

# Blockchain and artificial intelligence in intellectual property management

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ORIGINAL ARTICLE

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**Abstract.** This article discusses the use of blockchain technology and artificial intelligence in the intellectual property management industry. Intellectual property is the result of human activity and an important product for society. Indeed, this product needs copyright protection. Blockchain is an information technology for data transmission and encryption. It is based on a chain of blocks recording the information about all transactions in the system. Artificial intelligence is the property of artificial intelligent systems to perform creative functions. Those traditionally considered the human prerogative. The use of these technologies will contribute to the development of a more convenient intellectual property management system: the use of blockchain and artificial intelligence in the field of intellectual property management is promising, as it greatly facilitates the digital processes; the use of blockchain helps to improve the protection of patent rights and facilitates the monetisation of intellectual property; artificial intelligence and machine learning make routine processes more effective.

**Keywords:** blockchain; artificial intelligence; intellectual property; machine learning methods; decentralisation; distributed data; information technology; digitalisation

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## Introduction

Nowadays, the intellectual property management (IP) industry plays an important role in macro- and microeconomics of regions and state. However, the concept of IP includes the results of human ingenuity, creativity, and scientific activity [1].

Today, the world is in the era of society digitalization. However, not all areas are affected by this concept yet. One of these areas is the intellectual property management industry. Moreover, the process of registering patents, trademarks and technologies is provided by huge amount of paperwork, which significantly complicates it. For example, we can consider the patenting process in the Russian Federation and the EU. The registration of intellectual property in Russia consists of the following stages:

1. Preliminary search. It is a research process establishing compliance with the basic criteria for patenting, namely novelty, inventive step and industrial applicability. During this search, the closest analogues of the registration product are found, followed by a descriptive part specifying the differences between the products. Moreover, patent databases are not always easily accessible.

2. Application formalization. This process involves the preparation of a patent application.

3. Submission of documents to Rospatent.

4. Expertise. Experts are studying the patent application in detail. There are 2 types of examinations: formal and substantive one. The first one examines all documents and the fact of payment of the state fee. The examination is provided in the case of an invention; product analysis for novelty, inventive step and industrial suitability takes place.

5. Confirmation of the patent receipt.

6. Acquisition of a protection document based on examination results.

All these stages can take quite a lot of time.

In general, the registration system in the European Union is similar to the Russian one. However, it is necessary to determine the place of registration there.

Therefore, the registration of intellectual property is followed by a huge number of bureaucratic formalities and inconveniences. It significantly slows down patenting and cause great discomfort. Among other things, not all applications can be considered and processed.

Indeed, the development of 3D printing and artificial intelligence is a threat to copyright holders, since they can easily reproduce existing intellectual property objects.

Therefore, traditional systems no longer fully cope with the legal protection of intellectual property objects and do not ensure their effective use [2]. Hence, it is necessary to modernise the intellectual property management industry with new technologies, one of which may be blockchain technology.

Blockchain is an information technology for data transmission and encryption. It is based on a chain of blocks recording the information about all transactions in the system. Each block in this chain has its own hash amount and the hash amount of the previous block, which allows ones to guarantee data transparency; when one block is changed, its hash amount changes and it will have to be changed in the following blocks, which in turn will change their hash amount. The concept of blockchain is not new. However, a protocol similar to it was first published in 1982 by David Chaum, but its full appearance was presented by Satoshi Nakamoto in 2008.

The purpose of this study is to analyse the possibilities of integrating blockchain technologies and artificial intelligence into the intellectual property management system to increase its efficiency, reduce bureaucratic processes, and improve the protection of intellectual property rights.

This issue is considered in the following works:

1. For instance, Chandratre, A. & Pathak, A. (2021) in the paper Blockchain Based Intellectual Property Management in SSRN Electronic Journal suggest use blockchain technology as an intellectual property (IP) registry to ensure the reliability and transparency of the IP management process. The authors describe a theoretical framework for creating a smart contract allowing storage of IP in encrypted form and present them as digital certificates of authenticity [5].

2. However, Asghar, M. Z., Egaji, R. M. & Griffiths, M. (2023) in the paper The Role of Blockchain in Intellectual Property Management in International Journal of Engineering Research & Technology consider the role of blockchain technology in intellectual property management. They discuss the way blockchain is changing the information storing and processing; consider its potential application in intellectual property management [6].

3. Moreover, Bonnet, M. & Teuteberg, F. (2023) in the paper Blockchain for Managing Intellectual Property: A Multiple Case Analysis in Journal of Information Science and Engineering analyse several cases of using blockchain for intellectual property management. The authors explore various business projects using blockchain to create, protect, manage, and monetise intellectual property [8].

