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ENFORCEABILITY OF SMART CONTRACTS UNDER THE ELECTRONIC TRANSACTIONS ORDINANCE 2002: ISSUES AND CHALLENGES

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Abstract
Contractual relationships have taken on a new meaning in the era of blockchain technology, with smart contracts being self-executing digital agreements that can carry out contractual obligations without the need for constant human participation. Smart contracts are unlike traditional contracts, in which the terms of the agreement are written in computer code and are performed automatically once the specified conditions are met. Through this technological innovation, the efficiency, transaction cost, absence of intermediaries and transparency of commercial dealings can all be improved, making it an increasingly appealing method of modern electronic commerce.

INTRODUCTION

Lawyers are increasingly confronted with the question of whether existing contract law is capable of governing technologically mediated transactions as digital commerce grows beyond national boundaries. The basic principles of contract law (offer and acceptance, consideration, free consent and the intention to create legal relations) remain the same, but their application becomes much more complex when contractual obligations are formulated in programming code and executed automatically on decentralized blockchain platforms. As a result, the enforceability of smart contracts has become one of the most important legal questions of the day in commercial and technology law.

The Electronic Transactions Ordinance 2002 (ETO 2002) is the principal legal instrument in Pakistan that regulates electronic records, electronic communications and digital signatures. The Ordinance was passed well before the advent of blockchain technology, and it does not explicitly mention smart contracts, decentralized ledger technology or automated contractual performance. In the absence of any legislative guidance, it remains unclear whether smart contracts satisfy the requirements of valid and enforceable contracts under Pakistani law, particularly when read together with the provisions of the Contract Act 1872.

The lack of a comprehensive statutory framework leaves several legal issues unresolved in the process of creating, proving, enforcing, interpreting and executing smart contracts. The current legal framework does not provide detailed answers to questions of automated consent, coding mistakes, the immutability of blockchain transactions, jurisdiction over decentralized networks, dispute

resolution and the allocation of liability. All of this uncertainty can result in a drop in commercial confidence, safe and competitive technological development and innovation in digital economy in Pakistan. It is therefore pertinent to look into the Electronic Transactions Ordinance 2002 in this context and whether the Ordinance can be effectively enforced to control the smart contracts or whether there is need for legislative amendment to ensure that the smart contracts can be controlled.

The study therefore is designed to solve the issue of smart contracts enforceability under Electronic Transactions Ordinance (ETO) 2002 by critically analysing the relationship between the existing framework of contract law in Pakistan and smart contracts system of contract. It aims to find the legal and practical hurdles in the recognition and enforcement of smart contracts and recommendations for the changes in laws needed for the legal security and innovation in the commercial operations of the digital ecosystem in Pakistan.

Smart contracts have been popular worldwide, but as yet, there is no legislation or regulation that regulates blockchain technology, or the use of digital contracts with automation in Pakistan. Some jurisdictions have made modifications to the law or made interpretations through case law to clearly define the legal nature of smart contracts, whereas in Pakistan, the law is still largely contract law and Electronic Transactions Ordinance 2002. This dependency creates several problems about the security offered by the current legal system to blockchain transactions, about the meaning of the coded elements of the contract, about the responsibility of the programmer in case of error, mistake, and about the possible enforcement of the contract by the judges.The absence of a definite statutory framework leaves businesses and investors in legal limbo, and it may also inhibit the adoption of innovative digital technologies in Pakistan's commercial sector. In view of this, it is timely and necessary to critically analyse the existing legal framework in order to determine whether it is able to meet the changing needs of the digital economy.

BACKGROUND OF THE STUDY

Smart contracts are part of the broader development of information technology and e-commerce. In the early days of the internet, business was conducted online mainly in two ways: through email and through online platforms. As digital trade grew, the need to give legal recognition to electronic records and electronic agreements came to the fore. In response, many jurisdictions enacted legislation that followed the UNCITRAL Model Law on Electronic Commerce 1996, which introduced the principle that electronic communications should not be denied legal effect merely because they exist in electronic form. This principle formed the basis on which modern electronic commerce laws around the world were established, including Pakistan's Electronic Transactions Ordinance 2002.

