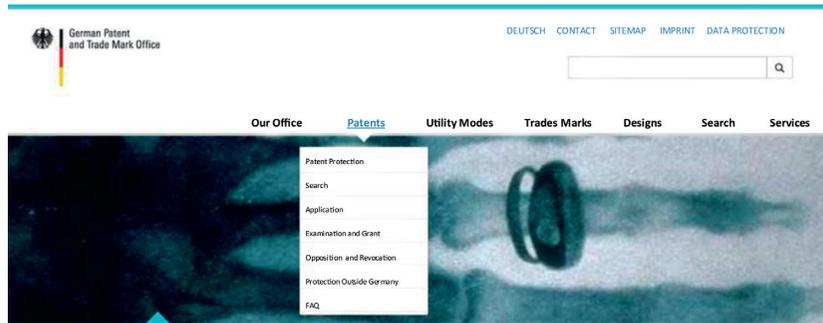


FIGURE 7: Intellectual property information search page of DPMA [24].

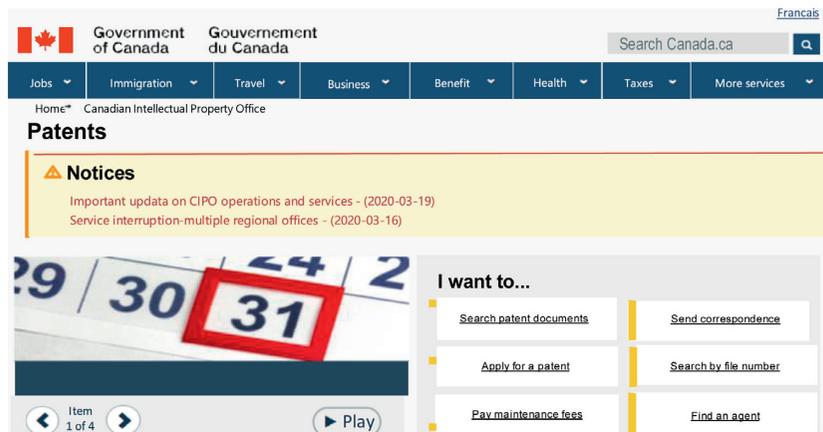


FIGURE 8: Intellectual property information search page of CIPO [25].

home and abroad and compares different platforms to provide reference for researchers.

3.2.1. Patent Analysis Tools in China

(1) *Patent Search and Analysis System*. Patent search and analysis system is an independent system established by the CNIPA [30]. With the continuous upgrading and improvement in recent years, the system has become a widely used search and analysis platform for the public, covering patent data of 103 countries, regions, and organizations. It includes two subsystems: retrieval and analysis. The retrieval subsystem provides the general functions of general retrieval and table retrieval and also independently opens the drug subject retrieval function. The analysis subsystem mainly includes document database analysis, rapid analysis, customized analysis, advanced analysis, and other functions. Through the patent data analysis model provided by the system, users can effectively and comprehensively analyze the potential information relationship and complete patent information chain in patent data and improve the efficiency of patent information utilization. Customized analysis and advanced analysis provide more specialized functions such as technology evolution trend, enterprise positioning development analysis, list analysis, and matrix analysis, which are only used by advanced users at present.

(2) *Patentics Retrieval and Analysis Platform*. Patentics is the most advanced dynamic intelligent patent data platform system in the world, which integrates patent information retrieval, download, analysis, and management [31]. The foreign patent database retrieval is integrated into the platform, which is divided into three parts: Web version, client version, big data analysis module, patent operation analysis platform, and big patent analysis system. The patent retrieval system has the function of intelligent semantic retrieval. It can search related patents in the global patent database according to the semantics contained in the text content and sort them according to the relevant degree, which greatly improves the quality and efficiency of the retrieval. In addition, it has automatic translation search function in Chinese and English. At the same time, based on the research of intelligent classification of American patent classification and international patent classification, online intelligent analysis of patent information can realize real-time monitoring and intelligent patent early warning of competitors.

(3) *Dawei Innojoy Patent Search Platform*. Dawei Innojoy patent search engine is a patent information integrated application platform integrating global patent search, analysis, management, transformation, independent database building, and other functions [32]. At present, it is one of the professional patent search and analysis tools in China,

including more than 100 million business patent data in more than 100 countries. The patent search engine adopts advanced data mining and natural language processing technology, highly integrates patent literature resources of various countries, such as patent abstracts, specifications, legal status, family patents, and other information, supports more than one million level patent information for online analysis, and provides users with major special intellectual property review and technical development decision support. Figure 9 depicts the data search and analysis function diagram of this system.

(4) *Hengheton Hit_Hengku*. Hit_Hengku is a patent analysis system independently developed by Hengheton, which integrates patent information retrieval, management, and analysis [33], as depicted in Figure 10. The analysis functions of this system include authorization information statistics, current technology ownership of competitors, technology information statistics, patent citation analysis, and patent value analysis. The original file can be converted into various general format files, which is easy to use and manage. In addition, the system can make a variety of statistical charts for patent description items and operate various command controls in images, such as color, data, 2D or 3D, title annotation, and legend controls. According to the needs of users, various forms of statistical reports are automatically generated, in which all kinds of important statistical information and charts are clearly presented to provide valuable information for users.

