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Compensation for Loss of Opportunity in Electronic Transactions: A Comparative Analytical Study in Light of Contemporary Digital Developments

Ibrahem Ali Hammadi[1*], Salman Ali Humadi[2], Husham Hamed[3], Sameer Aboud Farhan[4], Kamil Sulaiman[5]

[1,3,4,5]College of Law, Alhuda University College, Iraq
[2]Algarmah Education Department, Iraq
*Corresponding Author: ibrahem.ali@uoalhuda.edu.iq

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Abstract: The rapid expansion of electronic commerce and digital technologies has generated new forms of civil liability, particularly concerning compensation for the loss of opportunity arising from electronic transactions. Existing legal frameworks, primarily developed for conventional contractual and tortious relationships, often fail to adequately address damages arising from technical failures, cybersecurity incidents, system disruptions, delayed electronic performance, and other digital risks. This study aims to examine the legal nature of compensation for loss of opportunity in electronic transactions, identify the legal requirements for establishing liability, analyse the evidentiary standards applicable to digital harm, and evaluate the principles governing the assessment of compensation. The research employs a comparative analytical methodology to examine legal doctrines, statutory provisions, and judicial precedents across the French, Egyptian, and selected Arab legal systems, particularly those of the United Arab Emirates and Jordan. The findings reveal that loss of opportunity constitutes an independent and legally compensable category of damage whenever a genuine and substantial probability of obtaining a benefit or avoiding a loss is interrupted by an electronically attributable fault. The study further demonstrates that compensation should be calculated based on the objective value of the lost opportunity rather than the total anticipated benefit, thereby preserving the proportionality between the interests of injured parties and the limits of civil liability. Moreover, the increasing reliance on digital evidence, electronic records, cybersecurity documentation, and technical expert testimony significantly strengthens the determination of causation and the assessment of damages in electronic transactions. This study contributes to the advancement of comparative civil liability scholarship by clarifying the legal framework governing compensation for digital loss of opportunity and by proposing a contemporary legal approach that enhances legal certainty, reinforces judicial consistency, strengthens consumer and commercial protection, and promotes greater confidence in electronic commerce amid the ongoing digital transformation.

Keywords: Civil Liability; Comparative Law; Digital Evidence; Electronic Commerce; Electronic Transactions; Loss of Opportunity.

INTRODUCTION

The contemporary world is witnessing an unprecedented technological transformation that has fundamentally reshaped the structure of commercial and civil transactions. Traditional paper-based dealings and face-to-face negotiations have increasingly been replaced by electronic transactions conducted through digital platforms and interconnected communication systems.[1] The rapid expansion of electronic commerce, online banking, smart contracts, and digital services has created a new legal environment in which rights and obligations are performed instantly across geographical borders without physical interaction between contracting parties.[2] This transformation has significantly increased individuals' and corporations' dependence on digital infrastructure, making economic opportunities closely linked to the efficiency, speed, and reliability of electronic systems.[3]

In parallel with this technological evolution, the digital economy has become one of the primary pillars of global economic growth. Electronic transactions now account for trillions of dollars annually, while millions of contracts are concluded every day through websites, mobile applications, cloud-based platforms, and automated systems.[4] The growing reliance on technology has undoubtedly facilitated commercial operations and reduced transaction costs; however, it has simultaneously introduced new forms of legal risks and damages that were either unknown or relatively limited in traditional transactions.[5] Among the most critical of these emerging harms is the "loss of opportunity" resulting

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[1] Wijayanto Setiawan, 'Aspek hukum kontrak dagang via internet (cyberspace transactions) dalam perspektif sistem hukum Islam', *Ijtihad : Jurnal Wacana Hukum Islam dan Kemanusiaan* 10, no. 2 (2010): 123–155, https://doi.org/10.18326/ijtihad.v10i2.123-155.