While the concept of smart contracts was originally introduced by the computer scientist Nick Szabo in the mid-1990s as a computerized transaction protocol capable of automatically executing contractual terms, it only became a commercial reality after the invention of blockchain technology, and especially after the arrival of programmable blockchain platforms. Today, smart contracts are being increasingly applied across various domains such as financial services, digital payments, insurance, healthcare, supply chain management, intellectual property licensing and digital asset transactions. Recognizing the significance of e-commerce, which paved the way for modern digital commerce, Pakistan passed the Electronic Transactions Ordinance 2002, which legally recognizes electronic records, electronic documents and digital signatures. When enacted, the Ordinance was a progressive piece of legislation designed to foster trust in electronic transactions and to promote commercial dealings through electronic means.

Over the last two decades the technological landscape has undergone significant transformation. New legal challenges have arisen since the drafting of the Ordinance owing to the swift development of blockchain technology, decentralized networks, cryptocurrencies and smart contracts. As a result, the current statute

offers minimal instruction on how to legally recognize, interpret and enforce agreements executed through a blockchain system. There are no specific legislative provisions in Pakistan regarding smart contracts, which adds to the confusion surrounding their status. The Contract Act 1872 sets out the requirements for an agreement to be treated as a contract, but it does not explicitly mention computer code or automated blockchain systems. Likewise, the Electronic Transactions Ordinance 2002 acknowledges the existence of electronic records but pays no attention to the fundamental problems of decentralized execution, programming errors, transactional immutability, jurisdiction, liability and dispute resolution. These legal constraints can pose practical problems for courts, businesses, investors and technology innovators looking to utilise smart contracts in business transactions. Based on the principle of "Smart Legal Contracts" (Advice to Government, Law Commission of England and Wales, 2021); Contract Act 1872 (Pakistan).

In the past few years, the legal landscape has seen some changes across different jurisdictions, with new laws, court decisions and policies coming into effect to facilitate the usage of blockchain and 'smart contracts'. They are a general recognition worldwide that the present state of contract law is inadequately developed in the nature of automated digital contracts. Here, Pakistan should determine whether there are any laws or legal frameworks to regulate smart contracts or whether the laws need to be changed. This study aims to examine the enforceability of smart contracts, per Electronic Transactions Ordinance 2002, to understand legal challenges that may arise in enforcing smart contracts, and propose potential future developments for a more conducive legal framework that will pave the way for innovative solutions and clarity in the legal landscape of Pakistan's digital economy.

The advent of smart contracts in trade has led to substantial scholarly investigations of the nature and enforceability of smart contracts. In the past 30 years, technology has revolutionized the way relationships are established, carried out and upheld under a contract. Contracts that used to be "paper" and executed in court are more and more being supported by digital contracts that self-execute contractual obligations. Smart contracts are among the most impactful innovations in eCommerce. They have garnered a wide range of interest from legal scholars, policy makers, technologists, and commercial interests for their ability to enable automatic performance of contractual obligations without the need of intermediaries. Yet, despite their technological benefits, their legal treatment remains unclear in many jurisdictions, particularly those whose legislative frameworks were put in place before the rise of smart contracts and blockchain.

The current body of literature shows that the smart contract debate transcends technology.Researchers have turned increasingly to how smart contracts interact with traditional contract law principles, whether they are enforceable under existing law, and whether legal reform is required to meet the challenges that automated contracting poses. While there is a significant volume of international scholarship covering these aspects, comparatively little work has analysed smart contracts within the Pakistani legal framework, and in particular under the ETO 2002. This literature review therefore focuses on the major research carried out in this field, analyses the applicability of existing scholarship to Pakistani law, and highlights the research gap on which the present study is based.

RESEARCH METHODOLOGY

The present research is qualitative and doctrinal which aims at examining the enforceability of smart contracts in the Electronic Transactions Ordinance 2002 (ETO) and to analyse the issues arising in the recognition and enforcement of smart contracts under the present legal framework of Pakistan. Doctrinal research is carried out mainly by analysing and interpreting statutes, judicial decisions, legal principles and other authoritative legal documents to determine the current law and the necessity of legal reforms.