4. Furthermore, Bonnet, M. & Teuteberg, F. (2023) in the paper Blockchain Technology for Intellectual Property Management: A Systematic Literature Review using PESTEL Framework in International Journal of Computer Applications present another systematic review of the literature, but using the PESTEL framework to explore the advantages and limitations of blockchain technology in intellectual property management [7].

5. For instance, Sekerin, A. (2021) in the paper Blockchain for Security Enhancement in Additive Manufacturing Intellectual Property Management in International Journal of Advanced Manufacturing Technology analyses the possibilities of using blockchain to improve the security management and protection of intellectual property rights in the field of additive manufacturing. The author proposes the development of a blockchain-based digital platform for file sharing and describes three main steps for its establishing [9].

6. Futhermore, Gurkaynak, G. & Yilmaz, C. (2018) in the paper The Use of Blockchain Technology in Intellectual Property Management: A Literature Review in Journal of Intellectual Property Law &

Practice consider the literature on the legal and practical aspects of using blockchain in intellectual property management. The authors discuss the prospects of using blockchain in registration, management, and protection of intellectual property rights [10].

### Main part

Blockchain technology has certain advantages in the management of intellectual property. These include: data transparency and immutability, their secure storage and transfer, improved rights management system, reduction of bureaucracy and costs, global access and new models of patent monetisation.

Data transparency is a feature concerning all transactions and data recorded in the blockchain and accessible to all users or network participants. However, centralised data warehouses contain and manage only one organisation information. Transparency is based on a chain of transactions. This system allows the user to see the transaction history without the intervention of centralised authorities or third parties. It also can be perfectly used in the intellectual property management industry, as it provides easy and quick access to patterns and their owners in court proceedings.

The immutability of data in the blockchain is based on impossibility of information editing and deleting without the consent of network participants. It is possible through the use of cryptographic methods. They guarantee data immutability and authenticity. They include: hashing – the process of converting input data of arbitrary length into a fixed set of fixed-length data; digital signatures – they allow network participants to verify legal establishing of transactions and blocks; smart contracts – are software tools specifying the necessary conditions for a transaction. Therefore, the blockchain ensures the preservation of intellectual property rights and can be used for other tasks in this area.

The improved rights management system allows ones to significantly reduce the monetary and time costs during patent registration, ensure a higher level of patent security, and simplify the monetisation of patents. It can be implemented using smart contracts. They can automate the process of receiving remuneration for copyright holders or regulate access to content. Hence, a scientific article, an educational video, or other content on the Internet can be accessible to other people only after making a certain payment [3].

Indeed, blockchain is a global technology capable to provide remote access to patents for people from different countries. It can ensure more extensive protection of intellectual property rights.

New monetisation models imply the possibility of creating tokens certifying intellectual property rights [2]. This feature allows ones to share and sell IP rights. On the one hand, it provides the opportunity for crowdfunding, as funds will proceed directly from investors to copyright holders. On the other hand, smart contracts can be used to make micropayments for the use of a patent.

**Table 1** – Top 10 Blockchain and TPP Technologies

Place	Technology	Effects	Significance index
1	Non-Fungible Tokens (NFT)	Uniqueness	1
2	Crypto Assets	Safety	0.89
3	Decentralised applications	Efficiency and transparency	0.42
4	Smart contracts	Safety	0.28
5	Distributed Hash tables	Safety	0.20
6	Digital tokens	Uniqueness	0.17
7	Tokenised assets	Uniqueness	0.15
8	Smart property	Safety	0.12
9	Decentralised Autonomous Organisation (DAO)	Efficiency and transparency	0.11
10	Open Source Blockchain Platforms	Efficiency and transparency	0.03

Source: FINAM<sup>1</sup>

<sup>1</sup> TFINAM. URL: <https://www.fnam.ru/publications/item/top-10-blokcheyn-tekhnologiy-20230705-1254/> (Accessed 01.02.2024).

Smart contracts (No. 4) provide security by automating the execution of contracts without the presence of intermediaries. It reduces the risk of fraud and increases transactions reliability. Digital tokens (No.6) contribute to uniqueness by presenting assets digitally. It simplifies their transfer, trading, and reduces management costs. Decentralised Autonomous Organisations (DAO) (No. 9) increase the efficiency and transparency of management by allowing organisations to function without central leadership and use smart contracts to automate processes. Open source blockchain platforms (No. 10) ensure efficiency and transparency, facilitating the development and implementation of blockchain technologies through open access to source code and opportunities for teamwork<sup>2</sup>.

