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The Use of Blockchain Technology in Corporations and Its Legal Implications

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ABSTRACT

This study comprehensively examines the areas of application of blockchain technology within corporations, the structural and functional transformations brought about by this technology, and the legal consequences it engenders, particularly from the perspective of Turkish law. The fundamental characteristics of blockchain—decentralization, immutability, transparency, and security—open the door to new governance models in corporate law. In this context, the functionality of blockchain applications in areas such as general assembly meetings, stock transactions, and corporate control mechanisms in joint-stock companies is addressed, and the impact of digital transformation on capital markets and shareholding structures is evaluated. In the following sections of the study, the compatibility of blockchain technology with the existing legal infrastructure within the framework of the Turkish Commercial Code is discussed, and comparative analyses from European and international legal perspectives are provided. Furthermore, the legal challenges of blockchain applications, such as the protection of personal data, the legal validity of smart contracts, jurisdiction issues, and cross-border data flows, are addressed in detail, and solutions to these problems are proposed. In conclusion, blockchain applications in joint-stock companies have the potential for comprehensive transformation not only at the technical level but also at the normative level. In this context, the need for innovative and comprehensive regulation has been highlighted from both private and public law perspectives.

Keywords: Blockchain, corporation, Turkish Commercial Code, smart contracts, data security.

1. INTRODUCTION

Blockchain technology, as the most advanced example of distributed ledger technology, constitutes one of the cornerstones of digital transformation.[1] This technology offers revolutionary innovations, particularly in the recording of financial transactions.[2] With its fundamental elements of transparency, security, and immutability, blockchain technology is not limited to the financial sector; it also has the potential to transform the field of corporate law.[3]

In corporations, blockchain technology offers solutions to structural problems such as slowness, trust issues, and transaction costs, particularly in decision-making and document verification processes, through its decentralized and immutable data structure. [4] Specifically in corporations, this technology is known to be effective in many areas, from decision-making processes and board meetings to shareholder relations and document management. [5] While it is emphasized that decision-

[1] Elif Nuroğlu and Hüseyin H. Nuroğlu. "Turkey and Germany's digital transformation in industry: roadmaps and company comparisons." Süleyman Demirel University Journal of Economics and Administrative Sciences 23. Industry 4.0 and Organizational Change Special Issue (2018): 1537-1560.

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making processes in corporations are often based on rigid procedures, reducing internal flexibility, it is argued that blockchain can function as a factor that accelerates and increases the transparency of this process. [6] Similarly, it is stated that blockchain offers significant advantages, particularly in terms of digitizing general assembly meetings and ensuring secure voting. [7]

This technology should be considered not only as a technical tool but also as a tool for legal transformation. [8] Therefore, how blockchain technology changes the operation of joint-stock companies and how it is accepted within the framework of the current Turkish Commercial Code has become a subject of discussion in both academic and practical studies. Today, the business world must effectively manage digital transformation processes.[9] Integrating innovative technologies such as blockchain into company operations offers new opportunities in terms of legal compliance, but also brings with it some regulatory risks. [10] However, it is stated that whether Turkish legislation has sufficient infrastructure, especially in areas such as the protection of personal data, archiving obligations, and the validity of transactions conducted electronically, is open to debate. On the other hand, it is stated that blockchain is not only a technical innovation but also creates a "digital governance culture" and will cause fundamental changes in the corporate governance understanding of joint-stock companies.

The transformation that blockchain technology is creating in corporate governance has the potential to lead to fundamental changes not only in decision-making processes but also in the functioning of corporate governance principles and audit mechanisms. This article will present a detailed legal analysis, in light of the Turkish Commercial Code (TTK) regulations, of how recording board decisions in encrypted form on the blockchain can make retrospective audits more secure and resistant to interference. This assessment will include whether the existing legal infrastructure can adapt to these new technologies, potential legal gaps, and, if necessary, proposed legal regulations. In this context, the fundamental characteristics of blockchain technology and its potential applications in joint-stock companies will first be discussed; subsequently, the legal problems arising from this technology and proposed solutions will be discussed in detail. Thus, both the reflections of technological developments on company law and the extent to which these reflections are compatible with the legislation will be subjected to a comprehensive evaluation.

1.1. Key Features and Functionality of Blockchain Technology

In recent years, blockchain technology has been considered not only in relation to digital currencies, but also as a paradigm capable of creating radical changes in the corporate structures and governance processes of companies. Without understanding the fundamental characteristics of this technology, it is impossible to properly assess its potential structural and legal impacts within the context of corporations. Blockchain technology is a crucial tool enabling corporations to transition to a more open, reliable, and participatory form of governance. This technology is not merely a computer-related innovation; it can also transform how companies operate and are managed.

The conceptual foundation of blockchain technology is built upon the principles of decentralization, immutability, and transparency-security. These principles reveal the technology's potential to revolutionize financial, social, and industrial fields. This section will examine in detail the conceptual basis of blockchain technology and the three fundamental principles upon which it is built: decentralization, immutability, and transparency-security.

1.2. Decentralization

The most important feature of blockchain is that information is stored in many different places, not in a single location. Unlike traditional centralized systems, blockchain offers a distributed network structure that is

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[9] Elif Nuroğlu and Hüseyin H. Nuroğlu. “Turkey and Germany's digital transformation in industry: roadmaps and company comparisons.” Süleyman Demirel University Journal of Economics and Administrative Sciences 23. Industry 4.0 and Organizational Change Special Issue (2018): 1537-1560.

