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Case Note

ENHANCING DIGITAL TRANSACTIONS WITH BLOCKCHAIN TECHNOLOGY: DESCRIPTIVE-ANALYTICAL STUDY

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ABSTRACT

Background: *The emergence of Blockchain technology has led to profound transformations in digital transactions, offering a secure and transparent ledger for recording and processing transactions. This innovation holds promise for enhancing security, efficiency, and cost-effectiveness across various sectors, including healthcare, education, finance, and real estate.*

Methods: *This descriptive-analytical study explores the potential of Blockchain technology to revolutionise digital transactions. It employs a comprehensive review of existing literature and case studies to analyse the impact and applications of Blockchain across different domains.*

Results and conclusions: *This research underscores the multifaceted benefits of Blockchain technology in streamlining processes, reducing transaction times, minimising fraud, and lowering costs across diverse industries. Blockchain emerges as a pioneering technology, functioning as the largest decentralised open database and facilitating transparent and secure data management. The technology, categorised into public, private, and hybrid types, comprises fundamental elements such as blocks, consensus mechanisms, cryptographic hash functions, and timestamps. With its core functions of transmission, storage, and automation, Blockchain disrupts conventional processes. Smart contracts, supported by external intermediaries like Oracle Programs, access data from external systems, enhancing their functionality and applicability. Moreover, Blockchain enables a departure from routine practices, ensuring robust monitoring of manufacturing processes, evaluating product quality, and verifying compliance with standards prior to market release.*

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1 INTRODUCTION

Blockchain technology has the potential to revolutionise digital transactions by providing a secure and transparent ledger system. This innovation promises enhanced security, efficiency, and cost-effectiveness across various sectors, including healthcare, education, finance, and real estate. However, despite its numerous advantages, significant challenges must be addressed for effective implementation; one major issue is transaction speed. Blockchain networks, particularly public ones like Bitcoin, often experience slower transaction processing times compared to traditional banking systems, which can handle payments almost instantaneously. This delay is primarily due to the time required for consensus mechanisms to validate and add transactions to the blockchain. To address this, several solutions are being explored. The development of faster consensus algorithms, such as Proof of Stake (PoS), which requires less computational power and time compared to Proof of Work (PoW), can significantly reduce transaction times.

Additionally, Layer-2 scaling solutions like the Lightning Network for Bitcoin enable off-chain transactions later settled on the blockchain, thus increasing the overall transaction speed and reducing congestion. Another substantial challenge is the legal and regulatory hurdles in real estate transactions. Existing legal frameworks for property rights registration are typically incompatible with blockchain technology, leading to potential conflicts and inefficiencies. The traditional process of property registration involves multiple intermediaries and verification steps, which are not inherently built into blockchain systems. To mitigate this, efforts are underway to harmonise blockchain protocols with existing legal systems. Smart contracts, which are self-executing contracts with the terms directly written into code, can be designed to comply with legal standards. Collaborations with regulatory bodies are essential to update and adapt laws to accommodate the use of blockchain for property transactions. This may include the development of new legal frameworks that recognise and validate blockchain-based property records.

Scalability is another critical issue. Blockchain networks struggle to process large volumes of transactions efficiently, which can hinder their adoption for high-frequency trading or large-scale applications. The inherent design of blockchain, where each node in the network must validate every transaction, can lead to significant bottlenecks. Implementing sharding techniques, where the blockchain is divided into smaller, more manageable pieces, can help enhance scalability. Each shard processes its transactions independently, thereby increasing the overall capacity of the network. Additionally, employing sidechains, which are separate blockchains linked to the main blockchain, can offload transactions from the main chain, further improving scalability.

Furthermore, the energy consumption associated with blockchain mining operations is exceedingly high, raising environmental concerns. Mining, particularly in PoW systems, involves solving complex mathematical problems that require substantial computational power and energy. Transitioning to more energy-efficient consensus mechanisms, such as

PoS, can help reduce the energy footprint of blockchain operations. In PoS systems, validators are chosen based on the number of coins they hold and are willing to "stake" as collateral, which consumes significantly less energy compared to PoW. Additionally, developing green energy mining solutions, such as utilising renewable energy sources for mining operations, can further mitigate environmental impacts.

By addressing these issues, blockchain technology can be more effectively integrated into various sectors, realising its full potential while mitigating associated risks. This balanced approach ensures that the transformative promise of blockchain is met with practical solutions to its current limitations.