**Table 2 – Top 10 Blockchain and TPP Technologies**

Rank	Technology	Effects	Significance index
1	Supply chain and logistics monitoring systems	Transport and logistics	1.00
2	NFT applications	Creative industries	0.83
3	IoT applications with data management decentralisation	Trade, communications and data transmission	0.75
4	Digital platforms for real estate transactions	Real estate transactions	0.62
5	Electronic voting system	Communications and data transmission	0.61
6	Anti-money laundering systems	Finance	0.53
7	Tokenised assets	Uniqueness	0.15
8	Smart property	Safety	0.12
9	Decentralised Autonomous Organisation (DAO)	Efficiency and transparency	0.11
10	Open Source Blockchain Platforms	Efficiency and transparency	0.03

Source: FINAM<sup>3</sup>

Smart contracts ensure new opportunities for monetisation of creative products. These technologies enable the management of digital contracts and copyrights, effectively controlling access and preventing unauthorised distribution of digital content. They also prevent piracy and ensure accurate royalty payments. In the next 3-5 years these systems are expected to be widely implemented in the creative industries, including the media and entertainment ones. This will significantly increase intellectual property protection and optimise content management processes, making them more transparent and reliable<sup>4</sup>.

Examples of using blockchain for patent management:

**Blockstack.** It offers decentralised data and application repositories using blockchain technologies. The main idea is to give users control over their data by removing intermediaries and centralised servers. Users can store their data on their own devices or choose trusted storage sites. It increases user security and privacy. The platform also provides tools for developing decentralised applications operating on top of this network.

**Chronicle.** It uses blockchain to register and track medical products. Using unique identifiers based on the blockchain, they create a digital footprint for each drug lifecycle. It allows ones to effectively combat the falsification of medicines and ensure control over their quality and authenticity.

**Ujo Music and Mycelia.** These projects use blockchain to transform the music industry. They offer transparent payment and rights management systems for musical works, allowing artists to receive fair compensation for their creative work. Thanks to the blockchain, participants in the music ecosystem can

<sup>2</sup> FINAM. URL: <https://www.finam.ru/publications/item/top-10-blokcheyn-tekhnologiy-20230705-1254/> (Accessed 01.02.2024).

<sup>3</sup> TFINAM. URL: <https://www.finam.ru/publications/item/top-10-blokcheyn-tekhnologiy-20230705-1254/> (Accessed 01.02.2024).

<sup>4</sup> TFINAM. URL: <https://www.finam.ru/publications/item/top-10-blokcheyn-tekhnologiy-20230705-1254/> (Accessed 01.02.2024).



trace every stage of the use and monetisation of their works. It eliminates the problems of unfair income distribution and lack of transparency.

Guardtime. It offers solutions to protect digital assets, including movies and television programs through using blockchain technology. They help organisations to ensure the security and integrity of content by preventing unauthorised access and distribution. Thanks to the blockchain, it is possible to create a transparent digital footprint for each content object. It provides reliable protection against cyber threats and piracy<sup>5</sup>.

Artificial Intelligence. It can be an excellent tool for establishing an intellectual property management system based on blockchain technology. However, there is a routine task to search for similar IP products in the registry. Therefore, AI can be used to automate it in case of formalized patents. We believe, the method of extracting information from the text (IE) documents can be used [4].

Machine learning methods (MLT). They contain clustering (uncontrolled MLT) and classification (controlled MLT) used for text mining. Therefore, clustering can be used to analyse existing patents. This technique will be effective one as follows: the key functions of patent documents are defined on the basis of different IP objects. Therefore, the analysis is provided in 2 stages: data preparation and analysis itself.

Artificial intelligence can help determine the value of intellectual property and enter this information into smart contracts for their further use. It will help automate the process of IP monetisation. The applied machine learning methods include:

#### 1. Regression models

– Linear regression is one of the simplest MLT methods used to analyse dependencies and predict values. Within the framework of intellectual property, it is able to determine the relationship between value and various factors affecting it. The factors include: the number of patent citations, the age of the patent, the number of applications and legal protection.

– Multiple linear regression is an extension of linear regression. It is used to model the relationship between one dependent variable and two or more independent variables.

– Polynomial regression is a generalisation of linear regression. It is used to model nonlinear dependencies between a dependent variable and one or more independent variables.

#### 2. Neural networks

– Multilayer perceptrons (MLPs) are one of the most popular types of artificial neural networks. They are used to solve a wide range of tasks, including estimating the value of intellectual property (IP). MLPs are able to model complex nonlinear dependencies between variables. It makes them especially useful for forecasting and analysing the cost of IP. MLPs consist of several layers of neurons: an input layer, one or more hidden layers, and an output layer. Each neuron in the layer is connected to the neurons of the previous and next layers through weights adjusted during the learning process.