(5) *Incopat*. Incopat global technology analysis and operation platform is the first patent information platform integrating the world’s top innovation intelligence and translating it into Chinese [34], which includes a large number of patent information from all over the world and integrates patent search and analysis, data and user management, and other functional modules. Incopat has collected more than one hundred million patent data in the world. It has collected and processed patent data of 22 major countries, with complete data field and high data quality. Incopat has comprehensive data integration and processing functions, with more than 230 search fields and multidimensional patent laws, references, and operational information. Incopat uses the methods of data mining and iterative optimization and uses more than 20 patent parameters to establish an objective value evaluation system. It enables users to pay attention to key information in time and rank the value of patents. Incopat’s semantic retrieval adopts the advanced international deep learning algorithm and supports the input of voice, and the system automatically matches related patents, conducts clustering analysis according to the technical theme, displays the technical layout among competitors through various visualization methods such as competitive molecular map and patent topographic map, and forms a variety of analysis maps combining with a variety of analysis templates.

(6) *PatSnap Smart Bud Global Patent Analysis and Retrieval System*. PatSnap smart bud is a global patent retrieval database, which integrates patent information retrieval,

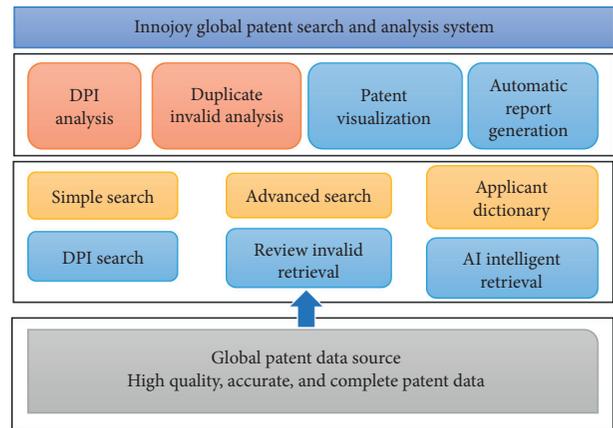


FIGURE 9: Innojoy global patent search and analysis system diagram.

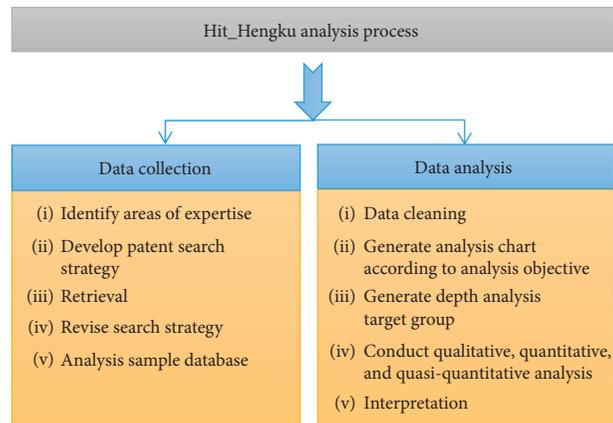


FIGURE 10: Hit_Hengku analysis process diagram.

management, and analysis and deeply integrates 140 million patent data of 116 countries and regions from 1790 to now. The update speed is timely. The specific functions include global patent data, full-text translation, advanced search, multidimensional browsing, insights patent analysis report, citation analysis, and patent value evaluation. Among them, insights patent analysis report means one click to generate patent analysis report to understand industry development and peer technology layout [35], shown in Figure 11.

3.2.2. Commercial Patent Analysis Tools in Foreign Countries

(1) *The Derwent Analysis Software (DA)*. Derwent Analytics (DA) is a kind of software developed by former Thomson Reuters Company, which can deeply mine data and conduct visual analysis. It classifies information and data analyzes and summarizes them and has the characteristics of friendly and intuitive interface. It can analyze the industry trends according to the original data provided by Thomson Derwent patent database and provide the basis for comprehensively mastering the industry information [36]. The specific functions of DA include automatic summary, data

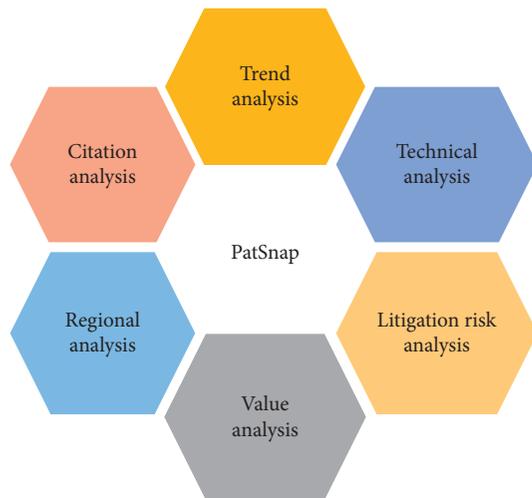


FIGURE 11: PatSnap search analysis function diagram.

sorting, comparison matrix, data mapping, preset analysis module (macro), and toolbox.

(2) *Thomson Data Analyzer*. Thomson Data Analyzer (TDA) is patent analysis software developed by Thomson Company [37]. It is the second generation of Derwent Analytics. It is text mining software with powerful analysis function, through which patent data can be deeply mined and visualized, and from a lot of patents to find competition and technical information, find new technology in the industry, and determine research strategy and development direction. In addition, TDA has the features of high degree of automation, friendly interface, and intuitionistic and has the functions of data import, management, cleaning, and analysis, as illustrated in Figure 12.