2 NATURE OF BLOCKCHAIN TECHNOLOGY

To explore the nature of blockchain technology, three key aspects will be covered: defining this modern technology, clarifying its types, and determining its elements.[1]

Blockchain technology is defined as a database that stores records in a block (instead of a collection in a sheet or table). Each block is linked to the next blocks and is signed with a common encrypted signature in cooperation with anyone with sufficient powers. According to the stated definition, blockchain is the largest digital database characterised by security, transparency, credibility,[2] low costs, and immutability. The International Business Machines Corporation (IBM) defines blockchain as a shared ledger technology that allows any network participant to view the transaction system records.[3]

Accordingly, this technology is a decentralised database that stores a record of assets and business processes and collects data and information about all performed transactions within chronologically serial blocks from oldest to newest. These blocks form a chain called a blockchain. Each block contains information related to the previous block.[4] More simply, it is a global ledger that uses the highest level of encryption. When a transaction is carried out, it is published globally, and data is collected in separate blocks, each linked to the previous block and sealed with a digital signature, forming an endless chain that is difficult, if not impossible, to breach. Breaching one block requires altering all the previous blocks, making it highly secure.

1 Farouq Ahmad Faleh Alazzam and others, 'The Nature of Electronic Contracts using Blockchain Technolog – Currency Bitcoin as an Example' (2023) 17(5) Revista de Gestão Social e Ambiental e03330, doi:10.24857/rgsa.v17n5-014.

2 Lian Yuming, *Sovereignty Blockchain 1.0 : Orderly Internet and Community with a Shared Future for Humanity* (Springer 2021) 25.

3 'What is Blockchain?' (*IBM*, 2023) <https://www.ibm.com/topics/blockchain> accessed 7 April 2024.

4 This definition was adopted by the United Kingdom Government Office in its report to the English Government. 'Chief Scientific Advisers' (*Gov.UK*, 2023) <https://www.gov.uk/government/groups/chief-scientific-advisers> accessed 7 April 2024.

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Blockchain technology is not merely a means of digital document storage but a record that aims to prove the existence of such documents and track related transactions. Each block could represent documents, such as transfer documents, concluded contracts, or tax-related transactions. Thus, it is the latest method for collecting and storing administrative and legal processes and transactions.

This technology ensures greater confidence in the encryption system, transparency, credibility, collective oversight, and the ability to mutually verify user transactions, i.e., for all parties simultaneously. Moreover, it provides robust privacy protection, which constitutes the core of blockchain technology. This herald promising applications in strategic areas, such as banking, energy, agriculture, supply chain management, intellectual property, healthcare, digital identity, and other fields, whether in the public or private sector.[5]

Digital blockchain can be categorised based on the authorisation of individuals to access it, and it can be divided into three types: public, private, and hybrid.

Public blockchains, such as Bitcoin, are open to everyone and do not require special permission to join or leave. This is possible because they can be conducted directly without the need for a neutral intermediary to secure them.[6.]

Private blockchains, known as permissioned blockchains, are blockchains in which access to data is limited to network users only. Therefore, contrary to the above, it is only possible to enter it with access permission through a central unit, which gives permission to enter the blockchain and conducts and verifies transactions. This type of blockchain is a closed and restricted network subject to the control of an intermediary who can, at any time, change the use controls, such as if an enterprise desires to create its own supply chain to follow up on the movement of supplied goods.[7] It is worth noting that this type is more vulnerable to piracy because securing transactions is made

5 UK Government Office for Science, *Distributed Ledger Technology: Beyond Block Chain: A report by the UK Government Chief Scientific Adviser* (*Gov.UK*, 19 January 2016) <https://www.gov.uk/government/publications/distributed-ledger-technology-blackett-review> accessed 7 April 2024.

6 It is necessary to indicate that Ethereum Platform, which is used to create a decentralized network files, depends on Ether as a cryptocurrency. It includes two types of accounts: externally owned accounts and contract accounts. See: Mohamed Kais Adel Al-Gnbri, 'Blockchain Technology and its Repercussions on the Internal Auditing Profession' (2020) 11 Internal Auditing Journal 26; Parth Kothari and others, 'Smart Contract for Real Estate Using Blockchain' (Proceedings of the 3rd International Conference on Advances in Science & Technology (ICAST) 2020) doi:10.2139/ssrn.3565497 <https://ssrn.com/abstract=3565497> accessed 7 April 2024; Rahime Belen-Saglam and others, 'A Systematic Literature Review of the Tension between the GDPR and Public Blockchain Systems' (2023) 4(2) Blockchain: Research and Applications 100129, doi:10.1016/j.bcra.2023.100129.

7 Ayman Mohamed Sabry Nakkhal, 'The Impact of the use of Digital Block Technology "Blockchain" on the Responsibility of the Auditor' (2020) 24(1) Accounting Thought Journal 11.

by the network administrator. Therefore, some consider it just a deceptive or fake appearance of blockchain technology.[8]

Hybrid blockchains[9] combine the characteristics of the previous two types, forming a somewhat open network, i.e., between a limited number of enterprises that are linked to each other through common transactions, such as commercial companies, financial banks, and some government agencies.[10]

The blockchain system consists of four elements: block, single order, hash, and time stamping, which together form the blockchain. They are explained as follows:

It is the building unit of blockchain. It can be metaphorically called "A container that holds the upper part of the blockchain." It contains the block number, code of the previous block, time stamping, i.e., when a blockchain is created, and data of the agreement algorithms. The second part is the blockchain content, the lower part of the blockchain. It contains transaction data, such as amounts, addresses of parties, and the code of the current blockchain.[11]

