# Implementation and Cost-Effectiveness of Blockchain Technology within the IP Ecosystems

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***Abstract* - The Fourth Industrial Revolution (Industry 4.0) enables the new digital economy by merging technologies such as blockchain, big data, artificial intelligence, the Internet of Things (IoT), and other emerging technologies through digital transformation. Blockchain technology is among the emerging technologies that are affecting the ways of business operationalization through the automatization of tasks, but also the management of intellectual property rights (IPRs) protection process. The digital economy has an important role in both social and as an engine for economic growth while the IPRs have an important role in the development of the digital economy. The aim of this paper is to investigate and analyze the cost-effectiveness and positive impact of blockchain technologies adoption and implementation in IPRs protection process within the IP ecosystem.**

***Key words – Industry 4.0; blockchain technology; economic growth; IPRs protection management; IP ecosystem***

## I. INTRODUCTION

The Fourth Industrial Revolution (Industry 4.0) gave rise to new emerging and disruptive technologies such as blockchain, big data, artificial intelligence, the Internet of Things (IoT), and other emerging technologies that affect human lives, but also the way how businesses operate. The digital transformation of companies and institutions was accelerated by COVID-19 in adapting to the new digital communication channels. Companies with a higher level of digital transformation adapted faster to the new situation and developed business models that implement blockchain and other emerging technologies.

Intellectual property rights (IPRs) protection and management became more challenging with the rapid development of digitalization and the digital economy where the number of disputes in the IPRs infringement is constantly increasing. The existing technologies used for IPRs protection process are not adequate in the digitalized world to fight against IPRs infringements in a way to monitor, discover, authorize, or forbid the misuse of the IPRs.

Blockchain technology has a transformative and disruptive potential within the IP ecosystems and for this reason, it needs to be properly addressed to fully realize the benefits that blockchain technology offers. It can be used in the management of the IPRs protection process in registration, management, and enforcement of the IPRs.

Practical implementation of blockchain technology within the IP ecosystem can be seen in performing of several activities: providing proof-of-rights, keeping the record of rights, registering the rights, controlling, and tracking the distribution of rights, etc. The idea of a distributed network could be a beneficial solution for IPRs management since IPRs by their nature are distributed across countries and dispersed around the world [1].

The IP system is today faced with problems arising in the digital age where it is very difficult to fight and struggle against the internet who is developing much faster than the laws governing IPRs protection.

The aim of this paper is to investigate and analyze the impact and cost-effectiveness of blockchain technology adoption and implementation for relevant stakeholders in the IPRs protection process within the IP ecosystems. The research question addressed in this paper is whether the implementation and adoption of blockchain technology improve the management and cost-effectiveness of the IPRs protection process within the IP ecosystem, based on the preliminary literature review. It is important to note that the existing literature on this specific topic is scarce and therefore still without sufficient relevant information on the practical implementation of blockchain technology in the IPRs protection process management within the IP ecosystem which presents the research limitation. Therefore, the purpose of this paper is to fill the identified research gap in a way to capture and summarize the available important and relevant information on this research topic.

The paper is organized as follows. In the introduction part, the research topic is introduced and elaborated. In the second part of the paper, the IPRs are defined and elaborated in the economic context, as well as the role of IPRs protection system in economic development. In the third part of the paper is presented and elaborated based on the current literature on how blockchain technology can be implemented within the IP ecosystem. The fourth part of the paper discusses the challenges and opportunities of the potential application of blockchain technology in the management of the IPRs protection process. The final part of the paper, the conclusion, summarizes relevant findings based on the conducted preliminary literature review and proposes the elements for future research on this topic.

## II. IMPORTANCE OF IPRS PROTECTION AND MANAGEMENT

Intellectual property rights in a broader sense are the rights that resulted from a creative and intellectual effort of an individual, and that fall into the scientific, literary, and artistic domains. The IPRs can take several forms such as copyright, patents, trademarks, industrial design, trade secrets, and various strategies of IPRs management are implemented accordingly to the specific IPRs form and entering the new or existing market.

The IPRs have all characteristics of any other asset. An asset can be defined as an item, thing, or entity that has potential or actual value to a company or an organization. The value of an asset can be tangible or intangible, financial, or non-financial, and includes consideration of risks and liabilities. While the physical assets refer to the equipment, inventories, and properties owned by a company or an organization and are tangible in its nature, the intangible assets refer to the non-physical assets such as brands, digital assets, use rights, licenses, intellectual property rights, reputation, or agreements [2]. The aim of IPRs protection and management is in transforming intangible assets into tangible ones in a form of products and services, and to commercially exploit them on the market.

From an economic point of view, IPRs can play an important and positive role in economic development and growth. There are two economic objectives of the IPRs system: to promote investments in knowledge and technology creation and business innovation through the exclusivity rights to use and sell the newly developed technologies and to promote the dissemination of new knowledge and technology by encouraging rightsholders to place their inventions on the market. There is a need for a tradeoff between these objectives by policy balancing between the weak and overprotective IPRs system [3].