[10] Elif Nuroğlu and Hüseyin H. Nuroğlu. "Digital transformation in industry in Turkey and Germany: roadmaps and company comparison." Süleyman Demirel University Faculty of Economics and Administrative Sciences Journal 23. Industry 4.0 and Organizational Change Special Issue (2018): 1537-1560.

not dependent on a single authority. This structure allows trust to be distributed among network participants. Bitcoin's decentralized nature is described as "a peer-to-peer network that enables transaction verification without a central server or trusted third party."[11]

The decentralization of blockchain is achieved through cryptographic techniques and consensus algorithms (e.g., Proof-of-Work), ensuring equal authority among nodes in the network. The economic impact of decentralization is highlighted as "reducing costs and increasing efficiency by eliminating intermediaries." Studies indicate that this system helps in making decisions more transparently and securely within a company, thus giving shareholders more say in management.

It is pointed out that the decentralized nature of blockchain may conflict with traditional corporate governance structures, because in joint-stock companies, the decision-making authority of the board of directors represents a central authority, while blockchain replaces this centralization with a sharing environment with equal rights. This structural difference also brings some compatibility issues with the existing legal framework. However, in the long term, it is predicted that greater participation and control can be achieved in the management of small and medium-sized joint-stock companies in particular. Therefore, harmonizing technological innovations with the legal infrastructure is an urgent need for both the business world and legal professionals.

1.3. Immutability

Another fundamental characteristic of blockchain technology is that data entered into the system cannot be altered later. The fact that data recorded on the blockchain is irreversible and unchangeable is one of the technology's most critical features. This feature is achieved through cryptographic hash functions and the chain structure. On Ethereum, once a block is confirmed, changing the data it contains requires the cooperation of the majority of the network; this is practically impossible. Immutability is defined as "a feature that ensures data integrity and prevents manipulation of historical records." The Bitcoin ledger is a "continuously growing chain of records," and it is emphasized that "past transactions cannot be deleted." The most important advantages this technology provides for companies are listed as data security, corporate transparency, and the automation of governance mechanisms. These qualities of blockchain can contribute to corporations becoming more democratic, auditable, and participatory. In particular, the immutability feature provided by blockchain offers a significant guarantee against the retroactive alteration of general assembly and board of directors' decisions of corporations.

However, the principle of immutability also presents some legal challenges. The irreversible nature of transactions on the blockchain raises questions about how to correct erroneous or illegal records. In Turkish corporate law, retroactive correction or cancellation is possible in some cases, which may conflict with the inflexible nature of blockchain technology. Therefore, while the principle of immutability offers benefits in terms of oversight and security, it will also necessitate legal reforms in certain areas of corporate law.

1.4. Transparency and Security

One of the most important benefits of blockchain is that transactions are recorded securely and in a way that is visible to everyone. Blockchain offers transparency with a public ledger while ensuring security through cryptography and distributed consensus mechanisms. Blockchain strikes a balance between transparency and privacy: transactions are visible to everyone, but identities remain pseudonymous. The verifiability of transactions builds trust. In a token economy, smart contracts and open-source protocols increase transparency and reduce systemic risks. This allows every employee to verify whether transactions have been processed correctly. Such a system helps companies operate more transparently and honestly, making it more difficult for employees and managers to do wrong. This helps reduce negative events such as corruption within the company. A study on post-Soviet countries indicated that blockchain strengthens audit mechanisms and improves trust within companies. According to the study findings, transparency stands out as a trust-building element not only among shareholders but also in relations with public authorities. However, it should not be overlooked that this principle of transparency needs to be limited in terms of personal data protection; because the fact that information on the blockchain is indelible and accessible may create a potential conflict with data protection regulations such as the KVKK and GDPR.

Blockchain technology is attracting increasing attention with its potential to provide transparency, reliability, and efficiency in the corporate governance and auditing processes of joint-stock companies. The decentralized and immutable nature of this technology increases the verifiability of internal decision-making mechanisms and financial transactions, strengthening the trust relationship between governing bodies and stakeholders.

[11] Andreas Antonopoulos, *Mastering Bitcoin: Programming the Open Blockchain*. 2nd ed., O'Reilly Media, 2017.s. 5

1.5. Blockchain Applications in Joint Stock Companies

A study examining the impact of blockchain applications on corporate governance through international examples shows that this technology offers structural improvements in many areas, from voting systems to decision-making processes. According to the study's findings, blockchain-based governance systems enable shareholders to participate more actively and securely in decision-making processes and facilitate the auditing of board activities. Thus, the accountability of governing bodies and the prevention of internal corruption are significantly supported.

According to the findings of a study that evaluates how blockchain technology supports digital transformation in corporate governance from a legal perspective, blockchain technology not only increases information and transaction security but also improves the quality of management through functions such as process automation and document verification in corporate management. However, adapting legal regulations to the technology stands out as a critical element in terms of applicability.