Hence, the block is a set of processes or functions required to be performed or executed within the blockchain, such as money transfer, data recording, or follow-up of a specific situation. Thus, each block accommodates a certain amount of similar transactions. Then, another block is created that is chronologically linked to it. Each group of these blocks is regulated by a single blockchain, and the blockchains grow steadily with each group of transactions recorded in a new block. This is to prevent any fake transactions within the block, which may freeze the blockchain or prevent it from recording and finalising transactions.[12]

The structure of the block has a single order. It is the sub-process that takes place within a single block. Therefore, along with other single orders, it represents the block itself.

In the structure of the blockchain program, the hash also takes place. It is the encryption, i.e., a code or a symbol of fixed length. It is the distinctive DNA of the blockchain. It can be called a digital signature. It is produced through an algorithm within the blockchain program called the 'Hash Function.' It has four main functions: distinguishing a blockchain

8 Ihab Khalifa, 'Blockchain: The Next Technological Revolution in the World of Finance and Management' (2018) 3 Academic Papers of the Future Center for Advanced Research and Studies 1 <https://futureuae.com//media/Ehabpdf_d1f747f1-7ba7-4390-bd3f-918c5dbf6ead.pdf> accessed 7 April 2024.

9 It is called hybrid because some of the devices connected to this network may be public and others may be private.

10 Ashraf Gaber, 'Blockchain and Digital Evidence of Copyright' (2020) 1 International Journal of Doctrine, Judiciary and Legislation 37, doi:10.21608/IJDJL.2020.49876.1038.

11 Mada Al-Rahili and Hanaa Al-Dahawi, 'Development of Real Estate Rental Sector Aligned with the Digital Transformation of Saudi Arabia: Proposed Study of Blockchain Technology' (2020) 1 Journal of Information Studies and Technology 6, doi:10.5339/jist.2020.5; Gaber (n 10) 38.

12 Khalifa (n 8) 2.

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from others, identifying each block, marking each piece of information within the block itself with a distinct hash, and finally linking blocks to each other within the blockchain. Therefore, the hash does not allow modification to blocks that have been created, as each block is linked to the previous hash and the following hash. Thus, the hash goes in only one direction of the original block that follows it.

One of the elements of a blockchain system is time stamping. It is the stamp, or what is referred to as the digital date. It is the time at which any process is conducted to create a block or data within the blockchain. A unique digital stamp consisting of an encrypted set of letters and numbers is created, which in turn constitutes the code or hash that distinguishes the data creation process from all others.

3 LEGAL IMPORTANCE OF BLOCKCHAIN TECHNOLOGY

This chapter will discuss three issues to shed light on the legal importance of this technology by listing its most important functions, explaining its characteristics,[13] and finally presenting the most important blockchain applications, as described in the following three sections:

3.1. Functions of Blockchain Technology

Blockchain technology provides clear functions, especially in a world that needs to provide and create an ideal environment for trust and security. It is a database in which data is stored and managed from a single source. Data management and storage processes are characterised by being decentralised and distributed across a computer network (peer-to-peer network, i.e., decentralised). This database is secured by protected encryption, through which transactions are processed by computers and ultimately uploaded to the database. This network is either completely public, i.e., available to all interested users, or private, i.e., designed for users with the ability or permission to participate.

It is available to participants with no need to transfer information, manually or in writing, from one party to another. Further, there is no need to store information. Thus, the blockchain database has grown to form a comprehensive record that includes all transactions conducted since the creation of the database. Therefore, once data is stored, it becomes impossible to delete, remove, change, or edit it. According to the blockchain system, data is immutable and resistant to modification, manipulation, or fraud.[14]

In view of the foregoing, it can be said that this technology performs three simultaneous functions: transmission, storage, and automation.

13 Enas Mohammed AlQodsi, Iyad Mohammad Jadalhaq and Mohammed El Hadi El Maknouzi, 'Comparative Legal Perspectives on Voluntary Restraints: Analyzing the Adaptation of Preventive Conditions on Property Rights' (2024) 10(9) Heliyon e30509, doi:10.1016/j.heliyon.2024.e30509.

14 Kothari and others (n 6).

From the outset, blockchain technology aims to facilitate two main processes: the transfer of cryptocurrencies and the transfer of assets. The first process enables the creation of virtual or digital currencies, such as cryptocurrencies like Bitcoin and Ethereum, represented by digital symbols that are traded securely without intermediaries. These transactions occur on decentralised networks, ensuring transparency and security.