This research is based on qualitative, doctrinal legal research that seeks to examine the enforceability of smart contracts under the Electronic Transactions Ordinance 2002 (ETO)

and to analyse the legal issues involved in the recognition and enforcement of smart contracts within the existing legal framework of Pakistan. Doctrinal research proceeds primarily through the analysis and interpretation of statutes, judicial decisions, legal principles and other authoritative legal materials in order to assess the existing law and identify the need for legal reform. The Electronic Transactions Ordinance 2002, the Contract Act 1872, relevant case law (particularly on electronic evidence) and other pertinent statutes are treated as primary sources. The secondary sources include books, peer-reviewed journal articles, legal commentaries, law commission reports, conference papers, government publications and reports by international organisations such as the United Nations Commission on International Trade Law (UNCITRAL).

The study also adopts a comparative legal methodology in order to compare the legal treatment of smart contracts in selected jurisdictions, namely the United Kingdom, the United States, Singapore and the European Union. This comparative approach is used to identify international best practices and to examine whether Pakistan's legal framework can address the legal issues arising from smart contracts. The study further employs an analytical and critical approach to determine whether the provisions of the Electronic Transactions Ordinance 2002 are sufficient to accommodate the distinctive features of smart contracts. Particular attention is paid to issues such as contract formation, contractual consent, automated signing, coding errors, electronic evidence, jurisdiction, liability and dispute resolution. The paper critically analyses how traditional concepts of contract law interact with new blockchain technologies and assesses the need for legal reform.The research is done with Library Based, Documentary Sources Only. There is no empirical method, survey, interview or questionnaire used. The study aims to give a holistic view of the issues that are surfacing in the context of smart contracts and feasible recommendations on how to strengthen the enforceability of smart contracts in Pakistan's legal framework.

SIGNIFICANCE OF THE STUDY

The advent of blockchain technology and smart contracts is revolutionizing the trading landscape across the globe and creating alternative methods for entering and executing contracts. Digital technologies for better efficiency, transparency and security have become commonplace in business and legal systems need to evolve to meet these advances. However, the law pertaining the electronic transactions in Pakistan is mostly in the form of Electronic Transactions Ordinance 2002 – a law that was made before the advent of blockchain technology and thus does not specifically address the legal standing and enforceability of smart contracts. This research will also significantly add to legal discourse given the limited existing literature on smart contracts and blockchain technology in Pakistan.42 This study will further serve a critical function of questioning the capacity of the existing legislative framework to respond to such modern technological advances and will identify some of the potential legal issues that would be faced in the recognition and enforcement of blockchain-based contracts. Although the legal implications of smart contracts have been researched extensively at the international level, research within Pakistan remains scarce and fragmented. By explaining the interaction between the Electronic Transactions Ordinance 2002, the Contract Act 1872 and comparable international developments, this research provides a comprehensive understanding of the legal issues surrounding smart contracts and will be of value to researchers, students, legal practitioners, policymakers and judicial officers with an interest in technology law and electronic commerce.

Moreover, the findings of this research could help policymakers and regulators determine whether the current legislation is sufficient to safeguard the interests of those participating in blockchain transactions, or whether legislative change is necessary to provide legal certainty. The recommendations made by this study could assist in shaping a modern and technologically sensitive

legal framework that would promote innovation, facilitate trade in electronic commerce, enhance investor confidence and enable Pakistan to move towards a secure, technology-driven digital economy. In this way, the study aims to add to the academic conversation and to offer practical solutions for future legal and policy reform on the enforceability of smart contracts in Pakistan.

CONTRIBUTION OF THE RESEARCH

It provides a comprehensive analysis of how the Electronic Transactions Ordinance 2002 and the Contract Act 1872 apply to smart contracts and of how well the current legal framework can regulate contractual relationships formed through blockchain. The research also adds value by identifying the legal and practical problems encountered in enforcing smart contracts, such as issues of contractual consent, automatic execution, coding defects, electronic evidence, jurisdiction, liability and dispute resolution. Drawing on a comparative analysis of international developments and best practices, the study sets out practical legislative and policy recommendations to help decision makers, judges, regulators, lawyers and commercial parties address the problems created by smart contracts. The results are expected to enrich the scarce literature on blockchain technology and smart contracts in Pakistan, to serve as a helpful reference for future academic study, and to assist in creating a contemporary, technology-aware legal framework that ensures legal certainty and fosters innovation and the development of e-commerce and the digital economy in Pakistan.

