

Wenhong LI, Chunxiao FU, Deli CHENG

Comments on the development of blockchain technology from the perspective of patent analysis

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Blockchain is a new application mode of distributed data storage with point-to-point transmission, consensus mechanism, encryption algorithm and other computer technologies. In particular, blockchain is a kind of chained data structure that combines data blocks in sequence in accordance with time and an unchangeable and unforgeable distributed ledger that is ensured by cryptography. It utilizes distributed node consensus to generate and update data and cryptography to secure data transmission and access (Yang, 2017). The characteristics of blockchain include decentralization, openness, independence, security, and anonymity. Blockchain is widely used in trading securities, e-commerce, Internet of Things, social media, file storage, authentication, stock crowdfunding, and many other fields because of its core technologies, including distributed ledger, asymmetric encryption, consensus mechanism, and intelligent contract. Blockchain technology is the fourth milestone in the evolution of human credit after “blood credit”, “precious metal credit”, and “central bank note credit” (Yuan and Wang, 2016). Blockchain technology is widely used in finance owing to its natural demand for credit (Swan, 2015). It is first known as the underlying technology of virtual currency. Bitcoin has now become the major virtual currency in the world after years of development and promotion since its introduction in 2009 (Nakamoto, 2009). Estimations show that in 2027, 10% of the world’s gross domestic product will be stored through blockchain technology (World Economic Forum, 2015). An increasing number of scholars have conducted

in-depth studies on the combination of blockchain and traditional industries, including medical, education (Xu and Ma, 2016; Zhao and Ma, 2018), logistics (Ma et al., 2018), and many other traditional industries.

This study uses the data of INCOPAT science and technology innovation information platform. The data of the platform mainly come from official and commercial data providers of various patent offices in the world. The platform has collected more than 100 million patent data from 120 countries, organizations, and regions. The data are updated at least three times a week. Therefore, the data sources are comprehensive and accurate. The search date in this study was November 5, 2019. In this study, we used keywords, such as blockchain, virtual currency, virtual storage, and super blockchain, to collect data, and the International Patent Classification was used to remove the patents with small relevance to blockchain. We obtained 21833 patents and the preliminary search database by analyzing the overall development of patents of blockchain technology. The results shown in this study were provided by the analysis and clustering functions of the INCOPAT technology innovation information platform.

Several outcomes about the blockchain technology from patent analysis are provided as follows.

1. Patent applications of blockchain have increased in recent years

Blockchain technology is a new value network composed of various underlying technologies and blockchain technology patents require many innovations and breakthroughs. The first year of blockchain is 2015, when it started to develop and attract attentions from increasing institutions and enterprises around the world, resulting in a remarkable increase in blockchain patent applications. The number rises from 214 in 2014 to 9292 in 2018, with an annual average increase rate of 160%¹⁾. In 2018, blockchain technology transformed from virtual economy

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Wenhong LI, Chunxiao FU, Deli CHENG (✉)
Shanghai International College of Intellectual Property, Tongji University, Shanghai 200092, China
E-mail: cdl@tongji.edu.cn

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1) The count is 214, 438, 1422, 3552, and 9292, respectively, in 2014, 2015, 2016, 2017, and 2018.

to practical application. Although all patents have not been disclosed, the number of patent applications has increased in 2019. The number will keep rising with the formulation of national blockchain strategic planning and the application of blockchain technology in many fields.

2. China plays a leading role in terms of the number of patents

The distribution of patent applicants of global blockchain technology is studied. China applicants filed 13253 patents, accounting for 60.7% of the total applications. Seven of the top 10 applicants are from China, indicating that China is determined to gain competitive edge in the competition of intellectual property regarding this new technology of blockchain. Alibaba ranks first with 798 patent applications and is far ahead of the others in the number of patent applications. The number of applications and the activity of major applicants have increased in the past three years, indicating that blockchain technology is an emerging field with low maturity and is still in the competitive stage for the dominant position in technology and market shares. In the years when the digital currency experienced a downturn, the application number of patent of blockchain has remained constant.