In the second process, blockchain technology allows for the transfer of various types of assets. For example, it supports the secure transfer and management of assets like real estate titles, intellectual property rights, and commodities. This capability is bolstered by the technology's decentralised ledger system, which records ownership changes transparently and immutable. While blockchain enhances transactional transparency and security, it is important to note that it operates within the legal frameworks governing asset transfers, ensuring compliance with applicable laws and regulations.[15]

A blockchain has a very important characteristic, namely keeping records, which allows no opportunity for fraud and deception during the execution of transactions. It helps access, exchange, and manage data at any time between users, which raises confidence in the data exchange process at all levels and in all areas. In banking transactions, when exchanging customer data, blockchain technology accurately determines their financial position and solvency to ensure that none are included in the trading ban list.[16] Within the Insurance Law, this function helps exchange data between insurers, especially during reinsurance processes. Likewise, in the medical area, the storage function enables the exchange of patient information and data through their electronic files and records, which ensures that no medical errors have occurred and the confidentiality of this data is maintained.

Blockchain technology can be considered the foundation on which artificial intelligence is based. In addition to both the functions of storing and retrieving the digital content installed on it securely and transparently for all users, it enhances and develops artificial intelligence systems[17] by allowing the integration of systems with the digital content stored on it. The best evidence is what blockchain technology offers as a platform that supports the automation of the contractual process, commencing from the preliminary stages of the contract, the stage of conclusion, and ending with its performance, passing through the application of some penalties for violation of implementation. Truly, it manages the contract system via an intelligent self-management.[18]

15 Gaber (n 10) 39.

16 Emad Abdel Rahim Dahiyat, 'Online Shopping and Consumer Rights in the UAE: Do we Need a Specific Law?' (2019) 33(1) Arab Law Quarterly 35, doi:10.1163/15730255-12331014.

17 Yue Liu and others, 'Decentralised Governance for Foundation Model based Systems: Exploring the Role of Blockchain in Responsible AI' (*arXiv*, 21 February 2024) arXiv:2308.05962v3 [cs.SE], doi:10.1109/MS.2024.3369551.

18 Gaber (n 10) 40.

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3.2. Characteristics of Blockchain Technology

There is no doubt that the emergence of blockchain technology has provided great opportunities to deliver decentralised services,[19] especially in an environment and climate that requires more trust, such as government services for documenting personal data, whether in the area of identity, taxes, or medical records. The blockchain system provides a distinctive environment that is the most secure in storing and encrypting data to date. It is supported by the encryption feature, which replicates all data or processes recorded on the network in all connected devices. This achieves administrative decentralisation and a lack of central control over records. Thus, there is no employee or specific person responsible for the system. Rather, all network participants are the guarantors of trust and decentralisation, meaning no intermediation or documentation offices exist.[20]

Rather, they are replaced by the blockchain network as a third party distributing documented information. At the same time, this network places trust directly in its members, where every member or participant, whether a consumer or a supplier, becomes a contributor to the documentation and proof process through smart, direct communication devices.[21]

Given the multiplicity of functions provided by the blockchain system, a multitude of characteristics it possesses can be found. It is an administrative and financial system capable of accomplishing unique functions while saving the greatest possible time, effort, and cost. At the same time, it ensures the monitoring of all processes carried out by this unique system. In view of the above, it can be said that blockchain technology has several advantages and characteristics within which individuals' transactions are carried out.

The first advantage to draw attention to in this study is open record. It allows all users, whether a public or private entity, to record and manage their data and information. Such information is available to everyone, and all participants within the blockchain can view each other's property. This may be the main flaw of this system, as it enables one to know personal information relating to specific individuals. For example, when it comes to sending money, one may know the amount of money, the purpose of sending it, and the

19 Surbhi Sharma and Rudresh Dwived, 'A Survey on Blockchain Deployment for Biometric Systems' (2024) 4(2) IET Blockchain 124, doi:10.1049/blc2.12063.

20 It is known that any financial transaction using money requires an intermediary to carry it out, whether by banks, government institutions, or companies. Most of them still suffer from slow and routine completion of transactions, in addition to high commission rates or fees imposed on services. See: Saleh Ali Abu Al-Nasr, 'Blockchain Technology and the Impact of its Application in the Financial Sector (Banks) in the Kingdom of Saudi Arabia' (2022) 23(1) Journal of the Faculty of Economics and Political Science of Cairo University 46, doi:10.21608/jpsa.2022.211366.

21 Marcelo Corrales, Mark Fenwick and Helena Haapio, 'Digital Technologies, Legal Design and the Future of the Legal Profession' in M Corrales, M Fenwick and H Haapio (eds), *Legal Tech, Smart Contracts and Blockchain* (Perspectives in Law, Business and Innovation, Springer 2019) 4, doi.org/10.1007/978-981-13-6086-2_1.

sender's relationship to the recipients at the time of sending by reviewing the record. Accordingly, this information can be used later to organise a criminal act within family members. However, it may be difficult to pinpoint their true identities because the blockchain allows them to use nicknames, which makes it difficult to pinpoint a person's true identity, even though it is easy to know the amount of money and properties.[22]

The next one is a distributed database. It is a decentralised network,[23] as the blockchain is distributed among all individual participants across the world. This is an element of security. If a hacker wants to break through the blockchain, it must break through all individuals in it, which seems unlikely.