(3) *VantagePoint*. VantagePoint is a product of search analysis technology, which is a data mining tool developed by our search technology company to deeply mine patent information [38]. The data used in the system is purchased by the user directly from the data supplier. It mainly makes statistical analysis on various items in the data domain and provides data cleaning function. If the data field contains written text, the software uses natural language algorithm for subject analysis. This system uses many algorithms such as model matching, basic rules, and natural language processing technology to mine text. It allows the users to create user management dictionaries that refine specific data. Based on one-dimensional and two-dimensional analysis, VantagePoint provides multidimensional analysis function to help establish clustering or interrelationship in various relationships, depicted in Figure 13.

(4) *STN AnaVist*. STN AnaVist is software with a strong interactive analysis and visualization, which is developed by CAS itself. It provides a variety of types of scientific literature and tools for analyzing patent search results. From the analysis results, it can present the research mode and trend of the current industry. STN AnaVist can analyze search

results from patent databases, such as multidisciplinary CAPLUS, USPATFULL, PCTFULL, and DWPI. And it can analyze the data of the CAPLUS and DWPI at the same time. From patent analysis, we can track competitive information, understand the latest application of existing technology, determine research trends, and provide strategic decision-making basis [39–41].

(5) *Delphion*. Delphion is a patent information service platform developed by Thomson Reuters in the United States [42]. It integrates five tools, snapshot, enterprise tree, Patentab II, text clustering, and citation link, and provides online analysis, list and histogram generation, document clustering, and citation analysis. Delphion has a wide range of patents and a variety of comprehensive analysis tools [43]. It has collected patent documents of several countries and also linked the world patent library and INPADOC (International Patent Document Centre) of Derwent Company. Patent retrieval methods include fast retrieval, patent number retrieval, Boolean retrieval, and advanced retrieval.

(6) *Innography*. Innography is a high-quality IP data used for patent analysis in the US. Innography is patent search and analysis software with core patent mining function launched by ProQuest dialog company [44]. It is the latest patent retrieval and analysis platform based on the Internet, which contains patent literature information of major international intellectual property institutions. Its data sources include patents of more than 90 countries and regions, more than 80 million global patent data, business data, US patent litigation, and US business standard data, which provide support and help for patent analysis. Its characteristic functions are core patent mining based on patent intensity, similar patent retrieval, semantic retrieval, powerful analysis function, and visualization technology.

4. Discussions

4.1. *Advantages of Present Intellectual Property Platforms*. Each State Intellectual Property Office has different search characteristics and advantages [45]. Function comparison is conducted in Table 1 in order to provide detailed differences between these platforms. It takes patent search platforms in major intellectual property offices as an example to introduce the advantages of each platform in terms of information acquisition, search function, and characteristics.

It can be seen from Table 1 above that the patent collection information of each intellectual property office is relatively rich and the information acquisition channels are relatively comprehensive. Patent retrieval methods include basic retrieval, advanced retrieval, and patent number retrieval in different degrees and have different advantages and characteristics. In terms of information acquisition methods, different national patent offices can link databases of different types and institutions with a wide range of collection, so as to improve the quality of IP information. However, the language retrieval pages of each organization are different. For example, WIPO provides nine language retrieval interfaces, including China, Russia, Germany, and Japan.

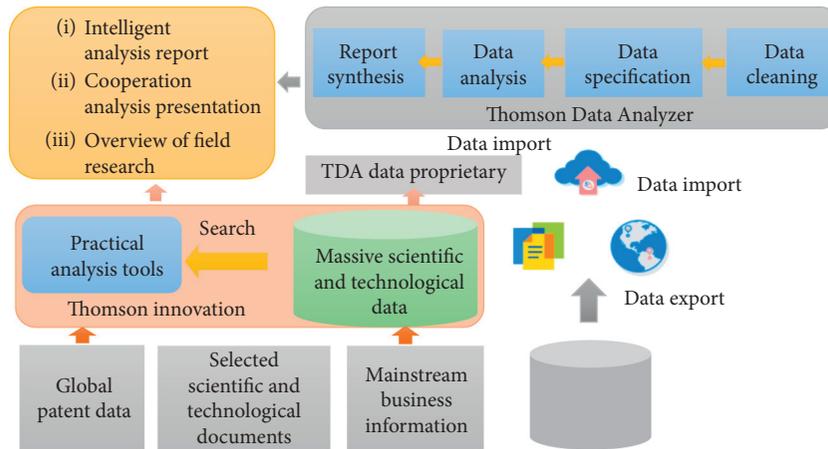


FIGURE 12: TDA structure diagram.

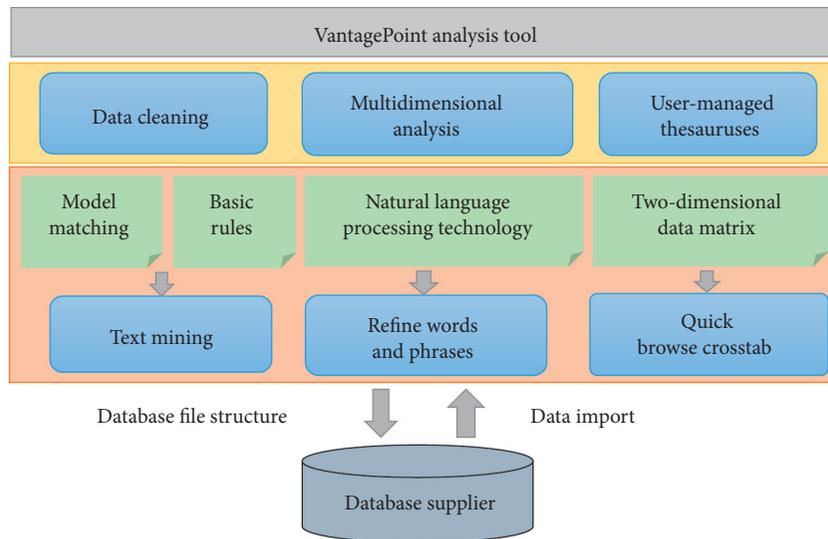


FIGURE 13: VantagePoint analysis tool diagram.