3. China's patent quality needs improvement

Chinese applicants have made a great contributions to the rapid growth in the number of patent applications for blockchain technology globally (Hu et al., 2017). Unlike the US applicants who attached importance to multinational deployment, Chinese applicants have focused on domestic deployment rather than overseas deployment. Most Chinese applicants are blockchain-based start-ups or Internet tycoons, whereas US applicants are mostly large-scale enterprises. Factors, such as patent citation, patent family size, claim counts, and license counts, are usually used to evaluate patent technology quality (Harhoff et al., 1999; 2003; Fisch et al., 2016). We found many gaps by comparing the four factors between the applications of US and China, as shown in Table 1. Great differences are found in the factors of forward citation and license counts with at least 5 times of gap. At present, blockchain patents are still in a period of rapid development. The entry threshold of the industry is low because of the high maturity of the underlying technology of blockchain. Thus, institutions can seize the opportunity to quickly enter the market and deploy patents.

Table 1 Comparison of some evaluation factors between the patent applications of US and China (on average)

Country	Forward citation	Family size	Claims counts	License counts
China	0.5	1.2	11	0.03
US	2.8	2.3	20	1.4

4. Technology hotspots of blockchain patents

The blockchain itself is not a new technology but a combined innovation network that integrates various existing mature technologies. We found that blockchain technology patents value cryptography and payment system at a high degree in recent years as they can enhance privacy protection and provide high security authentication for users. Other important technologies focus on the confidentiality or security of communication devices, protection of computer parts or programs, and the underlying technology of blockchain. In the context of standardized blockchain and severe competition for rule-making power in the field, the underlying technology should continue to be highly valued. From the cluster analysis, we can observe that the current hotspots of blockchain are digital signatures, security defense, data storage, and system transaction, which witnessed a rapid increase in patent application. Practitioners can closely track advanced and core technologies from these aspects.

Although the number of patent applications for blockchain technology has increased, many new areas should be opened in the application fields. For example, Mastercard has a good accumulation of blockchain applications in finance, but the markets of blockchain are extremely broad in other application scenarios. The Internet of Things, copyright, automotive, logistics, cross-border payments, physical assets, medical care, government affairs, 5G, artificial intelligence, and other aspects can be applied to blockchain, or blockchain can be deeply integrated. Therefore, blockchain is bound to extend from the financial sector to applications in other areas.

References

- Fisch C O, Block J H, Sandner P G (2016). Chinese university patents: Quantity, quality, and the role of subsidy programs. *Journal of Technology Transfer*, 41(1): 60–84
- Harhoff D, Narin F, Scherer F M, Vopel K (1999). Citation frequency and the value of patented inventions. *Review of Economics and Statistics*, 81(3): 511–515
- Harhoff D, Scherer F M, Vopel K (2003). Citations, family size, opposition and the value of patent rights. *Research Policy*, 32(8): 1343–1363
- Hu A G Z, Zhang P, Zhao L J (2017). China as number one? Evidence from China's most recent patenting surge. *Journal of Development Economics*, 124: 107–119
- Ma X F, Du M X, Yu W B, Wang Y (2018). Blockchain based supply-chain finance service platform. *Big Data Research*, 4(1): 13–21 (in Chinese)
- Nakamoto S (2009). Bitcoin: A peer-to-peer electronic cash system. Available at: bitcoin.org/bitcoin.pdf
- Swan M (2015). *Blockchain: Blueprint for A New Economy*. USA: O'Reilly Media, 213–267

- World Economic Forum (2015). World Economic Forum Survey: 10% of global GDP maybe stored with blockchain technology by 2027. Available at: coinfox.info/news/3184
- Xu Y, Ma X F (2016). Research and implementation of comprehensive evaluation system of student behavior based on blockchain. *Information Technology and Informatization*, (12): 131–133 (in Chinese)
- Yang M (2017). Accounting model based on blockchain technology. *Modern Accounting*, (9): 57–58 (in Chinese)
- Yuan Y, Wang F Y (2016). Blockchain: The state-of-the-art and future trends. *Acta Automatica Sinica*, 42(4): 481–494 (in Chinese)
- Zhao W Q, Ma Z Y (2018). The application of blockchain in higher education field. In: *Proceedings of 3rd International Conference on Politics, Economics and Law (ICPEL 2018)—Advances in Social Science, Education and Humanities Research*. Atlantis Press, 246: 311–313