The blockchain system also allows the tracking of all steps related to a transaction, which reflects positively on ensuring that the service is provided with the best possible quality. By using the capabilities of computers to search for the correct hash or distinctive code of transaction to be carried out successfully, it ensures that the quality of manufacturing processes is monitored, the quality of final products is evaluated, they comply with standards before being put on the market, and no tampering or fraud occurs.[24]

This blockchain can settle transactions and deals in record time and more quickly compared to other systems that require more traditional manual auditing.[25]

The blockchain system undoubtedly helps government agencies achieve institutional effectiveness, as all individual transactions are clear within the blockchain. If information, certificates, or documents need to be verified, they can be viewed easily, which saves time and breaks the routine.

3.3. Applications of Blockchain Technology

Blockchain technology has revolutionised various sectors by enhancing transparency, security, and efficiency. Below is a detailed exploration of its applications, focusing on real-world implementations in legal contexts and other critical areas.

Blockchain enables individuals to register various assets, including jewellery, cars, patents, and intellectual property rights. This secure and transparent registration system protects ownership rights and facilitates transactions. For example, individuals can sell possessions via blockchain or conduct other transactions, ensuring data immutability and transparency.

22 ibid 4.

23 Archana Chhabra and others, 'Navigating the Maze: Exploring Blockchain Privacy and Its Information Retrieval' (2024) 12 IEEE Access 32089, doi:10.1109/ACCESS.2024.3370857.

24 Khalifa (n 8) 2.

25 Ayman Mohammad Sabry Nakkhal, 'The Impact of Blockchain on Auditor Responsibility' (2020) 24(1) Accounting Thought Journal 754.

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Blockchain technology can replace traditional intermediaries in various processes. For instance, blockchain can substitute real estate registries and traffic departments, offering a more transparent and efficient system.

In banking, blockchain reduces transaction processing costs, accelerates operations, and ensures data security. It minimises fraud and operational errors and enhances trust in financial transfers. Banks can benefit from blockchain's decentralised infrastructure, which reduces operating costs and improves efficiency.

Blockchain is used to document various transactions, whether personal, corporate, or governmental. This includes monitoring aircraft itineraries, factory production lines, or oil tankers, all under careful scrutiny to ensure quality and accuracy.

One of the known fields of using blockchain technology is smart contracts. Smart contracts are self-executing contracts with terms directly written into code. They facilitate automated, secure execution of agreements, reducing the need for intermediaries and minimising transaction costs. Key stages include:

1) **Contract Negotiation**: Automatically sending contract documents on specified dates.
2) **Contract Performance**: Executing obligations upon specific events, such as insurance payouts for crop damage.
3) **Contract Termination**: Automatically terminating contracts if obligations are unmet.

In addition to the above, blockchain simplifies real estate trading by providing a transparent platform for property transactions. It allows easy review and evaluation of property conditions without needing technical inspections. This transparency attracts owners, lessees, and buyers, enhancing the overall efficiency of the real estate market.

The practical applications of blockchain technology in legal contexts have expanded significantly, offering innovative solutions for handling legal disputes, property transactions, notarisation, digital identity management, and corporate filings. These applications leverage blockchain's features of transparency, security, and immutability to enhance the efficiency and reliability of various legal processes.

A primary example is blockchain courts in China. China has pioneered blockchain technology in its legal system by establishing blockchain courts. These courts aim to handle legal disputes more efficiently and transparently. Key aspects include:

1) **Immutable Records**: Blockchain ensures that all case records and evidence are stored in an immutable ledger, which prevents tampering and guarantees the integrity of the information. This feature is crucial for maintaining trust and transparency in judicial processes.
2) **Efficiency and Speed**: The automation capabilities of blockchain reduce the time required for various legal procedures, from filing cases to rendering

judgments. Smart contracts can automate certain aspects of the legal process, such as the execution of court orders, which streamlines operations and reduces administrative burdens.

3) **Transparency**: All parties involved in a legal dispute can access the blockchain ledger to verify the authenticity of records and evidence. This openness fosters trust in the judicial system and ensures that all actions taken by the court are visible and accountable.

Another example can be found in Sweden. Sweden has implemented blockchain technology in its real estate registers to enhance the security and efficiency of property transactions. Blockchain's decentralised and immutable nature ensures that property transactions are secure and resistant to fraud. Each transaction is recorded in a blockchain ledger, creating a transparent and tamper-proof history of property ownership. By automating the recording and verification of property transactions, blockchain reduces the time and cost associated with traditional real estate processes. Smart contracts can facilitate automatic transfers of ownership and payments once predefined conditions are met, expediting transactions. The transparency and immutability of blockchain make it difficult for fraudulent activities to occur. All parties involved in a property transaction can verify the authenticity of the records, reducing the risk of disputes and legal challenges.