[2] Padian Adi Salamat Siregar, 'Legal Liability For Lost Goods Purchased Online Under A Personal Shopper Service Agreement', *Proceeding International Seminar of Islamic Studies* 0, no. 0 (2026): 1362–1369, https://doi.org/10.3059/insis.v0i0.28909.

[3] Abdul Mujib, 'The Failure of Indonesian E-Commerce Law in Adapting to Digital Economy', *Ijtihad : Jurnal Wacana Hukum Islam Dan Kemanusiaan* 25, no. 2 (2025): 213–230, https://doi.org/10.18326/ijtihad.v25i2.213-230.

[4] Ismawati and Suud Sarim Karimullah, 'Consumer Protection in the Digital Era: An Analysis of Consumer Protection in E-Commerce', *Nusantara: Journal of Law Studies* 3, no. 02 (2024): 68–80, https://doi.org/10.5281/zenodo.17376951.

[5] A. Mohamed and A. Abdelrahman, 'Civil Liability for Digital Products: A Comparative Study', *Journal of Jurisprudential and Legal Research*, 2026, https://doi.org/doi.org/10.1007/978-3-031-40118-3_2.

from technical failures, electronic delays, cybersecurity breaches, software malfunctions, or interruptions of digital services.

The doctrine of *Perte de Chance* originated in French jurisprudence and has gradually developed into a recognised form of compensable damage in comparative civil law systems. It is traditionally applied in cases where an individual is deprived of a serious and real probability of obtaining a benefit or avoiding a loss due to wrongful conduct. Over time, courts have accepted that the lost chance itself constitutes a compensable harm, even when the final result is uncertain. However, its application has largely remained confined to conventional areas such as medical liability and procedural negligence, with limited exploration in electronic transactions and digital environments.

Recent scholarly literature has increasingly addressed the legal implications of electronic transactions, particularly regarding liability, digital harm, and the evolving nature of civil responsibility in the digital environment. However, most studies remain fragmented, focusing either on general electronic liability or specific issues such as cybersecurity, digital content damage, or payment systems, with limited attention to the doctrine of loss of opportunity (*Perte de Chance*) in electronic contexts. Similarly, recent comparative scholarship has emphasised that the legal adaptation of electronic contracts requires the reinterpretation of traditional contractual principles to accommodate digital environments while preserving legal certainty and contractual fairness. This demonstrates the continuous evolution of legal doctrines in response to technological transformation.[6]

Several studies emphasise the complexity of establishing civil liability in electronic transactions, given the multiplicity of actors and the technical nature of digital systems. For instance, Bouaoune highlights that electronic liability is a dynamic legal construct that must continuously adapt to technological developments such as artificial intelligence and the Internet of Things, which complicate the traditional understanding of fault and causation in civil law systems.[7] Similarly, Se-Hak Chun demonstrates that security breaches in e-commerce and mobile payment systems significantly affect the allocation of liability between service providers and users.[8] These findings confirm that existing liability frameworks are often insufficient to address the complexity of modern digital risks.

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[6] Pauzi Muhammad et al., 'Actualizing Islamic Economic Law in the Digital Era: A Study of the Application of Khiyar al-Majlis in Electronic Contracts', *JURIS (Jurnal Ilmiah Syariah)* 23, no. 2 (2024): 205–214, https://doi.org/10.31958/juris.v23i2.11573.

[7] Nidhal Bouaoune, 'Determination of Liability in Electronic Transactions', *Professor Researcher Journal for Legal and Political Studies* 11, no. 1 (2026): 883–905.

[8] Se-Hak Chun, 'E-Commerce Liability and Security Breaches in Mobile Payment for e-Business Sustainability', *Sustainability* 11, no. 3 (2019): 715, https://doi.org/10.3390/su11030715.