Evolution of Smart Contracts

Smart contracts are built on a conceptual framework first proposed by the computer scientist and legal theorist Nick Szabo in the mid-1990s. He did not seek to supplant legal contracts, but to develop a technological means of executing contractual obligations effectively and reliably. In Szabo's view, contractual performance should be built into computer code and executed automatically once certain conditions are met. When he first proposed the idea, however, the infrastructure needed to implement smart contracts simply did not exist. There were no decentralized computer networks capable of ensuring transparency, immutability and security, and so for nearly twenty years the concept remained largely theoretical. Nevertheless, Szabo set out a number of principles that remain relevant today in legal scholarship, including technology-based enforcement, the minimisation of reliance on intermediaries, the reduction of transaction costs, the automation of contractual performance, and the enhancement of commercial certainty through technology.

The practical implementation of smart contracts was not possible until the advent of blockchain technology. Bitcoin, first introduced in 2009, provided a decentralized blockchain that could record transactions in an immutable and transparent manner; its scripting language, however, was not powerful enough to support complex contractual arrangements. Since 2015, the Ethereum blockchain has made a significant contribution through the development of programmable smart contracts, enabling complex contractual functions within decentralized applications (DApps) and extending their reach into many sectors beyond cryptocurrency, such as banking, insurance, logistics, healthcare, intellectual property management and public administration. This technological development has radically changed the academic discussion of contract law. Earlier scholarship focused largely on whether electronic communications could satisfy the legal requirements for offer, acceptance, signature and documentary evidence. More recent literature engages with the more complex issues of automated contractual execution, blockchain governance, algorithmic decision-making and decentralized legal relationships.

Scholarly Perspectives on the Legal Nature of Smart Contracts

A substantial body of academic work has sought to establish the legal nature of smart contracts. Some scholars regard smart contracts as legally binding contracts that happen to be written in code. From this viewpoint, blockchain technology affects only how the contract is performed and does not alter the fundamental legal rules governing contract

formation. Where the elements of offer, acceptance, consideration, intention to create legal relations and contractual capacity are satisfied, the agreement should be legally binding regardless of the technological platform on which it is performed. Others take the view that smart contracts should not necessarily be equated with legal contracts. Scholars adopting this perspective distinguish between contractual obligations recognized by law and software applications that merely carry out pre-programmed instructions. They argue that many blockchain applications described as "smart contracts" are not, in law, binding contracts at all. It is therefore important to examine the contractual relationship surrounding a particular smart contract, and not merely the computer code, in order to determine whether it constitutes a legally binding contract.

Among the more important voices challenging a purely technological view are Kevin Werbach and Nicolas Cornell. Smart contracts, they argue, do not represent an architecture of distrust but rather a "new architecture of trust": while smart contracts reduce the risk of contractual breach by automating the triggering of contractual clauses, they frequently cannot replace legal enforcement because of problems that computer code alone cannot adequately address. Judicial intervention remains necessary on questions concerning fraud, coercion, illegality, contractual interpretation, public policy, consumer protection and equity. Notwithstanding technological advances, the law therefore remains a crucial part of blockchain governance.

Similarly, Chris Reed observes that there is no single, self-contained category of "electronic contracting" to be understood; electronic contracts are simply valid contracts governed by well-recognized contract law principles. Reed argues that history shows the law to have been highly flexible in applying existing contract law principles to new technologies, adapting traditional doctrines to new commercial usages rather than developing entirely new categories of legal rules. This observation is significant for Pakistan, where the Electronic Transactions Ordinance 2002 was enacted to promote technological innovation without making any radical change to the substance of contract law.

One of the more resonant contributions is that of Professor Lawrence Lessig, whose proposition that "code is law" has had a profound impact on subsequent scholarship on digital regulation. On this view, software, like law, can either empower or restrict the actions of individuals within a digital environment. While software has the power to regulate, many legal scholars caution that technological regulation cannot replace legal regulation. Although smart contracts can execute programmed obligations, they cannot by themselves address larger legal concerns of fairness, justice, public policy, constitutional principle or consumer protection. The relationship between legal rules and technological regulation is thus one of the central themes of the modern literature. Recent scholarship increasingly treats law and technology as two systems that complement one another. Smart contracts undoubtedly bring much to commerce by reducing reliance on intermediaries and automating the performance of contracts. Their successful application, however, will depend on laws that can accommodate digital contracts, establish liability, resolve conflict and safeguard legitimate contractual expectations. This is an essential foundation for analysing the enforceability of smart contracts under Pakistan's Electronic Transactions Ordinance 2002, which was enacted before the commercial realisation of blockchain.