Espacenet provides Chinese, English, German, French, and Japanese retrieval interfaces. USPTO only includes US patents. In terms of retrieval methods, each platform supports basic and advanced retrieval. It is worth mentioning that USPTO provides retrieval of specific themes and images, bringing features and convenience to the public. CNIPA provides patent search, bilingual dictionary, and other functions. The Boolean logic retrieval provided by CIPO is also one of the highlights. In addition, some countries also provide automatic machine translation of patent documents, such as CNIPA, EPO, and WIPO. In the sorting of search results, CNIPA is sorted according to the rise and fall of application date and announcement date, while USPTO does not support sorting of search results.

4.2. Provision of Intellectual Property Search and Analysis Services. In addition to the intellectual property information collected by the Intellectual Property Office of the official governments of various countries, with numerous patent search and analysis methods or special tools, it is very

convenient for the public to screen and analyze them [46, 47]. The patent analysis method is based on bibliometrics, using quantitative or qualitative analysis methods to process, count, and combine patent information to obtain competitive intelligence. It is mainly divided into four ways: basic statistical analysis, cluster analysis, cooccurrence analysis, and citation analysis.

- (i) Statistical analysis: the method of quantitative analysis is used to make combination statistics of patent information to obtain information analysis method of technology dynamic development trend. The results are mainly presented in statistical reports, charts, etc.
- (ii) Cluster analysis: gathering patents in different technical fields into different subcategories to understand the technical distribution in each technical field. The display methods include clustering map, structured data clustering, and unstructured data clustering.
- (iii) Cooccurrence analysis: including cocitation, coword, and cocategory analysis, which is a quantitative analysis method of the information in the literature.

TABLE 1: Function comparison of patent search platform of different State Intellectual Property Offices.

No.	Patent databases	Information available	Search function	Advantages
1	CNIPA	The CNIPA owns all kinds of patent documents of more than 90 patent agencies and nearly half of patent specifications issued by patent agencies. China has announced more than 50000 patents. China has announced over 50000 patents	Search function field search, IPC category navigation search	It provides Chinese patent machine translation service with comprehensive information and fast and accurate retrieval information.
2	EPO	Espacenet contains more than 90 million files of various countries; the global patent index (GPI), as a complementary tool of Espacenet, is used to search global patents	Quick query, advanced search, number search, category search	It provides browsing options for the search function of CPC; compared with other patent search systems, it is a unique function. It provides patent legal status information directly linked to patent public reference documents and provides complete machine translation to translate patent documents.
3	WIPO	PATENTSCOPE contents include PCT electronic bulletin, Madrid application trademark database, US, Canada, European patent database, and Jopai technology journal database	Simple search, advanced search, by file combination, advanced cross language query	The search results are sorted by relevance for easy reference; support machine translation; provide legal information query; can be linked to the main databases of patents in the world. It provides full-paper search capabilities. There is no limit to the number of patent search results.
4	USPTO	The database is updated every Tuesday, providing a full-text image description of the film since 90 years and a full-text text description since 1976	Quick query, advanced search, official account query, fixed title query, number retrieval, picture retrieval	Complete database resources; access to patent information is very convenient, providing a rich information service platform, all-round service for innovation of small and medium-sized enterprises.
5	JPO	J-PlatPat publishes detailed information about the status of the whole process of patent application (e.g., examination and grant) and information publicity; PAJ (patent abstract of Japan) can also search for information	Quick search, joint search, multiple fields for category number or keyword search	Early Japanese patent documents are included completely, with huge data advantages and convenient retrieval methods. Patent texts included on the platform have basically been converted into text format and full-text application search fields; browsing interface can provide highlighting function, etc.
6	KIPO	KIPRIS provides patent (including patent and utility model) search, design search, trademark search, kPa search, Korean English machine translation, and other services. It updates data every day	Basic search, intelligent search, advanced search	Viewing the full text, legal status, priority, race, and other information, providing Korean patent summary translation, linking to domestic and foreign online patent databases, etc.
7	UK-IPO	Check the patent status to get the latest information about the patent application in the UK. Search for published patent applications and registered UK patents	Ipsum search methods include publication number, Espacenet, patent classification, and review date	Providing a variety of search paths and search systems and searching a comprehensive range. In addition, three kinds of patent information retrieval systems are provided, which can be retrieved through the entry of application number, name, classification number, keyword, etc.
8	DPMA	DEPATIS searches for global patent publications. It is mainly to archive the electronic files of patent retrieval platform and then show the reclassified IPC in the search results	“IPC” tag search or browse international patent classification number system, keyword or symbol search IPC through rating page, or IPC through IPC index search IPC through IPC number	It covers nearly 90 million patent documents. You can use the patent number to search for successful retrieval information.

TABLE 1: Continued.