A recent study in the field of accounting and auditing details the transformation that blockchain technology is creating in financial reporting and independent audit processes. According to the study's findings, blockchain's real-time and immutable record-keeping capability increases the accuracy of financial statements and makes audit processes more efficient. This strengthens companies' financial transparency while simultaneously significantly reducing audit costs. The transformation created by blockchain technology in company management is not limited to decision-making processes; it also leads to fundamental changes in corporate governance principles and the functioning of audit mechanisms. In joint-stock companies, fundamental corporate governance principles such as management transparency, shareholder information, and participation in management can be made more effective and functional with blockchain-based systems. This technology accelerates digitalization, reduces information asymmetry between managers and shareholders, and enables audit processes to be conducted in real time. In particular, recording board decisions in encrypted form on the blockchain makes retrospective audits more robust and resistant to tampering. It is noted that blockchain technology is being used as an effective tool in solving transparency problems, especially in developing countries. A study shows that pilot projects implemented in companies operating in the former Soviet geography reduced internal corruption and created trust-based corporate structures. These examples offer guiding and noteworthy application models for Turkish companies that share structural similarities. It is emphasized that blockchain applications make decision-making processes more democratic by reducing centralization in corporate governance structures. The study states that blockchain-based systems, where shareholders can exercise their voting rights directly and transparently, increase the accountability of managers and thus improve the quality of governance.

Overall, the opportunities offered by blockchain technology in the field of corporate governance and auditing not only optimize business processes but also make significant contributions to stricter adherence to governance principles, transparency, and trust building. However, the realization of these contributions is hampered by the "written decision" requirement in Article 390 of the Turkish Commercial Code (TTK), which creates uncertainty regarding the legal validity of blockchain records. It is suggested that a definition of "digital record" be added to the TTK, taking the Swiss DLT Act as an example.

1.6. General Assembly and Management Processes

In joint-stock companies, general assembly meetings and board of directors' decision-making processes form the basis of the company's legal and administrative structure. The validity requirements of board decisions are specifically addressed in Article 391 of the Turkish Commercial Code (TTK). This article specifies procedural requirements such as the proper taking of decisions, their recording in the ledger, and their signing. The transparent, secure, timely, and effective execution of these processes is of great importance for the legitimacy of corporate governance. In recent years, the integration of blockchain technology into these processes has enabled the digitalization of traditional procedures and a more participatory and traceable structure. In particular, the combination of electronic general assembly systems and blockchain technology allows for the development of a new generation decision-making model.

It is noted that decision-making processes in joint-stock companies are generally bureaucratic, slow, and involve limited participation; blockchain technology, however, can accelerate this process, making it more transparent and democratic. In blockchain-supported general assemblies, voting can take place digitally, thus technically preventing the alteration or manipulation of votes. This increases both the security and traceability of internal decision-making processes within the company.

Blockchain technology serves as a significant example of integration into Turkish corporate law. While the Turkish Commercial Code currently stipulates that general assembly meetings are based on physical attendance, it is argued that blockchain-based systems could fundamentally change this understanding. Supporting general assemblies held electronically with blockchain technology not only provides flexibility in terms of

location and time but also ensures a stronger legal foundation. Another study supporting this view argues that integrating the currently implemented electronic general assembly system in joint-stock companies with blockchain technology would lead to significant improvements in data security, identity verification, and voting. In a blockchain-supported system, identity verification processes can be conducted transparently and securely; thus, documents such as representatives' authorization documents, proxies, and share registers can be integrated into the blockchain, allowing transactions to be processed without the need for a central authority.

An international study clearly demonstrates the contribution of blockchain technology to shareholder-based governance processes. Researchers note that, especially in publicly traded companies, this technology increases the accuracy of shareholder vote counting, thus enabling even small shareholders to participate effectively in decision-making mechanisms. Such applications offer a contemporary and participatory governance model proposal that should be considered in terms of Turkish corporate law.

Another study that takes the subject to a more advanced level discusses the holding of general assembly meetings in a Metaverse environment, supported by blockchain technology. Such meetings, held in three-dimensional digital environments, increase interaction and go beyond traditional meeting formats, making corporate communication more dynamic and efficient. In this structure, the blockchain infrastructure offers a system that can ensure both the technical and legal security of processes such as meeting participation, voting, and minute creation.

In summary, integrating blockchain technology into general assembly meetings in joint-stock companies carries strong potential not only in terms of technical conveniences but also in terms of legal transparency and democratic participation. However, for this technology to be implemented, the Turkish Commercial Code needs to be interpreted or revised to recognize such digital systems.

1.7. Stocks and Capital Markets

Capital and shares, which form the basic structure of joint-stock companies, are not only important elements representing company ownership but also determine the company's financial dynamics. Blockchain technology is entering this field, initiating a new era, particularly in the digitization, storage, transfer, and traceability of shares. This technology not only provides technical conveniences but also generates new questions and solutions within the framework of existing capital market law.

Studies conducted in Turkey also reveal that blockchain technology has significant transformative potential in joint-stock companies, especially within the registered capital system. In this context, blockchain offers not only a technical but also a structural innovation in terms of the electronic creation, transfer, and tracking of shares. The transition to blockchain-based systems in financial transactions in joint-stock companies and the tokenization and digital recording of shares can significantly improve efficiency in companies' capital increase and investment processes. On the other hand, the opportunities offered by this technology are not limited to increasing competitiveness in capital markets; they also necessitate a reassessment and updating of the existing legal infrastructure. In this context, while the role of traditional intermediary institutions such as the Central Registry Institution may decrease, the overall efficiency of capital markets can be improved by enabling transactions to be carried out more quickly, transparently, and with direct verifiability.