International Legal Scholarship on the Enforceability of Smart Contracts

A substantial body of international legal scholarship examines the enforceability of smart contracts. As smart contracts become more widely used in commercial transactions, many questions have been raised about their enforceability across different jurisdictions. Most of the legal community accepts that agreements executed on a blockchain can be efficient and reliable, but there is no consensus on how far existing contract law can accommodate such agreements without legislative change. While some scholars believe that traditional legal principles are flexible enough

to accommodate smart contracts, others argue that blockchain technology has given rise to new legal issues that require specific statutory provisions. The international literature thus reflects an ongoing tension between long-established contractual principles and technological innovation. A major contribution to this debate has been the internationally accepted principle of functional equivalence developed by the United Nations Commission on International Trade Law (UNCITRAL) in the Model Law on Electronic Commerce. This principle, incorporated into the Model Law, was an effort to modernise commercial law by allowing states to give legal effect to electronic records, electronic signatures and electronic communications that are not in writing. Many states, including Pakistan, adopted laws based on these ideas. Academic commentators note, however, that the Model Law was created before blockchain technology and smart contracts became a commercial reality. It therefore offers a sound basis for electronic commerce but provides little practical guidance on decentralized systems, the automatic execution of contracts and blockchain governance.

This limitation has received considerable scholarly attention. Amelia H. Boss maintains that the purpose of electronic commerce legislation was to replace the traditional obstacles posed by paper contracts with electronic equivalents, and that the law had been effective in doing so, but that it had not been written to regulate "self-executing" agreements. In her view, legislation recognizing electronic signatures and electronic documents accomplished the transition from paper-based transactions to electronic communication between parties, but did not address new methods of contractual performance. Significantly, smart contracts combine features of electronically communicated and executed contracts with contracts that cannot be modified once performed, creating legal issues beyond those originally anticipated by electronic commerce legislation.

The Law Commission of England and Wales has produced one of the most significant recent studies on the legal status of smart contracts. The Commission found that, in general, English common law is capable of recognizing legally binding smart contracts without the need for wholesale reform of contract law. It concluded that contract law has historically proved highly flexible and that the existing principles of offer, acceptance, intention and consideration are sufficiently adaptable to accommodate technological developments. The Commission nevertheless recognized significant uncertainties concerning digital assets, the meaning of coded terms, jurisdiction, remedies and conflict of laws. Rather than proposing to replace contract law, it urged the gradual evolution of the law, supported where necessary by carefully drafted legislative changes. The Commission's approach has been widely endorsed by the academic community because it challenges the notion that an entirely new legal framework is required for this technology. In similar terms, Chris Reed argues that technological innovation does not run counter to basic legal concepts. Smart contracts are not a novel phenomenon in commercial law but rather another iteration in the evolution of commercial contracting, from postal contracts to telegraph contracts, to telephone contracts, to electronic messaging contracts and now internet commerce contracts. This view provides further justification for holding that existing legal concepts remain relevant but require reinterpretation in the context of blockchain.

Other researchers argue, however, that smart contracts pose problems greater than existing laws can readily handle. Blockchain technology, contend Primavera De Filippi and Aaron Wright, has changed the relationship between the law and contractual performance. They note that traditional contracts rely on the possibility that a court will intervene in the event of a dispute or breach, whereas smart contracts are designed to perform contractual obligations automatically without the need for disputes. Once a transaction is executed on the blockchain, it can be very difficult or even impossible to reverse. There will therefore be cases in which a court-ordered remedy is ineffective because the contract has already been performed through irrevocable computer code. This is what distinguishes smart contracts from ordinary electronic contracts, and it raises

important questions about equitable relief, rescission, rectification and restitution.