The United Arab Emirates (UAE) has adopted blockchain technology for notarisation services, transforming how documents are verified and authenticated. Blockchain enables the secure and efficient verification of documents, significantly reducing the time required for notarisation. Documents are uploaded to the blockchain, where their authenticity is verified and recorded in an immutable ledger. The decentralised nature of blockchain ensures that notarised documents are stored securely and cannot be altered or tampered with. This enhances the integrity and trustworthiness of official documents. The automation capabilities of blockchain can simplify and accelerate various notarisation processes, such as verifying signatures, validating documents, and issuing certificates. This reduces administrative burdens and improves overall efficiency.

Estonia has been a pioneer in incorporating blockchain technology into its e-residency and digital identity systems. These systems provide a secure and transparent platform for managing digital identities, which are crucial for various legal and administrative processes. Blockchain ensures the secure and immutable storage of digital identities, protecting against identity theft and fraud. Residents and e-residents can use their digital identities to access a wide range of online services, from banking to government services. The transparency of blockchain allows individuals and organisations to verify the authenticity of digital identities and transactions. This fosters trust in digital interactions and enhances the security of online services. Blockchain simplifies and accelerates various administrative processes by enabling the secure and efficient verification of digital identities. This reduces the need for physical documentation and in-person verification, improving overall efficiency.

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Delaware in the USA, known for its business-friendly legal environment, has adopted blockchain technology for corporate filings. This innovation enhances the security and transparency of managing corporate records and transactions. In this case, blockchain ensures that corporate records are stored securely and cannot be altered or tampered with. This protects against fraud and unauthorised access, ensuring the integrity of corporate data. The transparency of blockchain allows all parties involved in corporate transactions to verify the authenticity and accuracy of records. This reduces the risk of disputes and enhances trust in corporate governance. Blockchain automates various aspects of corporate filings, such as updating shareholder records, recording transactions, and issuing dividends. This reduces administrative burdens and improves the efficiency of corporate management.

The integration of blockchain technology into legal contexts worldwide has proven to be transformative. By ensuring the security, transparency, and efficiency of various legal processes, blockchain addresses many of the challenges faced by traditional systems. As more countries and sectors adopt this technology, its potential to revolutionise the legal landscape continues to grow, offering innovative solutions that enhance trust, reduce fraud, and improve overall efficiency in legal and administrative processes.

Blockchain technology ensures that daily transactions, such as money transfers, shipments, and government transactions, are secure and transparent. This reduces the risk of fraud and errors, enhancing customer confidence and trust.

Blockchain technology's immutable nature prevents manipulation of transactions post-completion. This characteristic is crucial for ensuring the integrity of various processes, from money transfers to property registration. The technology's potential to prevent fraud and enhance security makes it invaluable in creating customer confidence and raising reassurance in various sectors globally. By focusing on these practical applications, the transformative potential of blockchain technology in enhancing legal systems, property registration, financial transactions, and more can be appreciated.

3.4. Recommendations for Legal Integration

To effectively integrate blockchain technology into real estate asset management, developing comprehensive frameworks that align with existing legal systems governing property rights and registrations is essential. These frameworks must address regulatory requirements while leveraging the efficiency and transparency benefits of blockchain. Establishing industry standards for blockchain applications in real estate transactions, including standardised smart contract templates, verification processes, and data security protocols, promotes uniformity and reliability across platforms. Implementing training programs for real estate professionals, auditors, and stakeholders on the benefits, implementation strategies, and legal implications of blockchain technology enhances competency and promotes the effective utilisation of blockchain tools in real estate asset

management. Collaborating with regulatory bodies to clarify the legal implications and obligations related to blockchain technology in real estate transactions reduces uncertainty and encourages broader adoption among stakeholders. Additionally, enhancing blockchain platforms with robust privacy and security measures safeguards sensitive real estate data from unauthorised access and ensures compliance with data protection regulations. By integrating these recommendations, the seamless adoption of blockchain technology in real estate asset management can be achieved, enhancing efficiency, transparency, and trust among stakeholders while respecting legal frameworks and regulatory requirements.

4 JUSTICE AND RIGHTS PROTECTION

Blockchain technology represents a paradigm shift in enhancing justice and rights protection within the UAE's legal framework. At its core, blockchain offers unparalleled transparency, immutability, and security, making it an ideal tool for safeguarding sensitive legal and financial transactions.[26]

In the UAE, blockchain's impact on justice and rights is profound, particularly in the realm of intellectual property (IP) rights protection. Intellectual property assets, such as patents, trademarks, and copyrights, are critical to fostering innovation and economic growth.[27] Blockchain provides a robust solution for securely recording and verifying ownership of these assets. By immutably storing IP transactions on a decentralised ledger, blockchain ensures that ownership claims are tamper-proof and indisputable. This capability is crucial in legal disputes where proving ownership and authenticity is paramount. Through initiatives like the Emirates Blockchain Strategy 2021, the UAE government recognises the transformative potential of blockchain in protecting IP rights, thereby fostering a conducive environment for innovation-driven industries.