No.	Patent databases	Information available	Search function	Advantages
9	CIPO	The database is provided by the Canadian Intellectual Property Office and contains patent documents since 1920. The classification of patent documents can be divided into two stages: The Canadian Patent Classification System (CPC) and then IPC (after October 1, 1989)	Basic query, patent number query, Boolean query, advanced query	Canada's patent search results are very rich, including almost all patent information. When retrieving, the number of Canadian patents hit out of all patents will be displayed so that users know total number of native patents and list of patents retrieved.

- (iv) Citation analysis: analyzing the citation and citation of patents to reveal the interdependence between technology competitors, including both qualitative and quantitative analysis. The quality of citation analysis tools lies in the source of citation data and the presentation of citation results.

In addition, the main functions of patent search and analysis tool data include data monitoring, collection, cleaning, and processing. There are different intellectual property analysis tools at home and abroad to link countries' intellectual property information for retrieval and analysis services [48–50]. The services provided by patent analysis tools commonly used at home and abroad for patent information of official patent offices in various countries are compared, as discussed in Table 2, where eight indicators are provided for these patent analysis tools, including data monitoring, data collection, data cleaning, data processing, statistical analysis, cluster analysis, cooccurrence analysis, and citation analysis.

According to Table 2, almost all of the 12 patent analysis tools have data cleaning and statistical analysis functions. It is not clear whether Incopat and PatSnap have data cleaning function. More than half of the platforms provide data processing and citation analysis services. It is worth mentioning that, on the whole, patent retrieval and analysis services provided by China Patent Office are more comprehensive, but whether there are data monitoring and symbiosis analysis is uncertain. In terms of data monitoring, only PatSnap, Delphion, and innovation have it. In data collection and data processing, the foreign platform is obviously weaker than the domestic platform, especially in data collection, and the foreign analysis platform cited in this paper has obvious defects. But in the function of cluster analysis and symbiosis analysis, the foreign analysis platform is better than the domestic one. From the eight indicators, innovation has the least. The results show that each platform has its own main functions, and there are some defects and imperfections in its functions.

4.3. Limitation of Present Intellectual Property Platforms and Patent Analysis Tool

4.3.1. Limitation of Present Intellectual Property Platforms. There are some limitations in the above intellectual property offices. First, in CNIPA, the search speed and full-text download speed are relatively slow, the search results do not highlight keywords, and there is no choice to translate patent publications. Second, in EPO, patent search is only

applicable to EP and WO files, and there are problems in using patent number to search information: compared with other databases, the maximum number of search words in each field is limited. Third, in WIPO, the data coverage is low for Espacenet; it is impossible to filter results based on publication date/applicant in the information retrieval of patent number retrieval. Fourth, in USPTO, full-paper search and other retrieve tools are only applicable to US patents. Fifth, in Japan Patent Information Platform, full-text search and other search tools are only applicable to JP and PCT files. Sixth, KIPO and KIPRIS are limited to special search and analysis tools, and activation of machine translation tools requires payment/subscription. Seventh, in UK, the Ipsum System is limited to specialized search and analysis tools. Finally, in DPMA, the full-text search of DEPATIS is only for patents, the search results are not highlighted with keywords, and there is no choice to translate patent publications.

4.3.2. Limitation of Present Patent Analysis Tool. In addition to the existing intellectual property information retrieval technology problems and challenges [51], data explosion in the network era, in particular patent in-depth analysis, has become a key research field for researchers or enterprises, combining with emerging science and technology and bringing new opportunities and challenges [52, 53]. The following mainly introduces the limitations from three aspects: cloud platform support, data encryption and privacy protection, and ontology model building knowledge system.

(1) Support of Cloud/Edge Platform. At present, there are few researches based on cloud platform and intellectual property protection at home and abroad, most of which stay in theoretical and experimental research. There are not many patent analysis products based on cloud platform in the market, which are not perfect, and there are technical loopholes [54–57]. There are few researches on patent analysis of cloud platform in China; besides, most of them are based on domestic cloud computing patents. However, there is no empirical research on the development, layout, and application of cloud platform technology at home and abroad.

(2) Data Encryption and Privacy Protection. Data protection is also one of the most important issues in the era of information explosion. More and more data protection

TABLE 2: Functional comparison and analysis methods of patent analysis tools.

No.	Names of analysis tools	Data monitoring	Data collection	Data cleaning	Data processing	Statistical analysis	Cluster analysis	Cooccurrence analysis	Citation analysis
1	Patent search and analysis system	—	✓	✓	✓	✓	✓	—	✓
2	Innojoy	—	✓	✓	✓	✓	✓	×	✓
3	Patentics	×	✓	✓	×	✓	✓	✓	✓
4	HIT_Hengku	×	✓	✓	✓	✓	×	×	✓
5	Incopat	×	✓	—	✓	✓	✓	—	✓
6	PatSnap	✓	✓	—	—	✓	✓	—	✓
7	Derwent Analytics	×	×	✓	✓	✓	×	✓	×
8	Thomson Data Analyzer	×	×	✓	✓	✓	✓	✓	×
9	Vantage point	×	×	✓	✓	✓	✓	✓	×
10	STN AnaVist	×	×	✓	×	×	✓	✓	×
11	Delphion	✓	×	✓	×	✓	✓	×	✓
12	Innography	✓	×	✓	×	×	×	×	×

methods are proposed by scholars [58, 59]. In terms of confidential storage of intellectual property data, homomorphic encryption technology has the best performance in security and functionality [60]. However, because its encryption algorithm needs a lot of complex exponential operation, which largely descends the data processing ability, the data processing technology based on encryption technology still needs to be improved. Besides, the vision of the exploration and application of big data has far exceeded the willingness to protect personal privacy. The high attention to the protection of IP information also makes privacy issues covered and ignored. The analysis of the above major database intellectual property protection platforms focuses more on the protection of data producers' rights and market interests but lacks the protection of data providers' privacy rights.