Similarly, another study conducted in Turkey addresses the issue more specifically from the perspective of "tokenization." According to this approach, converting shares into digital assets as tokens provides investors with easier access, increases divisibility, and strengthens liquidity in secondary markets. However, the lack of clear regulations in Turkish law regarding the definition, nature, and validity of tokenized shares restricts the direct applicability of this technology. In particular, the compatibility of the provisions of the Turkish Commercial Code regarding the form, transfer, and use of shareholder rights of shares with blockchain-based systems requires a comprehensive and careful legal compliance process.

International analyses show that conducting share transfers in privately held companies through blockchain infrastructure can make shareholder relations more transparent, faster, and less costly. However, the successful implementation of this transformation depends not only on the adequacy of the technological infrastructure but also on updating national legal systems to recognize and regulate these digital structures. International examples clearly demonstrate the structural transformation that tokenization can create in capital markets. In this context, blockchain-based share transfer models implemented in privately held corporations in Switzerland and the United Kingdom were examined; it was concluded that these applications increased transaction speed, reduced costs, and significantly facilitated shareholder tracking. While tokenization processes make shareholder relationships more liquid and transparent, facilitating access to capital markets for small investors, the restructuring of regulations in line with technology is crucial for the sustainable operation of this structure.

In short, the impact of blockchain technology on the capital structure of corporations is not merely a technical

transformation; it also represents a structural change proposal for company ownership relationships, share transfer processes, and the future of capital markets. The tokenization of shares offers a significant opportunity for corporations to digitize and modernize capital markets, contributing to the creation of a more transparent, accessible, and dynamic investment environment. However, realizing this potential depends on overcoming existing legal uncertainties and, in particular, on capital market regulators creating the legal infrastructure to support this technological transformation. In this context, it seems inevitable that Turkish corporate law should be interpreted flexibly enough to recognize blockchain technologies; and, where necessary, that structural reforms should be implemented to provide a legal basis for the digitalization process.

1.8. The Place of Blockchain Technology in Turkish Law and Legislative Compliance

1.8.1. Blockchain within the Scope of Turkish Commercial Law and International Law

The application of blockchain technology in joint-stock companies presents various compatibility issues with the current structure of the Turkish legal system. The innovations brought by this technology necessitate updating the legislation, especially in the field of company law. This section will examine in detail the place of blockchain applications within the framework of the Turkish Commercial Code (TTK), capital market legislation, and international regulations.

Blockchain technology significantly transforms decision-making and shareholder rights in joint-stock companies. According to studies conducted in Turkey, blockchain, particularly in the digitalization of general assembly meetings and voting processes, increases transparency and participation while reducing representation problems. However, although this technology facilitates recording and verification in call processes, existing legal regulations need to be reinterpreted or updated to adapt to these innovations.

The effective use of blockchain technology in joint-stock companies presents both opportunities and legal challenges within the framework of the Turkish Commercial Code (TTK). In this context, ensuring the compatibility of the technology with the existing legislation is critically important for the widespread adoption of the application. Assessments regarding the possibilities of using blockchain technology within the scope of the Turkish Commercial Code (TTK) indicate that integrating this technology into the structure of joint-stock companies necessitates a multi-layered compliance process at both legal and technical levels. It is stated that a legal infrastructure suitable for blockchain technology can be built, particularly based on provisions related to e-commerce and digital signature regulations. While the TTK's regulations concerning the capital market can be adapted to technological advancements, this necessitates either a technology-oriented interpretation of existing provisions or a direct legislative amendment. Indeed, the lack of clear legal regulations regarding the applicability of blockchain-based systems in fundamental processes of joint-stock companies, such as general meetings, share transfers, and capital increases, creates significant uncertainties in practice.

On the other hand, it is also noted that the advantages offered by these systems, such as transparency, traceability, and immutability, are consistent with the fundamental principles of the TTK; therefore, there is no fundamental obstacle to creating a technology-compatible normative infrastructure. In contrast, the lack of clear regulations regarding the legal status of digital assets, electronic general assembly practices, and digital representation forms of shares constitutes significant obstacles to this transformation process. Consequently, the healthy and sustainable use of blockchain technology in joint-stock companies is possible not only through strengthening the technical infrastructure but also through the evolution of the Turkish legal system to adapt to digitalization. Accordingly, the Turkish Commercial Code needs to be updated to meet current needs, and a technology-friendly interpretation practice should be developed among legal practitioners.

The regulation of blockchain technology within the context of European and international law has significant implications for corporate structures and cross-border commercial transactions. A study examining the impact of blockchain regulations on corporate structures in the European Union indicated that the technology makes corporate structures more transparent and flexible. According to the study's findings, while European legislation encourages blockchain applications, there is a need to accelerate legal compliance processes and clarify regulations. An international study evaluating the impact of blockchain technology on cross-border corporate transactions highlighted the advantages of the technology, such as accelerating international trade, reducing transaction costs, and increasing transaction security. However, differences in cross-border regulations can lead to significant complexities regarding the legal status of blockchain-based transactions and data protection. Another international study addressed the concept of justice in the digital age through the lens of blockchain technology, drawing attention to both the solutions offered by the technology and the risks it brings.