A related question concerns the difference between legal intent and technological execution. A number of scholars stress that a computer program does not always adequately capture the complexity of contractual relationships. Contractual provisions commonly employ open-textured standards such as "reasonableness," "good faith," "fairness" and "commercial practice," which require case-by-case interpretation by judges or arbitrators. Programming languages, by contrast, consist of explicit instructions that leave little room for ambiguity or unforeseen circumstances. When legal agreements are translated into computer code, important contractual assumptions that are legally relevant but not written into the code may be excluded. This concern is also reflected in the frequently used dichotomy between "code is law" and "law governs code." The phrase "code is law," coined by Lawrence Lessig, underscores the power of software design to govern human action through the engineering of the choices offered in digital systems; many scholars, however, caution against taking it at face value in the legal context. They argue that technological regulation cannot always replace legal regulation, since contractual disputes frequently involve more than automated performance. Programming logic alone cannot resolve issues such as fraud, coercion, mistake, duress, public policy, illegality and consumer protection. Modern scholars have therefore rejected the idea of deploying blockchain technology without the involvement of legal institutions.

A further current topic in international scholarship is the interaction between the "old" and the "new" conceptions of contractual consent. In classical contract theory, informed consent is preceded by negotiation over the contractual terms. Smart contracts, however, are most often created through standardized software protocols that ordinary people neither comprehend nor negotiate. Where unforeseen circumstances arise, Karen E. C. Levy suggests that excessive automation can create an "illusion of certainty" that reduces opportunities for human judgment and equitable intervention, even as it increases the scope for opportunistic breach. This concern has become more significant in the context of consumer protection and digital financial services. The question of jurisdiction and applicable law has also attracted significant scholarly interest. Blockchain networks are multi-jurisdictional and often lack any particular geographic origin. Traditional principles of private international law, by contrast, are generally based on territorial notions such as the place of contracting, the place of performance or the domicile of the contracting parties. Under conventional contractual arrangements, the applicable law and the competent judicial forum are far easier to determine than where, as Mik suggests, a contract is executed simultaneously on thousands of scattered computers across different countries on a decentralized blockchain network. This is an important issue, particularly in relation to cross-border electronic commerce and international dispute resolution.

Another relevant strand of the literature concerns the evidentiary issues raised by blockchain transactions. Although the immutability of blockchain records is widely regarded as a key characteristic of the technology, scholars note that "authenticity" does not necessarily entail "admissibility." Courts are likely to have to address questions of authentication, source or attribution, procedural fairness and statutory compliance before admitting blockchain records as evidence. Technological reliability and legal admissibility must therefore be treated as distinct, though related, concepts and analysed separately. Taken together, the international literature reveals that smart contracts have significantly broadened the study of the legal aspects of electronic commerce. Although there is broad agreement that existing contract law principles will remain an important legal basis for automated execution, there is significant disagreement about how well those principles are being integrated into existing legislative frameworks to address issues such as the execution of code, decentralized governance, coding errors, evidentiary questions, jurisdiction and judicial remedies. These international discussions offer valuable analysis for the

interpretation of the Electronic Transactions Ordinance 2002, which was enacted before the commercial value of these technologies became apparent. But they also indicate that the question isn't one of law's 'legality', it's whether law is adaptable to the increasing complexity of how they are being used in their business applications.

Pakistani Legal Framework and Existing Scholarship

While there is a considerable amount of work done around the world for the smart contracts technology in the last decade, there is not much academic research done with respect to smart contracts in the Pakistani context. Most of the literature of this nature in Pakistan has focused on the general issues of electronic commerce, electronic signatures, cybercrime and electronics evidence without the specific issue of smart contracts using blockchain. This is largely because Pakistan's principal legislation on electronic transactions, the Electronic Transactions Ordinance 2002 (ETO 2002), was formulated before the commercialization of blockchain technology and smart contracts. As a result, although the Ordinance legally recognizes electronic communication, it offers very little specific guidance on decentralized blockchain transactions or the autonomous execution of contractual terms.

The Electronic Transactions Ordinance 2002 was a major step forward in the development of Pakistani law, as it provided that electronic transactions, electronic records and electronic signatures should not be denied legal effect merely because they exist in electronic form. The purpose of the Ordinance was to promote electronic commerce, foster technological innovation and build trust in electronic commerce. It also established rules on the attribution of electronic communications, the time and place of dispatch and receipt, certification service providers and the legal validity of electronic signatures. These provisions were based on internationally accepted principles drawn mainly from the UNCITRAL Model Law on Electronic Commerce and represented a progressive response to the rapid development of internet commerce in the early 2000s.