(3) *Establishment of Ontology-Based Knowledge System.* In the modern society with explosive data volume, the concepts contained in the massive intellectual property related data and the relationship between them need to be described by a standard semantic model so that computers can better understand them and then realize the sharing and reuse of existing knowledge. As a tool for modeling conceptual models, ontology has gradually become the basis of knowledge management and semantic web since it was proposed and plays an important role in Digital Library and other applications [61–63]. This is because domain ontology library can make existing systems better understand the information expressed in natural language at the semantic level. With the progress of ontology learning research and the development of data mining and other related technologies, the application of ontology in intellectual property information retrieval has gradually become a trend in the future, but the current research on the application of ontology technology in intellectual property information retrieval and analysis platform is not mature and perfect. Therefore, using ontology to build knowledge system in intellectual property data management will become the future development trend; as a result, this concept and method are not widely used in various intellectual property management platforms.

5. Conclusions

Data covered by global IP rights is growing explosively. It is of great significance for enterprises, governments, institutions, and scholars to effectively retrieve and analyze the information collected by IP offices of various countries. This paper summarizes the current situation of IP offices in various countries, as well as the retrieval, analysis, and visualization function integration platform of data and information collected by IP offices in various countries. Developers have developed a variety of patent analysis tools, showing different characteristics. In addition, this paper introduces the official IP platform and patent analysis tools at home and abroad in detail, compares different dimensions and corresponding indicators, discusses the advantages and disadvantages, and brings reference value to researchers. In addition, combined with the emergence of new technologies, in view of the current emerging technologies, namely, cloud computing, data encryption and privacy protection, ontology knowledge system research, and other aspects, this paper expounds the shortcomings of the existing analysis platform, considering the limitations of the existing technology and framework, IP retrieval, and analysis and other technology related fields have very broad research and development prospects.

Data Availability

This paper reviewed 8 Intellectual Property Platforms and 12 intellectual property analysis tools. All the data can be accessed from their official websites: <http://english.sipo.gov.cn>, <https://www.gov.uk/government/organisations/intellectual-property-office>, <https://www.epo.org/index.html>, <https://www.gov.uk/government/organisations/intellectual-property-office>, <https://www.jpo.go.jp/e/index.html>, <https://www.kipo.go.kr/en/MainApp?c=1000>, <http://eng.kipris.or.kr/enghome/main.jsp>, <https://www.dpma.de/english/index.html>, http://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/h_wr00001.html, <https://www.thevantagepoint.com/>, http://www.stn-international.com/stn_anavist.html, and <http://www.delphion.com>.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Acknowledgments

This research was funded by NSSF, China (Grant no. 19ZDA078) and the Fund of Research for Decision Making and Consultation of Jiangsu Service-Oriented Government Construction, China.