According to the study findings, the transparency and traceability capabilities offered by blockchain technology can increase trust in legal processes; however, the complex nature of the technology and data security threats

necessitate the adaptation of legal regulations to accommodate this new reality.

1.8.2. Legal Challenges of Blockchain Technology

The use of blockchain technology in corporations brings with it various legal challenges. These challenges primarily include the protection of personal data, the legal validity of smart contracts, and issues arising from cross-border applications. This section will discuss these challenges and proposed solutions in detail.

1.8.3. Protection of Personal Data and Compliance with the KVKK

While the immutability and transparency features offered by blockchain technology provide significant advantages for anonymous companies, the compatibility of this technology with personal data protection law, particularly Turkey's Personal Data Protection Law No. 6698 (KVKK), has led to serious debates. In particular, the fact that data recorded on the blockchain cannot be deleted (the principle of immutability) creates a structural conflict with fundamental principles of the KVKK, such as the "right to be forgotten" and "deletion of data."

An assessment conducted specifically for the European Union emphasizes that blockchain systems contribute to the uncertainty surrounding the concept of "data controller." While the data controller can be clearly identified in traditional data processing systems, it is unclear who the data controller is in distributed ledger systems, or who bears the obligations arising from the processing of data. These ambiguities conflict not only with the European Union's General Data Protection Regulation (GDPR) but also with Turkey's KVKK, which adopts similar principles. Applications such as the processing of shareholders' identity information in anonymous companies on the chain give rise to serious responsibilities regarding data security.

A study examining the relationship between the concept of justice in the digital age and data technologies points out that blockchain can be both a solution and a threat. According to the study's findings, the transparency, auditability, and automation potential offered by blockchain technology can enhance data security; however, this potential can cause serious structural problems when it conflicts with legal obligations such as "anonymization" and "erasure" of personal data. In particular, the loss of control over data in public blockchain systems may prevent data owners from effectively exercising their rights.

In Turkey, within the framework of the obligations imposed by the KVKK, it has been observed that companies are attempting to comply by using methods such as anonymizing data or only recording hash values when using blockchain systems. However, even these solutions are controversial because they do not completely eliminate the trace of the data on the blockchain. Legally, these issues can be resolved by designing blockchain systems based on the "privacy-by-design" principle and supporting them with specific regulations.

The compliance of blockchain technologies with Turkey's KVKK (Personal Data Protection Law) poses significant challenges, particularly regarding the right to erasure. Since public blockchains do not allow data to be deleted due to their immutable nature, their use with personal data directly conflicts with the KVKK and carries serious legal risks. In contrast, privacy and KVKK compliance can be achieved in private blockchains through methods such as storing data off-chain (off-chain hash recording) or zero-knowledge proofs (zk-SNARKs). The widespread adoption of blockchain, particularly in anonymous companies, will expose companies to legal risks under both national and international data protection regulations. Therefore, it is crucial to consider legal norms during the technology's design phase and establish a balance between technology and law.

1.8.4. The Legal Validity of Smart Contracts

One of the areas directly impacted by blockchain technology for corporations is smart contracts. These digital structures, known as "smart contracts," enable the automatic fulfillment of predefined terms between parties through code. Although these structures appear as algorithmic systems at a technical level, their nature as declarations of intent leads to significant debates within the context of Turkish Contract Law.

The legal validity of smart contracts is causing important discussions in the field of private law in the digitalized world. The principle of freedom of contract, regulated in Article 1 of the Turkish Code of Obligations, also forms the basis for smart contracts. It is stated that smart contracts should be evaluated within the framework of traditional contract law rules, but their unique automatic structure may create new problems regarding issues such as declaration of intent (Turkish Code of Obligations, Article 2), contract form (Turkish Code of Obligations, Articles 12-15), and legal responsibility (Turkish Code of Obligations, Article 49). International commercial contract principles emphasize that the elements required for the validity of contracts must also be met in the context of smart contracts. When considering the legal consequences of digital communication, it is stated that the electronic communication rules regulated in Article 1527 of the Turkish Commercial Code No. 6102 also form the basis for smart contracts.

It is argued that the provisions regarding the formation of

contracts regulated in Article 26 and the validity conditions in Article 27 of the Turkish Code of Obligations should be adapted to smart contracts. In particular, it is observed that the determination of freedom of will (Turkish Code of Obligations, Article 2) and the mutual consent of the parties (Turkish Code of Obligations, Article 1) are difficult to prove in blockchain-based contracts. In light of the secure electronic signature rules regulated in Article 5 of the Electronic Signature Law No. 5070 and the provisions regarding electronic contracts in Article 4 of the Law on the Regulation of Electronic Commerce No. 6563, it is suggested that the secure and transparent structure of smart contracts can increase legal certainty, but that the legislation needs to be updated to encompass these innovations. Therefore, the validity of smart contracts must be evaluated within the framework of both traditional legal rules (Turkish Code of Obligations, Articles 1-50) and the new regulations required by digital transformation. Otherwise, companies may face serious legal risks when using blockchain-based systems.