Nevertheless, the existing literature makes clear that the Electronic Transactions Ordinance 2002 was drafted to regulate the traditional model of electronic transactions rather than the blockchain model of contracting. Its statutory provisions are confined to electronic documents, electronic messages and authentication, and do not expressly address distributed ledger technology, decentralized networks, programmable contracts, automated execution or blockchain governance. It is here that recent Pakistani legal scholarship has begun to engage with these concerns. In "When Code Becomes Contract: An Analysis of Smart Legal Contract Formation under Pakistani Law," the author seeks to determine whether smart legal contracts satisfy the fundamental requirements of a contract under the Contract Act 1872 and the Electronic Transactions Ordinance 2002. The study concludes that, in general, the principles of Pakistani contract law can recognize contracts formed through blockchain technology, provided that all the elements of a contract—offer, acceptance, lawful consideration, free consent and the intention to create legal relations—are satisfied. The author also acknowledges, however, that important practical questions remain to be addressed, such as automatic execution, contractual interpretation, coding errors and judicial enforcement.

Similarly, the recent study entitled "Enforcing Code: Doctrinal and Practical Remedies for Smart Legal Contracts in Pakistan" pursues a related theme. The authors take the view that the Contract Act 1872 already provides an adequate doctrinal basis for assessing contractual validity, but that it says little about the remedies available where contractual obligations have been performed automatically through unalterable blockchain technology. They observe that traditional remedies such as rescission, rectification, injunctions and specific performance may need to be rethought in cases where contractual obligations have been fulfilled automatically by computer code.

In parallel, several concerns regarding the relationship between electronic transactions and

evidence have been given prominence in Pakistani legal literature. One noteworthy contribution addresses the jurisprudential position of digital evidence under Article 164 of the Qanun-e-Shahadat Order 1984. That work shows how Pakistani courts have increasingly accepted the admissibility of electronic evidence while remaining alert to questions of authenticity, reliability and admissibility. It argues that although electronic records are now recognized by the courts, judicial practice in relation to them is still developing as new types of electronic evidence arise. This is important because, in light of the foregoing analysis of smart contracts, blockchain records may in time become significant evidence in disputes over the formation, performance and enforcement of a contract.

The legal status of electronic signatures, as well as advanced electronic signatures, under the Electronic Transactions Ordinance 2002 has also been analysed by Pakistani scholars. Sajjad Ali argues that the Ordinance was a positive step towards the validation of electronic signatures and provided a significant legal structure for authentication in e-commerce. The article nevertheless highlights continuing practical issues relating to the reliability of the underlying technology, the applicable standard of evidence and the judicial evaluation of digital authentication techniques. These observations are particularly relevant where smart contracts are executed using cryptographic signatures or decentralized authentication systems rather than handwritten signatures.

The continued significance of the Contract Act 1872 is another recurring theme in Pakistani scholarship. Although the Act was enacted during the colonial era, it remains the most important legislation governing contractual relations in Pakistan. Its provisions on offer, acceptance, consideration, lawful object, free consent, capacity of parties and void agreements remain relevant to the conclusion of commercial transactions, whatever the medium through which they are undertaken. Many Pakistani scholars therefore consider that a legal relationship can be formed through a smart contract and that smart contracts are not a new category of contractual relationship, but rather a technologically advanced means of performing contractual obligations. This supports the view that the essential legal question is not whether a particular technological platform has been used, but whether the requirements of the substantive law of contract have been satisfied.

This doctrinal approach is not, however, without its critics. A number of commentators note that smart contracts possess attributes that were not foreseen by nineteenth-century contract law. Their decentralized architecture, irreversible execution, reliance on programming code and transnational operation raise legal questions that go beyond the traditional rules of contract formation. Existing Pakistani legislation offers little clarity on coding errors, oracle failure, the allocation of liability, cross-border jurisdiction, applicable law, consumer protection and the modification or termination of self-executing agreements. The Contract Act 1872 therefore continues to govern the fundamental validity of a contract, but it does not address the operational realities of blockchain technology.