References

- [1] W. Yu, W. Wang, P. Jiao, H. Wu, Y. Sun, and M. Tang, "Modeling the local and global evolution pattern of community structures for dynamic networks analysis," *IEEE Access*, vol. 7, pp. 71350–71360, 2019.
- [2] J. Jin, L. Ma, and X. Ye, "Digital transformation strategies for existed firms: from the perspectives of data ownership and key value propositions," *Asian Journal of Technology Innovation*, vol. 28, no. 1, pp. 77–93, 2020.
- [3] H. M. Wu, X. Y. Li, and Y. J. Deng, "Deep learning-driven wireless communication for edge-cloud computing: opportunities and challenges," *Journal of Cloud Computing*, vol. 9, no. 21, pp. 1–14, 2020.
- [4] X. Xu, X. Zhang, X. Liu, J. Jiang, L. Qi, and M. Z. A. Bhuiyan, "Adaptive computation offloading with edge for 5G-envisioned internet of connected vehicles," *IEEE Transactions on Intelligent Transportation Systems*, pp. 1–10, 2020.
- [5] X. Xu, X. Zhang, H. Gao, Y. Xue, L. Qi, and W. Dou, "Be-Come: blockchain-enabled computation offloading for IoT in mobile edge computing," *IEEE Transactions on Industrial Informatics*, vol. 16, no. 6, pp. 4187–4195, 2020.
- [6] X. Xu, B. Shen, X. Yin et al., "Edge server quantification and placement for offloading social media services in industrial cognitive IoV," *IEEE Transactions on Industrial Informatics*, p. 1, 2020.
- [7] A. Brem, P. A. Nylund, and E. L. Hitchen, "Open innovation and intellectual property rights: how do SMEs benefit from patents, industrial designs, trademarks and copyrights?" *Management Decision*, vol. 55, no. 6, pp. 1285–1306, 2017.
- [8] L. Ma, Z. Liu, X. J. Huang et al., "The impact of local government policy on innovation ecosystem in knowledge resource scarce region: case study of Changzhou, China," *Science, Technology & Society*, vol. 24, no. 1, pp. 1–24, 2019.
- [9] P. R. Merges, "What kind of rights are intellectual property rights?" in *Oxford Handbook of IP Law*, R. Dreyfuss and J. Pila, Eds., pp. 1–50, Oxford University Press, Oxford, UK, 2017.
- [10] J. Yin, Z. Ge, and W. Song, "Research on the construction of intellectual property operation platform under the background of "internet +"," *Technology and Investment*, vol. 8, no. 4, pp. 179–194, 2017.
- [11] J. List, "Current trends and future directions for IP Information research," *World Patent Information*, vol. 52, pp. A1–A2, 2018.
- [12] L. Ma, J. Yu, and H. M. Song, "Research on innovation superhighway based on driving strategies," *Science & Technology and Economy*, vol. 24, no. 6, pp. 1–6, 2011.
- [13] Y. Chen, Z. Y. Liu, and L. X. Su, "A theoretical framework of internet enabled country/region "discovery-innovation" system," *Studies in Science of Science*, vol. 32, no. 2, pp. 170–177, 2014.
- [14] M. Lupu, "Information retrieval, machine learning, and natural language processing for intellectual property information," *World Patent Information*, vol. 49, pp. A1–A3, 2017.
- [15] X. Xu, Q. Liu, X. Zhang, J. Zhang, L. Qi, and W. Dou, "A blockchain-powered crowdsourcing method with privacy preservation in mobile environment," *IEEE Transactions on Computational Social Systems*, vol. 6, no. 6, pp. 1407–1419, 2019.
- [16] H. Wu, W. J. Knottenbelt, and K. Wolter, "An efficient application partitioning algorithm in mobile environments," *IEEE Transactions on Parallel and Distributed Systems*, vol. 30, no. 7, pp. 1464–1480, 2019.
- [17] China National Intellectual Property Administration, 2020, <http://english.sipo.gov.cn/>.
- [18] United States Patent and Trademark Office, 2020, <https://www.uspto.gov/>.
- [19] European Patent Office, 2020, <https://www.epo.org/index.html>.
- [20] Gov.UK, 2020, <https://www.gov.uk/government/organisations/intellectual-property-office>.
- [21] Japan Patent Office, 2020, <https://www.jpo.go.jp/e/index.html>.
- [22] Korean Intellectual Property Office, 2020, <https://www.kipo.go.kr/en/MainApp?c=1000>.
- [23] Korea Intellectual Property Rights Information Service, 2020, <http://eng.kipris.or.kr/enghome/main.jsp>.
- [24] German Patent and Trade Mark Office, 2020, <https://www.dpma.de/english/index.html>.
- [25] Canadian Intellectual Property Office, 2020, http://www.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/h_wr00001.html.
- [26] W. Shalaby and W. Zadrozny, "Patent retrieval: a literature review," *Knowledge and Information Systems*, vol. 61, pp. 631–660, 2019.
- [27] L. Ma, T. Li, J. X. Wu et al., "The impact of E-hailing competition on the urban taxi ecosystem and governance strategy from a rent-seeking perspective: the China E-hailing platform," *Journal of Open Innovation: Technology, Market, and Complexity*, vol. 4, no. 35, 2018.
- [28] A. Tolstaya, I. Suslina, and P. Tolstaya, "Information provision of patent research," *Biosciences, Biotechnology Research Asia*, vol. 13, no. 3, pp. 1479–1491, 2016.
- [29] S. Ranaei, A. Knutas, J. Salminen, and A. Hajikhani, "Cloud-based patent and paper analysis tool for comparative analysis of research," in *Proceedings of the 17th International Conference on Computer Systems and Technologies 2016*, pp. 315–332, Palermo, Italy, June 2016.
- [30] Q. X. Xu, R. Wang, and B. Q. Liu, "SIPO patent retrieval resources," *Shandong Chemical Industry*, vol. 43, no. 5, pp. 65–69, 2014.
- [31] L. Yu and X. Y. Zhao, "Search strategy of patentics intelligent search system in the field of analysis and detection," *Chinese Invention and Patent*, vol. 16, no. 11, pp. 104–110, 2019.
- [32] L. X. Zhang and W. Li, "Statistical analysis of patent results based on Innojoy," *Journal of Changchun University of Technology*, vol. 39, no. 6, pp. 613–618, 2018.
- [33] J. Guo and K. Shi, "On the application of patent search in patent search system," *Chinese Invention and Patent*, vol. 14, no. 8, pp. 123–127, 2017.
- [34] C. L. Sun and L. B. Sun, "IncoPat-based patent analysis of China pharmaceutical university," *Journal of China Pharmaceutical University*, vol. 50, no. 3, pp. 374–378, 2019.
- [35] D. Liang and Y. F. Wang, "Analysis of low-fat food research and development patents by PatSnap," *Journal of Food Safety and Quality*, vol. 10, no. 8, pp. 2420–2424, 2019.