1.8.5. Issues of Responsibility and Jurisdiction

The cross-border and distributed nature of blockchain systems raises serious issues of liability and jurisdiction, particularly in international transactions of corporations. Due to their decentralized nature, determining the "place" where the transaction takes place is difficult, leading to uncertainty about which country's law applies and which court has jurisdiction.

Researchers examining the legal implications of blockchain applications, especially in cross-border transactions, have emphasized that serious jurisdictional disputes arise when parties in multilateral transactions are subject to different jurisdictional systems. Particularly when smart contracts are implemented simultaneously in multiple countries, the question of which legal system applies and which court has jurisdiction in resolving contractual disputes becomes crucial. In this regard, pre-determined jurisdiction and choice of law provisions may be insufficient, as code-based contracts may not include such provisions.

A study focusing on the issue of liability in blockchain applications highlights the significant difficulties encountered in determining the source of damages due to the nature of the technological infrastructure. In particular, in cases of damage caused by technical errors or external interference on a blockchain network, it is unclear who among the developers, miners, or node owners involved in the network will be held legally responsible. This ambiguity also blurs the boundaries of the supervisory responsibility of the governing bodies of corporations and necessitates a redefinition of corporate responsibility.

Broadly speaking, the borderless nature of blockchain technology directly contradicts the principles of jurisdiction and responsibility based on the territoriality of classical legal systems. Therefore, it is of great importance for corporations to consider these legal challenges when transitioning to blockchain-based applications and to include explicit jurisdiction and choice of law provisions in international agreements.

1.8.6. Cross-border Applications

The borderless nature of blockchain technology presents both significant advantages and legal complexities for corporations in international transactions. In particular, inconsistencies between the legal systems of different countries lead to various problems regarding jurisdiction, applicable law, and dispute resolution in cross-border corporate transactions. While the integration process of blockchain technology into international law is not yet complete, there are noteworthy approaches to proposed solutions.

Studies addressing blockchain applications in cross-border corporate transactions reveal that despite advantages such as transparency and traceability provided by the technology, inconsistencies in the laws of different countries create significant problems. Situations such as blockchain-based share transfers valid in one country not being recognized in another legal system create serious uncertainties in practice. Similarly, it is unclear how smart contracts will be interpreted in local courts and which legal rules will apply in potential disputes. Therefore, researchers suggest that international arbitration mechanisms should be adopted as a more effective solution in interpreting smart contracts covering cross-border transactions.

Studies addressing the impact of digital technologies on international law particularly highlight the incompatibility of blockchain's cross-border nature with existing legal systems. The fact that blockchain systems are not tied to any physical jurisdiction severely restricts states' regulatory and supervisory authority over these systems. This situation leads to the inadequacy of traditional, state-based legal systems in digital environments and necessitates a new legal framework. In this context, some researchers propose the creation of "virtual jurisdictions" for digital transactions. This proposal aims to develop a globally consistent and functional digital legal regime by establishing rules and institutions that will be valid in the digital environment instead of classic national borders.

One of the most frequently suggested solutions in this context is the creation of common standards through international blockchain consortia. This would allow corporations operating in different countries to conduct their transactions in a more predictable framework by agreeing on certain legal principles in advance.

Furthermore, by reinterpreting international private law rules, the development of a new subfield such as "smart contract law" in digital transactions could be encouraged.

1.9. Data Security and GDPR

One of the most important claims of blockchain technology is that it offers secure data storage. However, this security does not always mean the protection of personal data; on the contrary, the openness and immutability inherent in blockchain technology also contain aspects that threaten personal data security. This situation directly affects joint-stock companies in Türkiye under the Law No. 6698 on the Protection of Personal Data (KVKK).

The use of blockchain technology in data-intensive fields such as accounting and auditing brings about important discussions in terms of personal data protection law. In particular, the processing of information belonging to company executives or shareholders on the blockchain during financial transactions can lead to the permanent and irreversible dissemination of this data. This situation carries the risk of clearly violating the Law No. 6698 on the Protection of Personal Data (KVKK) in Turkey and the General Data Protection Regulation (GDPR) in force in the European Union. In this context, technical solutions such as processing data on the chain in an anonymized form or using only hash values are suggested; however, it is stated that such measures alone are not sufficient. Companies need to develop corporate systems that enable them to fulfill all their obligations under the Personal Data Protection Law (KVKK), not just rely on technical security measures, but also act as data controllers. Therefore, when designing blockchain-based accounting and auditing systems, it is legally mandatory to adopt a structure that complies with the fundamental principles of the KVKK, such as data processing principles, data minimization, retention for a specified period, and the right to deletion. In short, the technical advantages offered by blockchain in the field of data security will continue to pose a risk for corporations unless they are fully compliant with legal norms. Therefore, companies must invest not only in technological competence but also in legal compliance processes.

2. PROPOSED SOLUTIONS FOR OVERCOMING PROBLEMS

The widespread adoption of blockchain technology in corporations and the overcoming of legal challenges is possible not only through adapting existing systems to this technology, but also through the simultaneous development of legal and technological infrastructure. In this context, two main solutions stand out: updating legal regulations and adopting hybrid blockchain models.