The IPRs protection system is the institutional system that fosters innovation and economic development. The innovators are enjoying the exclusivity right granted by the government to exclude others from commercial exploitation of their inventions. In return, the innovators are required to disclose the invention to the public and enable the society end economy to fully benefit from the innovation exploitation. The IPRs are having a limited duration of protection and when the protection expires the invention becomes the public good. For this reason, adequate IPRs protection process management needs to be put in place to address all potential difficulties in commercial innovation exploitation.

In the completely opposite approach, an Open Innovation model developed by Chesbrough [4], the companies are encouraged to use external ideas and to combine them with their own ideas to generate synergies for value creation and enable the internal ideas to be successfully applied outside of the company's market. This approach is far away from the traditional IPRs system management that promotes the creation of monopolies and exclusivity by enabling only one company a competitive advantage over all others [5].

Implementation of blockchain technology within the overall IP ecosystem could have a beneficial impact on the IPRs protection process management by making the process easier and smoother and in this sense cost-effective.

## III. IMPLEMENTATION OF BLOCKCHAIN TECHNOLOGY IN IP ECOSYSTEMS

The practical implementation of blockchain technology was introduced by Nakamoto. He introduced a new method for value transfer execution between parties that are traceable and reliable [6]. Blockchain technology can be considered as a kind of electronic bookkeeping model since blockchain technology includes distributed data storage, peer-to-peer transmission, consensus mechanism, and encryption algorithm [7].

The IP ecosystem can be defined as a network of different actors (e.g., inventors, companies, organizations, IP offices, enforcement authorities, etc.) that interact and collaborate in the IP environment by using the resources to generate, protect, manage, and commercialize intellectual assets. These interactions present the four phases within the IP value chain [8].

The management of the IPRs protection process is currently well digitalized since the IPRs application process is almost completely digitalized within the relevant national and international IP institutions (i.e., WIPO, EPO, USPTO, etc.). Due to the development and implementation of digital technologies such as blockchain, access to relevant market information, identification of suitable licenses, and automated systems for marketing and licensing are enabled [9].

IPRs and blockchain technology can be observed from two different perspectives: the technology using the blockchain as a basis that can be IP protected if satisfying the necessary requirements, while the blockchain technology can be used in the management of the IPRs protection process [10].

Blockchain technology has many different features such as tamper-evident, timestamp, and traceability possibilities. Another important characteristic that distinguishes blockchain technology is decentralization. This characteristic is very important in the context of IPRs protection process management. The process of IPRs protection is a highly regulative process with strictly defined and complex procedures. Besides the fact that two parties involved in the process of IPRs protection need to verify the authenticity of the information, the participation of the third-party institution is necessary and that is both time and cost-consuming. In addition, the presence of the third-party central institution is very important for controlling the whole process of information exchange and building trust between the two parties involved in the process of IPRs protection [7].

Blockchain technology as an emerging technology has a high potential of changing managerial tasks. There are several important features provided by blockchain technology identified by a number of scholars: an inherent degree of security, records immutability, transactions transparency, digital information integrity

and authenticity, data ownership, and trust substitution in intermediaries by trust in the predefined protocol consensus mechanism [11],[12],[13],[14]. All these aspects are very important for the smooth and successful management of the IPRs protection process.

The potential application of blockchain technology is in the concept of smart contracts. Narayanan et al. emphasize that smart contracts are not enforced by laws or courts of arbitration, but by blockchain technology. The rules and penalties embodied in the smart contracts are defined, and the obligations are automatically enforced [15].

The implementation of blockchain technology in the patent system could result in the reduction of the inefficiencies in recording and efficiently agreeing on the time registrations possibly across several national patent systems, and this could be the first step in the patent application and providing the proof of existence right from the beginning. Besides the fact that the entire process could provide a streamlined and transparent practice by limiting the inefficiencies and paperwork, the implementation of blockchain technology could be an efficient tool to fight against patent trolls, by reducing the costs for companies to timestamp and create track of records for their inventions [16].

The implementation of blockchain technology in a way of skipping the overall traditional process of a patent application for companies in registering their IP through a distributed ledger could reduce the total number of contract disputes and enable the cost-efficiency in reducing the number of interactions with local and national governments. As a result, the effectiveness of the IPRs management system could be improved as well as information distribution between the companies which could have a positive impact on the innovation process [17].

IPRs are traditionally governed and managed by centralized institutions in specific regions where IPRs holders wanted to enforce their rights. However, the globalization and digitalization of the market emphasized a need for a more plausible and novel solution for the management of the IPRs protection process that blockchain technology could offer. One of the potential solutions is a framework model that is based on the consortium blockchain that can potentially solve many practical difficulties that are detected in the IPRs protection process [1].