- [36] A. Barth, T. Stengel, E. Litterst et al., "A novel concept for the search and retrieval of the derwent markush resource database," *Journal of Chemical Information and Modeling*, vol. 56, no. 5, pp. 821–829, 2016.
- [37] Z. Zhang and Y. Guo, "The development and application of analysis tool of TDA (Thomson data analyzer)," *Shanxi Science and Technology*, vol. 28, no. 4, pp. 103–104, 2013.
- [38] VantagePoint, 2020, <https://www.thevantagepoint.com/>.
- [39] G. Fischer and N. Lalyre, "Analysis and visualisation with host-based software—the features of STN®AnaVist™," *World Patent Information*, vol. 28, no. 4, pp. 312–318, 2006.
- [40] STN_Anavist, 2020, http://www.stn-international.com/stn_anavist.html.
- [41] Y. Z. Cao and S. Z. Li, "Introduction of STN anavist analysis function in STN system," *Patent Literature Research*, vol. 1, no. 2, pp. 46–51, 2008.
- [42] M. K. Raturi, P. K. Sahoo, and A. K. Tiwari, "Delphion: a world class patent database—a comprehensive analysis from patent information professional's perspective," *SSRN Electronic Journal*, pp. 1–11, 2009.
- [43] Delphion, 2020, <http://www.delphion.com>.
- [44] H. Tang and H. Yang, "Analysis of patent information of supercapacitor based on innography," in *Proceedings of the 2018 International Conference on Robots & Intelligent System (ICRIS)*, pp. 321–325, Changsha, China, 2018.
- [45] J. Kim and S. Lee, "Patent databases for innovation studies: a comparative analysis of USPTO, EPO, JPO and KIPO," *Technological Forecasting and Social Change*, vol. 92, pp. 332–345, 2015.
- [46] Y. H. Chen and S. T. Wang, "Comparison of patentics and Incompat in semantic search," *China Invention & Patent*, vol. 16, no. 3, pp. 125–128, 2019.
- [47] Z. M. Xie, "An comparative study on the effectiveness of patent value evaluation tools," *Modern Information*, vol. 38, no. 4, pp. 124–129, 2018.
- [48] M. Burhan and S. K. Jain, "Tools for search, analysis and management of patent portfolios," *DESIDOC Journal of Library & Information Technology*, vol. 32, no. 3, pp. 204–213, 2012.
- [49] X. Jain, Z. Y. Peng, and B. Liu, "Summary of patent search and analysis," *Journal of Wuhan University (Engineering Edition)*, vol. 47, no. 3, pp. 420–425, 2014.
- [50] S. Ozcan and N. Islam, "Patent information retrieval: approaching a method and analysing nanotechnology patent collaborations," *Scientometrics*, vol. 111, no. 2, pp. 941–970, 2017.
- [51] L. P. Zhi and B. Q. Shi, "Research on the function mechanism of patent information in the patent operation of enterprises in China," *Humanities and Social Science Research*, vol. 1, no. 1, p. 60, 2018.
- [52] J. Shin, S. Lee, and T. Wang, "Semantic patent analysis system based on big data," in *Proceedings of the 2017 IEEE 11th International Conference on Semantic Computing (ICSC)*, pp. 284–285, San Diego, CA, USA, 2017.
- [53] D. Prokhorenkov and P. Panfilov, "Notice of violation of IEEE publication principles: discovery of technology trends from patent data on the basis of predictive analytics," in *Proceedings of the 2018 IEEE 20th Conference on Business Informatics (CBI)*, vol. 2, pp. 148–152, Vienna, Austria, 2018.
- [54] X. Wang, Y. Yang, J. Zhang et al., "Design and application of the business hosting cloud platform faced to intellectual property service provider," in *Proceedings of the 2015 5th International Conference on Communication Systems and Network Technologies*, pp. 1000–1004, Gwalior, India, April 2015.
- [55] J.-Y. Huang, "Patent portfolio analysis of the cloud computing industry," *Journal of Engineering and Technology Management*, vol. 39, pp. 45–64, 2016.
- [56] C. Cheng, P. H. Lyu, and C. Fu, "Cloud computing knowledge domains mining based on patent networks," in *Proceedings of the 24th International Conference on Industrial Engineering and Engineering Management 2018*, G. Huang, CF. Chien, and R. Dou, Eds., pp. 677–686, Changsha, China, 2019.
- [57] M. Bayramusta and V. A. Nasir, "A fad or future of IT?: a comprehensive literature review on the cloud computing research," *International Journal of Information Management*, vol. 36, no. 4, pp. 635–644, 2016.
- [58] L. L. Zhang, X. B. Hu, and F. Liu, "Patent analysis of data security protection technology for cloud storage platform," *Technology Outlook*, vol. 26, no. 23, pp. 268–270, 2016.
- [59] G. Guo, T. Yang, and Y. Liu, "Search engine based proper privacy protection scheme," *IEEE Access*, vol. 6, pp. 78551–78558, 2018.
- [60] M. Yang, Y. Man, N. Liu et al., "Design of searchable algorithm for biological databased on homomorphic encryption," *Lecture Notes in Computer Science*, vol. 11956, pp. 537–545, Springer, Berlin, Germany, 2019.
- [61] K. H. Law, S. Taduri, G. T. Law et al., "An ontology-based approach for retrieving information from disparate sectors in government: the patent system as an exemplar," in *Proceedings of the 2015 48th Hawaii International Conference on System Sciences*, pp. 2096–2105, Kauai, HI, USA, January 2015.
- [62] C.-P. Phan, H.-Q. Nguyen, and T.-T. Nguyen, "Ontology-based heuristic patent search," *International Journal of Web Information Systems*, vol. 15, no. 3, pp. 258–284, 2019.
- [63] X. J. Chen, S. Y. Cheng, X. R. Yang, and X. W. Zhang, "Establishment of patent knowledge function model based on function ontology," *Journal of Guangdong University of Technology*, vol. 36, no. 2, pp. 26–30, 2019.