Other contributions focus on digital goods and electronic commerce, showing that traditional civil liability doctrines struggle with intangible contractual objects and digital transmission errors.[9] These studies reveal persistent uncertainty regarding the burden of proof and causation in electronic environments. Doctrinal research on *Perte de Chance* further shows that compensation depends on evaluating probability rather than certainty, but its application remains largely limited to traditional sectors such as medical malpractice and procedural justice.[10] This indicates a theoretical gap in extending the doctrine to digital environments. More recent studies attempt to connect civil liability with electronic transactions and cross-border digital disputes, highlighting the expansion of liability into privacy, cybersecurity, and digital rights protection. However, they still do not fully analyse loss of opportunity as a distinct compensable damage in electronic transactions.

Despite the growing academic interest in electronic liability, a significant gap persists regarding the application of the doctrine of *Perte de Chance* in electronic transactions. Current studies have not adequately explained how courts can effectively distinguish between a genuine loss of opportunity and purely speculative or hypothetical damage in digital environments characterised by high-speed processing, automation, and technical complexity. Moreover, critical issues relating to proof, causation, and the probative value of digital evidence remain underdeveloped, particularly in cases involving interconnected technological infrastructures such as cloud computing systems, online payment gateways, and algorithmic trading platforms. Accordingly, the novelty of this study lies in its focused examination of the legal adaptation of the doctrine of loss of opportunity within electronic transactions. It seeks to bridge the conceptual and practical gap between traditional civil liability theory and the realities of the modern digital economy by analysing how compensation for lost opportunities can be legally conceptualised, evidentially established, and judicially assessed in technologically complex environments.

This study is guided by the following key research questions: what is the legal nature of loss of opportunity in electronic transactions; to what extent can the doctrine of *Perte de Chance* be effectively applied in digital environments; how are electronic fault and causation established in cases involving digital harm; what legal standards are used to distinguish compensable loss of opportunity from speculative damage; and how can digital evidence and technical expertise be utilised to prove loss of opportunity in electronic transactions?

[9] David Andrew Poyton, 'Dematerialized Goods and Liability in the Electronic Environment: The Truth Is, "There Is No Spoon (Box)"', *International Review of Law, Computers & Technology* 19, no. 1 (2005): 83–98, https://doi.org/10.1080/13600860500051630.

[10] Rafael B. Stern and Joseph B. Kadane, 'Compensating for the Loss of a Chance', arXiv:1412.1501, preprint, arXiv, 3 December 2014, https://doi.org/10.48550/arXiv.1412.1501.

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METHOD

This study employs a doctrinal and comparative legal research design using a qualitative approach to examine the legal framework governing compensation for loss of opportunity in electronic transactions. The doctrinal method is applied to analyse legal norms regulating civil liability, electronic transactions, and digital damages. At the same time, the comparative approach evaluates similarities and differences among the legal systems of France, Egypt, and selected Arab jurisdictions, particularly the United Arab Emirates and Jordan. Data were collected through comprehensive library research by examining primary legal materials, including legislation, judicial decisions, and international legal instruments, as well as secondary sources such as scholarly books, peer-reviewed journal articles, legal commentaries, and relevant academic publications. The collected materials were selected based on their relevance, authority, and contribution to understanding the evolving concept of loss of opportunity within contemporary digital transactions.

The data were analysed using qualitative legal analysis through descriptive, analytical, and comparative techniques. Descriptive analysis was employed to explain the legal characteristics of loss of opportunity in electronic transactions, while analytical interpretation examined the principles of civil liability, causation, digital evidence, and compensation mechanisms as set out in statutory provisions and judicial precedents. Comparative analysis was subsequently undertaken to identify convergences, divergences, and best practices across the selected jurisdictions in addressing electronic harm. To ensure the validity and credibility of the findings, the study adopted source triangulation by cross-examining legislative provisions, judicial decisions, legal doctrines, and contemporary academic literature. The analysis was further guided by the principles of legal coherence, consistency, and systematic interpretation, while incorporating the values of justice, good faith, proportionality, and protection from harm recognised in both Islamic jurisprudence and modern civil law. This methodological framework enhances the reliability of the research findings and provides a comprehensive basis for developing a contemporary legal model of compensation that is responsive to technological innovation and the evolving nature of electronic transactions.