2.1. Updating Legal Regulations

The procedures for calling general assembly meetings, the quorum requirements for meetings and decisions, and voting methods are detailed in Articles 407, 408, and 409 of the Turkish Commercial Code (TTK) and the related secondary legislation, the Regulation on the Procedures and Principles of General Assembly Meetings of Joint Stock Companies and the Ministry Representatives to be Present at These Meetings. However, to ensure the applicability of blockchain in joint stock companies, the legislation must first be adapted to the technology. It is essential to re-examine the regulations concerning fundamental processes of companies, such as general assembly and board of directors decision-making mechanisms, share transfers, and capital increases, from a digitalization perspective, especially in the Turkish Commercial Code (TTK). It is stated that the current TTK provisions are far from directly addressing new technologies such as blockchain, but there are some normative areas that can be made flexible to be compatible with this technology. In particular, explicit regulations allowing the integration of electronic general assembly and voting systems with blockchain in joint stock companies will pave the way for the technology. Research indicates that current legislation regarding the calling and participation processes of general meetings of joint-stock companies uses cautious and hesitant language towards technology, leading to hesitations in practice. In line with the requirements of the digital age, aligning the calling and decision-making processes with blockchain-based systems will not only increase transaction security but also limit the scope for interpretation by judicial authorities. Ultimately, this alignment will enable companies to have faster, more cost-effective, and transparent decision-making mechanisms.

2.2. Adoption of Hybrid Blockchain Models

Fully public blockchain systems carry certain risks, particularly in terms of personal data security, protection of trade secrets, and auditability. Therefore, another proposed solution model for corporations is the use of hybrid blockchain systems. These models aim to strike a balance between the two systems by leveraging both the security of private blockchain networks and the transparency of public networks.

In light of European regulations, it is emphasized that hybrid structures are the most suitable system for corporate structures. Conducting internal company transactions on private chains, while reflecting general indicators of these transactions on public chains, offers an optimal solution in terms of both auditability and transparency. Hybrid structures can play a critical role,

especially in terms of protecting shareholder rights, tracing capital movements, and ease of reporting to regulatory bodies. It is stated that for the use of blockchain in internal governance to be successful, transformation is needed not only technologically but also in terms of governance and organization. In this context, the adoption of hybrid models will allow companies to gradually adapt to digital transformation and will also increase investor confidence.

Finally, the transition of Turkish companies to blockchain technology is not merely a technical matter; it is a multi-dimensional process requiring a transformation of the legal infrastructure, corporate culture, and regulatory perspective. For this process to progress successfully, both legislative reforms and the development of hybrid solutions by companies that are open to next-generation technologies are needed.

2.3. International Cooperation Mechanisms, Practices and Proposed Solutions

The applications of blockchain technology in corporations are too broad and multifaceted to remain limited to the national level. Especially in today's world, where capital movements are globalized and investors are increasingly involved in cross-border transactions, coordinated international approaches to regulations and practices related to this technology have become a necessity. In this context, developing international cooperation mechanisms, adopting common standards, and addressing legal gaps encountered in cross-border transactions constitute priority areas for solutions.

3. RESULTS

Blockchain Blockchain technology promises revolutionary changes in the management and decision-making processes of corporations. This technology not only provides transparency, security, and speed in decision-making processes but also enables effective stakeholder participation[1]. In particular, the use of blockchain-based electronic systems in general assembly meetings increases participation and voting rates compared to traditional methods and offers significant advantages in terms of legal validity[2]. The tokenization of shares has initiated a new era of digitalization in capital markets, reducing transaction costs and increasing liquidity in financial markets[3]. Furthermore, the integration of blockchain applications into corporate governance and audit processes in corporations strengthens stakeholder trust by increasing corporate transparency and accountability[4].

Furthermore, the results of the research indicate a significant shift in the verification and storage of corporate records. Traditionally, the legal validity of corporate actions in joint-stock companies has relied on physical ledgers and centralized commercial registries. However, this study finds that blockchain's immutable ledger system effectively replaces the need for third-party verification by providing a "single source of truth" that is updated in real-time. This transition significantly reduces the "agency cost" associated with traditional management, as shareholders can verify corporate actions without relying solely on the reports provided by the board of directors. The automation of these processes through smart contracts ensures that corporate actions—such as dividend distributions or capital increases—are executed only when pre-defined legal and financial conditions are met, thereby minimizing human error and administrative delay.

However, ensuring the compliance of the Turkish Commercial Code and related legislation with blockchain applications is critically important in the adoption process of this technology[5]. From a legal perspective, the validity and applicability of blockchain-based smart contracts are still a subject of debate. The place of these contracts within the scope of private law in the Turkish legal system should be clarified[6]. Furthermore, issues of liability and jurisdiction arising in cross-border transactions can be overcome through international cooperation and the harmonization of regulatory frameworks[7]. In particular, data security and compliance with the Personal Data Protection Law (KVKK) are indispensable for the sustainability of blockchain applications[8]. Looking to the future, the adoption of hybrid blockchain models and the updating of legal regulations will increase the speed and efficiency of the digital transformation of joint-stock companies in Turkey[9]. Developing international cooperation mechanisms and aligning technological solutions with the legal system will increase reliability and transparency in cross-border transactions[10]. Accordingly, strengthening the legal infrastructure and increasing awareness of technology will pave the way for the widespread and effective use of blockchain technology in joint-stock companies.