Another potential use of blockchain technology is as a legal tool in IP law. The implementation of the blockchain technology is capable to affect several processes and provide cost-effectiveness in the IPRs protection process lifecycle such as: registration of the IP rights through blockchain by using mobile applications and replacing the relevant institutions which would minimize or fully reduce the IP registration costs for the IP holders, identification of the rightful IP holders, using smart contracts for IP licensing, reducing the need for third parties in the process, and IPRs protection enforcement against counterfeits [18].

Even though blockchain technology is constantly developing and evolving, when it comes to its practical implementation within the IP ecosystem it is still in the early stage of development.

## IV. DISCUSSION

The implementation of blockchain technology could offer new and improved ways of management of physical assets and their digital presentation, value exchange, business operations, and importantly trust mechanism enforcement. Blockchain technology has various implementation that goes beyond its original intent. The implementation of blockchain technology offers an innovative approach to the management of the IPRs protection process.

There is an evident need for both institutional and legislative support for blockchain technology implementation. The legislative support is lagging behind the concrete practical implementation of blockchain technology, especially in the area of IPRs management. The efficient application of blockchain technology is facing several concerns. The first concern is related to the legal binding of digital signatures used in blockchains because not all digital signatures are equally valid. The second concern is the use of blockchain-based evidence in courts. The third concern lies in the need for legislation to support the implementation of blockchain technology for copyright protection. Blockchain technology does not solve the unauthorized use problem, however, it does help creators to track their creations and to capture the value they generate [5].

From the standardization point of view, and in this sense important for the implementation of blockchain technology in the IPRs protection process management, the International Organization for Standardization (ISO) is currently developing standards for Blockchain, and distributed ledger technology called ISO/TC 307 (1). Adoption of such standardization will foster blockchain technology to achieve the relevant required legal status and enable IPRs holders to the creation and save evidence for their IP claims [19].

Implementation of blockchain technology for IPRs management from the operational point of view is faced with several challenges: authenticity problem, provenance problem, and royalty stability problem.

The authenticity aspect is an important and valuable aspect in providing the Proof of Existence of protected work at a certain point in time, as well as Proof of Ownership by including additional information on the IPRs holders the Proof of Ownership since blockchains in its nature are unchangeable. Blockchain technology cannot confirm the authenticity of the registered information per se even though it can store information in an unchangeable manner. Until the authenticity issue is resolved the implementation of blockchain technology in the management of the IPRs protection can only be realized through a permissioned network that requires the validation of the inserted information before it is published on the blockchain [20].

The provenance aspect is related to the question of how to record the transfer of IPRs ownership on the network. It is a very complex task to create a chain of different IP rights holders and it is expected that blockchain is capable to transfer the ownership without the trusted third party involved and to prevent piracy by issuing a digital certificate or a secret key to access the digital information. Until the provenance aspect is resolved, the implementation of blockchain technology in this respect will be by issuing a transferable certificate by a trusted third party such as a relevant government institution [21].

The Royalty Stability aspect presents a big challenge related to the stable payment methods for decentralized royalty management which make the implementation of blockchain technology in royalty payment exposed to a very high level of volatility of cryptocurrencies and respectively difficult to reach a fixed consumable price on the blockchain. For this reason, IPRs holders will have to accept the trade-off between price stability and efficiency [21].

The technical features of blockchain technology have a positive effect on the cost efficiency associated with the authenticity aspect. In addition, the implementation of blockchain technology radically changes the ways of doing business and impacts the changes in the market structures [22].

## V. CONCLUSION

Digital transformation is affecting organizations and businesses to adopt their digital transformation strategies. One of the reasons businesses are still not implementing blockchain technology is an economic aspect related to sunk costs and switching costs since money transactions and interactions are changing irreversibly.

Implementation of blockchain technology within the IP ecosystem has great disruptive and transformative potential that needs to be adequately addressed to fully realize its beneficial impact and to properly manage the associated implementation risks.

The implementation of blockchain technology in the IPRs protection process management has a large potential. However, there are some aspects that still need to be resolved to fully capture all the benefits that blockchain technology can bring, especially related to the costs and resources effectiveness. There are still some issues related to security, network size, transaction costs, etc. that need to be resolved and furtherly investigated.

The state-of-the-art related to the implementation and exploration of blockchain technology within the IP ecosystems is still in its beginnings. There is still a lack of understanding of all the benefits of adoption and implementation of blockchain technology can offer.

There is no doubt that the implementation of blockchain technology can improve the IPRs system management that did not follow the rapid technological changes that digitalization brought and the circumstances in which it operates. However, it is arguable if the implementation of blockchain technology can fully replace this system.

There is still a lot of research to be done on the implementation of blockchain technology in the IP system even though blockchain technology was introduced almost two decades ago. Its acceptance and practical implementation within the IPRs system will require further research based on its use cases and accompanying legislation. The results and findings of this preliminary literature review can serve as a basis for the future broader systematic literature review that will encompass all relevant aspects and implications (economic, legal, technical) of the implementation of blockchain technology in the management of the IPRs protection process.

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