RESULTS AND DISCUSSION

The Nature of Loss of Opportunity in Electronic Transactions

Understanding compensation for the loss of opportunity in electronic transactions requires, as a starting point, a clear definition of the concept and a careful distinction from other forms of compensable damage. This clarification has become increasingly important as commercial activities continue to shift from conventional physical interactions to digital platforms.[11] Unlike traditional transactions, electronic transactions are characterised by automation, instantaneous communication, algorithmic decision-making, and cross-border connectivity, all of which create new forms of legal relationships and potential harm. Consequently, legal concepts originally developed for tangible transactions must be reinterpreted to accommodate the distinctive characteristics of the digital environment.[12]

Within comparative legal scholarship, the doctrine of loss of opportunity has long occupied a prominent position in the law of civil liability. French jurisprudence, where the doctrine is known as *Perte de Chance*, defines it as the loss of a genuine opportunity to obtain a benefit or avoid a loss as a result of another party's wrongful conduct. The defining feature of the doctrine is not the certainty of the anticipated outcome but the existence of a real and substantial probability that has been wrongfully interrupted. Accordingly, the compensable damage lies in the loss of the opportunity itself rather than in the complete loss of the expected benefit. This approach has gained broad acceptance because an opportunity with measurable economic value is regarded as an independent legal interest deserving protection, even though the outcome remains uncertain.[13]

A similar understanding has emerged in Arab legal scholarship, where loss of opportunity is generally defined as the deprivation of a person of a realistic chance to obtain a specific benefit or avoid an expected loss due to another person's fault. Civil law scholars consistently maintain that the protected legal interest is the opportunity itself rather than the uncertain future result. Although the realisation of the anticipated benefit depends on probability, the opportunity exists as a present and identifiable legal interest capable of economic valuation. This interpretation has enabled courts to recognise loss of opportunity as an autonomous category of compensable damage without requiring proof that the expected benefit would certainly have materialised.[14]

In Anglo-American jurisprudence, the Loss of Chance Doctrine has evolved as an exception to traditional principles of causation, allowing claimants to recover damages for the loss of a meaningful opportunity to achieve a more

[11] Sanuri et al., 'Epistemological Transformation of ʿUrf in the DSN-MUI Fatwa on E-Commerce: A Maqāṣid al-Sharīʿah Based Analysis', *Al-Manahij Jurnal Kajian Hukum Islam* 19, no. 2 (2025): 167–190, https://doi.org/10.24090/mnh.v19i2.13145.

[12] Nibrosu Rohid et al., 'Reconstructing the Legal Enforcement Framework for Digital Activism in an Era of Technological Disruption', *Nusantara: Journal of Law Studies* 5, no. 2 (2026): 881–901, https://doi.org/10.66325/nusantaralaw.v5i2.236.

[13] Geneviève Viney, and Patrice Jourdain, *Les Effets de La Responsabilité* (LGDJ, 2017); Assia Ziani, 'Compensation arising from international electronic transactions: between subjective and objective theory', *Journal of Legal Studies and Researches* 10, no. 1 (2025): 175–187.

[14] Waleed Basim Aboud Al-Ankaz, 'Compensation for Loss of Opportunity in Tort Liability', *Al-Qarar Journal for Scientific Research*, 2024.

favourable outcome, even when the probability of success falls below the conventional evidentiary threshold. Rather than requiring proof that the desired result would have occurred on the balance of probabilities, the doctrine recognises that the destruction of a genuine opportunity may itself constitute actionable harm.[15] This development reflects a broader evolution in contemporary civil liability toward accommodating uncertainty and probabilistic harm in complex factual situations. As electronic transactions increasingly rely on automated systems, artificial intelligence, digital platforms, and interconnected technological infrastructures, the doctrine provides a valuable conceptual foundation for addressing economic losses arising not from the certainty of a missed benefit, but from the wrongful deprivation of a genuine and legally recognisable digital opportunity.[16]