4. DISCUSSION

Studies evaluating cross-border problems encountered in blockchain-based corporate transactions highlight that different countries approach the technology with different legal approaches, leading to significant uncertainties in transactions. In particular, the fact that smart contracts valid in one country are not recognized in another creates significant risks of disputes in cross-border company mergers, share transfers, and corporate transactions (Andhov, 2020). Therefore, researchers recommend the development of a "common denominator regulation" for blockchain applications in international law, and the

adoption of guidelines, even if not binding, within the framework of the G20 and OECD.

On the other hand, it is stated that the technological opportunities offered by the digital age create not only opportunities but also cross-border threats. In particular, it is noted that the anonymity provided by blockchain technology may conflict with companies' transparency obligations, and therefore international cooperation should be shaped not only within a technical framework but also within an ethical and legal framework. In this context, the solution mechanisms proposed include the development of multilateral audit protocols that consider both data security and corporate transparency (Aro et al., 2024). Furthermore, there are studies indicating that blockchain technology contributes to the principle of transparency and can function as a balancing element against the weakness of corporate structures, especially in former Soviet countries (Silagadze et al., 2025). These studies also raise concerns that this technology could be used as a tool for internal corporate surveillance in authoritarian regimes. Therefore, they argue that international cooperation should be shaped not only by technical protocols but also within the framework of fundamental rights and freedoms.

Beyond these legislative hurdles, the practical integration of blockchain into existing corporate structures reveals a fundamental tension between decentralization and traditional fiduciary responsibility. Current corporate laws generally hold a board of directors or specific officers liable for institutional actions; however, in a blockchain-based decentralized environment, power is often distributed among anonymous token holders (Yermack, 2017). This shift raises critical questions regarding who remains legally accountable when a smart contract executes an action that harms stakeholders or violates local market regulations. Consequently, the discussion must evolve from simply "legalizing" the technology to redefining the very nature of corporate personhood and managerial liability in a post-digital era (Bozkurt-Yüksel, 2024).

Furthermore, the transition to blockchain-based corporate governance necessitates a massive shift in digital infrastructure and professional literacy. While the technical promise of "immutable ledgers" reduces the need for traditional intermediaries like notaries or central registrars, it places a premium on the security of the underlying code (Werbach, 2018). The "code is law" philosophy inherent in blockchain applications can lead to rigidities where human intervention—traditionally used by courts to ensure equity and fairness—is technically impossible (Başar, 2022). Future international cooperation should therefore focus on "legal-by-design" frameworks, where smart contracts are programmed to include mediation protocols that allow for judicial oversight without compromising the efficiency and transparency that blockchain provides.

All these assessments reveal that the legal infrastructure needs to be harmonized on a global scale for the healthy use of blockchain in cross-border corporate transactions. In this context, it is suggested that similar regulations be encouraged in different legal systems, taking as examples texts such as the "Digital Services Act" (DSA) or the "Crypto Asset Market Regulation Act" (MiCA), which were prepared under the leadership of unions such as the European Union. Furthermore, the establishment of common oversight mechanisms, the joint implementation of data sharing, and consensus systems will enable the more widespread and secure application of blockchain-based company applications internationally.

5. CONCLUSION

Blockchain stands to redefine the operational DNA of joint-stock companies, provided that global legal systems adapt to support its innovative potential within the capital markets. In conclusion, blockchain technology emerges as a powerful tool in the structural and operational transformation of joint-stock companies. However, for this technology to be implemented to its full potential, legislation needs to be updated, legal gaps filled, and international harmonization ensured. This will lead to the widespread adoption of innovative and reliable practices across a wide range of areas, from decision-making processes in corporations to capital markets.

To ensure the effective and sustainable use of blockchain technology in joint-stock companies, the legal framework must first be updated. The scope and legal validity of blockchain and smart contracts should be clearly regulated in the relevant legislation, primarily the Turkish Commercial Code[1]. This will ensure that the innovations brought by the technology are aligned with the legislation, eliminating legal uncertainties and allowing companies to confidently adapt to digital transformation[2].

In addition to regulatory changes, compliance of blockchain applications with the Personal Data Protection Law (KVKK) should be ensured, particularly in the areas of personal data protection and data security[3]. For this, it is essential for companies to strengthen their technical infrastructure and increase transparency in data processing processes. Furthermore, international standards and cooperation mechanisms should be developed for cross-border transactions regarding jurisdiction and responsibility[4].

To promote wider adoption of the technology, blockchain training and awareness-raising programs should be organized in joint-stock companies. Company managers and stakeholders should be informed about the advantages and limitations of blockchain technology; thus, hesitations regarding its implementation should be

reduced[5]. Furthermore, it is recommended that general assembly and decision-making processes on new digital platforms such as metaverse and virtual environments be supported with experimental pilot applications[6].

Cooperation with state institutions and regulators should be increased in the legal compliance processes of blockchain solutions. Common standards should be established, especially in areas such as electronic general assembly systems and stock tokenization, and their applicability and supervision should be ensured[7]. In this context, existing digital transformation strategies in Turkey should be revised to support blockchain integration[8].

Finally, legal developments regarding blockchain technology at the international level should be closely monitored, and Turkey's legislative compliance and technology adaptation processes should be shaped according to these developments[9]. In this way, joint-stock companies can gain a competitive advantage both locally and globally, and sustainable digitalization can be achieved.

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