– Recurrent neural networks (RNNs) are a type of artificial neural networks. They are used to process sequential data and simulate time dependencies. In the field of intellectual property (IP) management, RNNs can be applied to predict the value of IP based on time series of data, such as the dynamics of patent citations or changes in market indicators. RNNs differ from traditional neural networks. They have recurrent connections that allow ones to take into account previous network states when processing current input. This makes RNNs especially effective for tasks concerning the order and temporal sequence of data.

Another possibility for integrating AI and machine learning methods may be the automatic generation of patent applications. The main principles of this process will be: collection and analysis of source data, structuring and creation of the application text, and verification of compliance with established standards. We can distinguish the following:

– Natural Language Processing (NLP). This method specialises in the interaction between a computer and a human language.

– LSTM (Long Short-Term Memory). It process long sequences of text and remember important

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<sup>5</sup> RBS. URL: <https://rbs.partners/mediatsentr/blokcheyn-i-zaschita-intellektualnoy-sobstvennosti-statya-sevil-baer-v-it-speaker> (Accessed 01.02.2024).

information in their memory cells.

– GRU (Gated Recurrent Unit). It is a simplified version of LSTM; it requires accounting for long sequences.

These ways of artificial intelligence interaction will help in the implementation of intellectual property management. However, blockchain and artificial intelligence technologies have potential risks and disadvantages.

The disadvantages are as follows:

1. Privacy and data privacy issues

– Leakage of confidential information. This problem is based on blockchain transparency principle: any network participant, in the absence of proper encryption and data protection, can gain access to confidential information.

– Violation of property rights. Despite the continuity and authenticity of the data provided by blockchain technology, it can also cause disputes about intellectual property rights in case of incorrect interpretation of data.

– Intellectual property theft. One of the options for such an outcome may be the lack of proper security. It will not be able to prevent attackers from gaining access to valuable patents. However, smart contracts controlling IP in the blockchain can be hacked. It can cause illegal transfer or data modification. Moreover, phishing and social engineering allow attackers to access to private keys and further data hacking.

2. Technical failures and vulnerabilities can pose serious risks to intellectual property management. They are as follows:

– Blockchain network failures. Insufficient scalability and performance issues can affect the stability of the blockchain and cause delays and disruptions in its operation. It can cause temporary data unavailability or delayed transaction processing.

– Smart Contract Security issues. Smart contracts are exposed to the risk of software errors. Significant consequences can arise in case they are misspelled; among them damage to intellectual property or leakage of confidential information.

– 51% attacks. 51% attacks are considered as a threat to decentralised blockchains. The attackers gain control over more than half of the network's computing power. It can cause data manipulation and transaction substitution.

3. Insufficient accuracy of artificial intelligence

– Incorrect conclusions or decisions. Artificial intelligence, especially in the initial stages of development, can make mistakes in data analysis or in the decision-making process.

– Errors in decision-making processes. Insufficient accuracy of artificial intelligence algorithms and models can cause errors in decision-making.

4. Issues of responsibility and ethics

– Problems with determining responsibility for automated solutions. The use of artificial intelligence in intellectual property management processes can create difficulties in determining responsibility for errors or problems in terms of automated systems.

– Ethical aspects of the use of artificial intelligence. Ethical issues arise when using artificial intelligence, such as transparency of algorithms, protection of data privacy and fairness in decision-making. They may affect the management of intellectual property.

5. Insufficient regulation and legislative framework

– Absence of clear legal norms. Nowadays, legislation in the field of artificial intelligence, and especially its application in the field of intellectual property management, is rather underdeveloped, and the previous laws can not be considered for new conditions.

– Uncertainty of legislative norms. Currently, the poor legal regulation in the field of new technologies, in particular blockchain and artificial intelligence, may be an obstacle to the widespread dissemination of these technologies in the field of intellectual property management.

## Conclusions

The conducted research of blockchain and artificial intelligence in the management of intellectual property use allows us to conclude the following:

1. The use of blockchain and artificial intelligence in the field of intellectual property management is promising, as it greatly facilitates the digital processes.
2. The use of blockchain helps to improve the protection of patent rights and facilitates the monetisation of intellectual property.
3. Artificial intelligence and machine learning make routine processes more effective.
4. Hence, the technologies discussed in this article have a huge impact on the field of intellectual property management, create new opportunities, and allowing patenting to be globalised.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## AUTHORS' CONTRIBUTION

Sergey N. Kosnikov – conceptualization, project administration, writing – original draft.

Vladislav A. Ivannikov – formal analysis; investigation.

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