Distinction Between Certain Damage and Hypothetical Damage

The distinction between actual and hypothetical damages is a cornerstone of civil liability theory. The general rule provides that compensation is awarded only for certain damage, whether present or future, whereas hypothetical damage does not give rise to compensation. The critical issue here lies in the classification of "loss of opportunity." Where does it fall within this spectrum? A precise legal analysis places loss of opportunity in an intermediate zone, yet leaning toward the category of "certain damage." The lost opportunity is considered a present and actual harm, namely, the deprivation of hope, even though the outcome (such as winning a tender or achieving profit) remains probabilistic. The fundamental distinction lies in the fact that compensation is not awarded for the unrealised "result," which is uncertain, but rather for the "opportunity" itself, which has indeed been lost and is recognised as certain. This nuanced distinction has enabled courts to accept claims for compensation arising from loss of opportunity in the digital environment without conflicting with the general rule that prohibits compensation for hypothetical damage.[17]

Table 1. Conceptual and Doctrinal Foundations of Loss of Opportunity

Dimension	Legal Content	Jurisdictional Position	Key Legal Implication
Definition in French Doctrine	"Disappearance of a hope of obtaining a gain or avoiding a loss due to a harmful act" (*Perte de Chance*)	France	Recognises opportunity as a protected legal interest based on serious probability

[15] Mahmood Alaloosh et al., 'Securing Digital Trade: A Techno-Legal Analysis of E-Commerce Safeguards in Iraq's Regulation No. 4/2025', *Nusantara: Journal of Law Studies* 5, no. 1 (2026): 44–60, https://doi.org/10.5281/zenodo.18452737.

[16] A. N. Al-Attar, *Compensation for Loss of Opportunity in Civil Law: A Comparative Study* (. Dar Al-Fikr Al-Jami'i, 2003).

[17] A. J. Al-Siddiq, *Compensation for Hypothetical Damage and Loss of Opportunity*. (Dar Al-Fikr wa Al-Qanun, 2011).

Arab Jurisprudence	Deprivation of a chance to obtain a benefit or avoid harm due to fault	Egypt, UAE, Jordan, Kuwait	Treats opportunity as an independent compensable value, not a final gain
Anglo-Saxon Doctrine	Compensation allowed even if probability < 50%	Common law systems	Expands liability beyond strict causation and certainty
Judicial Interpretation (France)	"Current and certain disappearance of a favourable eventuality"	Court of Cassation	Establishes opportunity as certain harm despite probabilistic outcome
Judicial Interpretation (Egypt & UAE)	Loss of opportunity constitutes harm in itself	Civil and Supreme Courts	Expands compensability of lost chance in commercial and digital disputes
Legal Classification	Intermediate between certain and hypothetical damage	Comparative doctrine	Allows compensation without violating the rule against speculative harm

Source: Prepared by the authors

The Legal Nature of Loss of Opportunity: Loss of Opportunity as an Independent Harm

The prevailing and modern trend in legal doctrine holds that loss of opportunity is an autonomous harm, entirely distinct from the feared final damage or the hoped-for gain. According to this perspective, the opportunity itself possesses an economic and financial value of its own, separate from the value of the anticipated outcome.[18] Based on this characterisation, compensation is assessed by the value of the lost opportunity rather than the total unrealised gain. This approach is particularly well-suited to the nature of electronic transactions, where outcomes are rarely guaranteed with absolute certainty, for instance, the fluctuation of digital currency prices. Nevertheless, the opportunity to access or participate in such transactions has clear economic value that can be evaluated financially. This perspective ensures fairness: it does not overburden the debtor with full compensation for an uncertain result, nor does it deprive the creditor of redress for a fault that deprived him of a legitimate expectation.