In addition to IP rights, blockchain technology holds promise in revolutionising electoral processes. Transparent and secure voting systems powered by blockchain can eliminate concerns over electoral fraud and manipulation. Each vote cast is recorded on the blockchain in a manner that prevents unauthorised changes or deletions. This ensures the integrity and accuracy of election results, upholding democratic principles of fairness and transparency. By leveraging blockchain for elections, the UAE can enhance public confidence in the electoral process and strengthen democratic governance.

Furthermore, blockchain's application extends to land registry systems, which are foundational to property rights protection. In the UAE's booming real estate sector,

26 Vishnu Chandra and Baladevan Rangaraju (eds), *Blockchain for Property: A Roll Out Road Map for India* (India Institute 2017).

27 Enza Cirone, 'Building a Techno-Legal Framework for Blockchain Technology and Data Protection under EU Law' (Doctoral thesis, Università degli Studi di Firenze 2024) <https://hdl.handle.net/2158/1349674> accessed 7 April 2024.

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blockchain offers a decentralised platform for recording property transactions securely and transparently. Traditional land registry systems often face challenges such as fraudulent transactions and lengthy bureaucratic processes. Blockchain addresses these issues by maintaining an immutable record of property ownership and transaction history. This not only reduces the risk of disputes but also streamlines property transactions, making the process more efficient and trustworthy.

To fully realise the benefits of blockchain in justice and rights protection, the UAE is actively developing and refining legal frameworks that accommodate blockchain technology. These frameworks aim to clarify the legal status of blockchain records and smart contracts,[28] ensuring their enforceability under UAE law. Collaborative efforts between technologists, legal experts, and policymakers are crucial in shaping these frameworks and addressing regulatory challenges associated with blockchain adoption.

Moreover, the UAE government's proactive stance on integrating blockchain into public services underscores its commitment to transparency, accountability, and efficiency. By embracing blockchain technology, the UAE aims to reduce administrative burdens, combat corruption, and enhance public trust in government operations.

In conclusion, blockchain technology holds immense potential in advancing justice and rights protection within the UAE and beyond. By leveraging its transparency, immutability, and security features, the UAE can establish itself as a global leader in innovative governance and legal practices. Through strategic integration and ongoing collaboration, blockchain will continue to play a pivotal role in shaping a more secure, transparent, and equitable society in the UAE.

5 CONCLUSIONS

Blockchain technology stands at the forefront of innovation, offering profound implications across various sectors worldwide. This study has delved into its fundamental characteristics, diverse applications, and the transformative potential it holds, especially within the context of the Arab region. As global interest in AI integration grows, blockchain emerges as a pivotal tool in enhancing transparency, security, and efficiency in legal and transactional processes.

The categorisation of blockchain into public, private, and hybrid variants underscores its versatility, supported by essential components like blocks, consensus mechanisms, hashing, and timestamping. Its inherent functionalities–transmission, storage, and automation–demonstrate its capacity to revolutionise traditional practices. Smart contracts, facilitated

28 Enas Mohammed Alqodsi and Leila Arenova, 'Smart Contracts in Contract Law as an Auxiliary Tool or a Promising Substitute for Traditional Contracts' (2024) 16(3) Journal of Legal Affairs and Dispute Resolution in Engineering and Construction 06524004, doi:10.1061/JLADAH.LADR-1132.

by Oracle programs, exemplify blockchain's capability to automate and secure contractual agreements, thereby streamlining operations and reducing transactional friction.

Moreover, blockchain technology is crucial in breaking traditional routines, monitoring manufacturing processes, ensuring product quality, and enforcing regulatory compliance. The significant operational savings reported in the banking sector of the United Arab Emirates serve as a testament to blockchain's efficiency in handling global transactions securely and cost-effectively.

6 RECOMMENDATIONS

1. Legal Framework Advancement:

Initiating comprehensive studies to thoroughly assess blockchain's legal implications in the Arab region is essential. These studies should include detailed examinations of how blockchain enhances the authenticity and security of digital proof and electronic transactions. Comparative analyses with global best practices and case studies specific to Arab countries will be crucial in developing robust legislative frameworks. Collaboration with legal experts, policymakers, and industry stakeholders is needed to draft clear regulatory frameworks that facilitate the adoption of blockchain technology. Addressing legal challenges such as contract enforcement, data privacy, intellectual property rights, and liability in transactions conducted via blockchain is imperative. This proactive approach will ensure legal certainty and foster innovation in blockchain applications across various sectors.

2. Educational Initiatives:

Establishing specialised training programs tailored for legal professionals, government officials, and industry leaders is crucial to enhancing their understanding of blockchain technology. These programs should focus on practical applications, legal implications, and regulatory compliance specific to the Arab region. Incorporating case studies and simulations will prepare stakeholders for real-world scenarios involving blockchain implementation. Additionally, launching targeted awareness campaigns through seminars, workshops, and industry conferences is necessary to educate a broader audience about blockchain's transformative potential. These campaigns should highlight successful use cases and practical challenges faced in integrating blockchain into existing legal and transactional frameworks. Engaging with academia, research institutions, and international experts will further enrich discussions on emerging trends and innovations in blockchain technology.