A further issue highlighted in Pakistani scholarship is institutional preparedness. Beyond legislative recognition, judicial awareness of blockchain technology, technical expertise, digital-forensic capability and regulatory oversight are all critical to the effective enforcement of smart contracts. Scholars observe that effective blockchain-based commercial systems will require coordination between legislators, judges, regulators, lawyers, software engineers and commercial parties; in the absence of such coordination, even well-drafted laws may fail to deliver meaningful legal certainty to participants in the digital economy.

Critical Evaluation and Research Gap

The literature review supports a number of observations. First, smart contracts have been explored extensively by international scholars in terms of their theoretical basis, technological functioning and legal implications. Secondly, comparative studies increasingly focus on judicial approaches in the United Kingdom, the United States, Singapore and the European Union. Thirdly, in the context of e-commerce and

contract law, Pakistani research on blockchain technology remains limited, and there is a clear need for more comprehensive study.

More importantly, there are very few studies that critically examine the enforceability of smart contracts under the Electronic Transactions Ordinance 2002. Most Pakistani publications focus on electronic signatures, digital evidence or the general aspects of electronic commerce, with only superficial or incidental reference to blockchain technology. Similarly, prior research tends to consider the Contract Act 1872 and the Electronic Transactions Ordinance separately rather than integrating the two statutes when examining their application to contractual relationships enabled by blockchain technology.

This study accordingly addresses an identifiable gap in the existing scholarship. It is distinctive in that it undertakes a thorough doctrinal analysis of the enforceability of smart contracts under the Electronic Transactions Ordinance 2002 while also taking account of the role of the Contract Act 1872, the law of electronic evidence and comparative developments around the world. The study aims to contribute to an emerging field of technology law, analyze the existing legal framework and gaps that could be filled by policy, and propose policy recommendations to help increase clarity in the legal field of rapidly evolving technological fields in Pakistan.

Conclusion

From the above literature review, it is evident that smart contracts are one of the most significant technological advancement in the modern day commercial law. International academics have talked about their theoretical basis, technological structure, legal features and enforcement against the traditional contract law. While smart contracts have potential for great commercial value, their recognition and enforcement is still a complex area of legal discussion, including contractual formation, interpretation, automated performance, jurisdiction, remedies and dispute resolution, and many others. Likewise, the UNCITRAL Model Law on Electronic Commerce with Guide to Enactment 1996 (United Nations 1999) has been an influential model for the recognition of e-transactions, which does not even consider blockchain contractual relationships.Similarly, the UNCITRAL Model Law on Electronic Commerce with Guide to Enactment 1996 (United Nations 1999) has offered a crucial model with regard to recognition of electronic transactions, but makes no mention of contractual relationships on blockchain.

The number of problem-related literatures in the field of problem in Pakistan is still limited. The existing research is focused on electronic commerce, electronic signatures and digital evidence as offered by the Electronic Transactions Ordinance 2002, while only a few recent publications have begun to discuss legal aspects of the blockchain technology and smart contracts. Other studies have recognised that electronic contracting is legally supported by the Contract Act 1872 and the Electronic Transactions Ordinance 2002, but have also pointed out that the Contract Act 1872 and the Electronic Transactions Ordinance 2002 do not explicitly address issues such as automated execution, coding errors, decentralised governance, cross-border jurisdiction, blockchain evidence and remedies for self-executing agreements. This creates a lot of doubts as to their enforceability in a Pakistani system of law.In this regard, there is a lot of uncertainty regarding the enforceability of the smart contracts in the legal framework of Pakistan.Moreover, most of the studies conducted so far have been exclusively on the technical aspects of smart contracts or on the overall aspects of the smart contracts without providing any comprehensive doctrinal analysis on the enforceability of smart contracts under ETO 2002. This correlation between Ordinance and the Contract Act 1872 and the comparative international developments and consequently, the current legal regime of Pakistan has been overlooked. An important new book.

The present research thus aims to fill this gap by critically examining the enforceability of smart contracts under the Electronic Transactions Ordinance 2002, based on principles of contract law, the pertinent comparative law and recent technological advancements. The study will review the efficacy of existing legal landscape for

regulating smart contracts or the necessity of a change in the existing laws to ensure legal certainty, foster innovation and further development of Pakistan's digital economy. The research is not only going to benefit the discussion regarding the law of technology but also provide some practical recommendations towards improving the legal regime of electronic transactions and blockchain transactions of Pakistan.

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