In contrast, a segment of traditional legal doctrine (a view now in decline) considers loss of opportunity merely a form of hypothetical damage, which cannot be compensated unless it has actually materialised. Proponents of this view argue that it

[18] Muhammad Azam et al., 'AI-Driven Sharia Governance in Islamic Digital Payment Systems: Developing a Contemporary Islamic Law Framework for Ethical and Regulatory Compliance', *Nusantara: Journal of Law Studies* 5, no. 2 (2026): 849–880, https://doi.org/10.66325/nusantaralaw.v5i2.339.

is difficult to separate the opportunity from the outcome, and therefore compensation for the opportunity is, in reality, compensation for speculative harm.[19] However, this position has faced sharp criticism in modern times, particularly with the advancement of economic theories such as game theory and probability theory, which assign precise mathematical and financial value to probabilities. This is especially evident in financial markets and electronic commerce, where probabilities are no longer regarded as mere speculation but as measurable, quantifiable realities approaching the certainty of mathematical calculation.[20]

Table 2. Legal Nature of Loss of Opportunity in Electronic Transactions

Analytical Aspect	Legal Description	Electronic Transaction Application	Legal Consequence
Independent Harm (Modern Doctrine)	Loss of opportunity is an autonomous harm separate from final damage	Missed trades, failed bids, lost online contracts	Allows direct compensation for the lost chance itself
Hypothetical Damage (Traditional View)	Considered speculative and dependent on the outcome	Unsuccessful or unrealised digital gains	Generally non-compensable under strict interpretation
Economic Valuation	Opportunity has measurable financial value	Forex, crypto, e-commerce probability pricing	Enables monetary estimation of chance
Doctrinal Development	Shift from strict certainty to probabilistic liability	Algorithmic and high-frequency trading systems	Expands the scope of civil liability
Legal Classification	Intermediate between certain and uncertain damage	Platform outages and transaction failures	Supports a partial compensation model
Judicial Trend	Increasing recognition of lost chance value	Electronic contracts and digital service failure cases	Strengthens claimant protection in cyberspace

Source: Prepared by the authors

Comparative Legislative Approaches to Compensation for Loss of Opportunity:

Egyptian Law: The Egyptian legislator did not explicitly refer to the term "loss of opportunity." However, Article 221 of the Civil Code stipulates that compensation

[19] Rui Cardona Ferreira, 'The Loss of Chance in Civil Law Countries: A Comparative and Critical Analysis - Rui Cardona Ferreira, 2013', *Maastricht Journal of European and Comparative Law*, 1 March 2013, https://journals.sagepub.com/doi/10.1177/1023263X1302000104.

[20] G. A. Al-Batoush, 'Compensation for Loss of Profit and Loss of Opportunity under FIDIC Contracts: An Analytical and Comparative Study' (Master's thesis, Amman Al-Ahliya University, Faculty of Law, 2024).

shall cover "the loss suffered by the creditor and the gain of which he has been deprived." Jurisprudence and case law have interpreted the phrase "deprived gain" broadly to encompass loss of opportunity, provided that the opportunity is genuine. French Law: Considered the principal reference in this field, French law, despite the absence of an explicit provision in the Napoleonic Code, through subsequent amendments and the jurisprudence of the Court of Cassation, firmly established the principle of compensation for loss of opportunity. It has become an integral part of French liability law and is rigorously applied in both contractual and tortious contexts.[21]

The civil laws of the United Arab Emirates, Jordan, and Kuwait follow the approach adopted in Egyptian and French law. Article 292 of the UAE Civil Transactions Law and Article 363 of the Jordanian Civil Code both recognise the principle of compensation for foreseeable direct damage. This has been interpreted by the higher courts in these jurisdictions to encompass compensation for loss of opportunity, provided that the opportunity is genuine and serious. [22]

The Concept of Electronic Transactions: Definition of Electronic Transactions

Legal and doctrinal definitions of electronic transactions vary. Electronic commerce and online contractual relationships should be interpreted through contemporary legal frameworks that preserve contractual certainty, transparency, and the protection of parties' legitimate expectations within digital marketplaces.[23] Terminologically, they may be defined as "all operations and procedures carried out wholly or partially through electronic and digital means, aimed at creating, modifying, transferring, or terminating obligations." This includes data exchange, contract formation, electronic payments, and digital communications with legal effect. [24]Contemporary legal research further explains that electronic contracts possess the same legal nature as conventional contracts despite being concluded through virtual communication systems, provided that the essential elements of contractual consent and legal certainty are maintained. [25]