3. Collaborative Research Initiatives:

Fostering collaborative research initiatives between government entities, academic institutions, and private sector organisations is essential to explore blockchain's applications

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across diverse sectors. Encouraging interdisciplinary research will address technological advancements, regulatory requirements, and societal impacts of blockchain adoption. Additionally, conducting studies to assess the feasibility of integrating blockchain across regional borders within the Arab region is crucial. Exploring potential frameworks for cross-border transactions, regulatory harmonisation, and interoperability of blockchain platforms will promote regional cooperation and enhance the scalability of blockchain solutions in facilitating international trade, finance, and governance.

4. Support for Blockchain Startups:

Establishing incubation programs and funding opportunities is essential to support blockchain startups and innovators in the Arab region. Providing mentorship, networking platforms, and access to resources will enable these startups to develop and scale blockchain-based solutions effectively. Additionally, creating innovation hubs and technology clusters specialising in blockchain research and development will facilitate collaboration among startups, academic institutions, and industry leaders, thereby accelerating innovation and promoting entrepreneurship in blockchain technology.

5. Policy Advocacy and International Engagement:

Advocating for favourable policies that promote blockchain adoption and innovation at national and regional levels is crucial. Engaging with policymakers, regulatory bodies, and international organisations allows for influencing policy decisions that support blockchain's integration into mainstream economic and legal frameworks. Furthermore, strengthening international collaboration and knowledge exchange on blockchain technology through partnerships with global organisations, diplomatic missions, and international forums is essential. Participating in global initiatives helps shape international standards, protocols, and governance frameworks for blockchain technologies, ensuring their effective implementation and scalability worldwide.

In summary, advancing blockchain technology in the Arab region requires a multi-dimensional approach encompassing legislative refinement, educational empowerment, collaborative research, support for startups, and proactive policy advocacy. By fostering an enabling environment and building capacity among stakeholders, the Arab region can harness the full potential of blockchain to drive economic growth, enhance transparency, and promote digital innovation across sectors. In conclusion, while blockchain technology promises transformative benefits across various domains, including legal and transactional sectors in the Arab region, future studies must underscore these advancements with empirical evidence tailored to regional contexts. This approach ensures that policy recommendations and practical applications align effectively with regional realities, fostering sustainable development and innovation in blockchain technology.

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RIGHTS AND PERMISSIONS

АНОТАЦІЯ УКРАЇНСЬКОЮ МОВОЮ

Практична нотатка

ПОКРАЩЕННЯ ЦИФРОВИХ ТРАНЗАКЦІЙ ЗА ДОПОМОГОЮ ТЕХНОЛОГІЇ БЛОКЧЕЙН: ОПИСОВО-АНАЛІТИЧНЕ ДОСЛІДЖЕННЯ

Хабіба Аль Шамсі*

АНОТАЦІЯ

Вступ. *Поява технології блокчейн призвела до ґрунтовних трансформацій у сфері цифрових транзакцій, запропонувавши безпечний і прозорий реєстр для запису та обробки транзакцій. Ця інновація обіцяє підвищити безпеку, ефективність та*

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рентабельність у різних секторах, включно з сектором охорони здоров'я, освіти, фінансів та нерухомості.

Методи. *Ця описово-аналітична робота досліджує потенціал технології блокчейн для революційної зміни в цифрових транзакціях. У ній використовується всебічний огляд наявної літератури та тематичних досліджень для аналізу впливу та застосування блокчейн у різних сферах.*

Результати та висновки. *Це дослідження підкреслює багатогранні переваги технології блокчейн в оптимізації процесів, скороченні часу транзакцій, мінімізації шахрайства та зниженні витрат у різних галузях. Блокчейн є новаторською технологією, яка функціонує як найбільша децентралізована відкрита база даних і сприяє прозорому та безпечному управлінню даними. Ця технологія, що поділяється на публічні, приватні та гібридні типи, складається з таких фундаментальних елементів, як блоки, механізми консенсусу, криптографічні хеш-функції та часові мітки. Завдяки своїм основним функціям передачі, зберігання та автоматизації, блокчейн руйнує традиційні процеси. Смарт-контракти, які підтримуються зовнішніми посередниками, такими як програми Oracle, отримують доступ до даних із зовнішніх систем, що покращує їх функціональність і застосовність. Крім того, блокчейн дозволяє відійти від рутинних практик, завдяки можливості забезпечувати надійний моніторинг виробничих процесів, здійснювати оцінку якості продукції та перевірку відповідності стандартам перед випуском на ринок.*

Ключові слова: *блокчейн, збережені дані, біткоїн, цифрові транзакції.*