The UNCITRAL Model Law on Electronic Commerce defines a "data message" as information generated, sent, received, or stored by electronic, optical, or similar means. In Arab legislation, the UAE Electronic Transactions Law defines an electronic

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[21] Khando Khando et al., 'The Emerging Technologies of Digital Payments and Associated Challenges: A Systematic Literature Review', *Future Internet* 15, no. 1 (2023): 21, https://doi.org/10.3390/fi15010021.

[22] Al-Jubouri Yaseen Mohammed, *Al-Wajeez fi Sharh al-Qanun al-Madani: Masadir al-Huquq al-Shakhsiyyah (Ahkam al-Iltizamat)* (Dar Al-Thaqafa for Publishing and Distribution, 2016), https://www.noor-book.com/book/review/567276.

[23] Sanuri et al., '(PDF) Epistemological Transformation of ʿUrf in the DSN-MUI Fatwa on E-Commerce'.

[24] Jum Anggriani et al., 'Civil Law Transformation in the Digital Age: Challenges and Opportunities', *ASAS* 17, no. 01 (2025): 100–109, https://doi.org/10.24042/asas.v17i1.25927.

[25] Muhammad et al., 'Actualizing Islamic Economic Law in the Digital Era'.

transaction as "any dealing, contract, or agreement concluded or executed wholly or partially by electronic means". [26]

Electronic transactions possess distinctive characteristics that differentiate them from conventional legal transactions and significantly influence the application of the doctrine of loss of opportunity.[27] First, they are inherently virtual, as contractual relationships are established through digital communication without any physical interaction between the parties or the exchange of paper documents. Consequently, the traditional concept of a contractual meeting evolves into a constructive legal interaction facilitated by electronic systems.[28] Second, electronic transactions are characterised by exceptional speed, with many transactions being completed within milliseconds or even microseconds. In such an environment, time becomes a critical legal factor, as even a brief technical delay can result in the loss of substantial commercial opportunities, particularly in electronic trading and financial markets. [29] Third, these transactions frequently transcend national borders, enabling parties from different jurisdictions to conclude agreements instantly through interconnected digital platforms. This cross-border nature introduces complex legal questions concerning applicable law, judicial jurisdiction, and the enforcement of compensation claims. Finally, electronic transactions depend entirely on technological infrastructure, including software applications, communication networks, cloud computing services, and cybersecurity systems. As a result, they are particularly vulnerable to technical failures, software defects, cyberattacks, data breaches, and network interruptions, all of which may directly deprive individuals or businesses of valuable economic opportunities. [30]

The diversity of electronic transactions further illustrates the broad scope of circumstances in which loss of opportunity may arise. Electronic commerce, encompassing both business-to-business (B2B) and business-to-consumer (B2C) transactions, is one of the most common forms of digital commercial activity, and technical failures or communication interruptions may prevent parties from

[26] 'UNCITRAL Model Law on Electronic Commerce (1996) with Additional Article 5 Bis as Adopted in 1998', United Nations Commission on International Trade Law, United Nations Commission on International Trade Law, accessed 22 May 2026, https://uncitral.un.org/en/texts/ecommerce/modellaw/electronic_commerce.

[27] Majed Alsarhan and Nader Alsarhan, 'The Scene of Electronic Fraud Crimes: A Comparative Study of Jordanian and Spanish Legislation', *Al-Biruni Journal of Humanities and Social Sciences*, 2 December 2025, 20, https://doi.org/10.64440/BIRUNI/BIR0010.

[28] A. Salama, *Electronic Transactions Law: A Comparative Study. , Cairo.* (Dar Al-Kitab Al-Qanuni, 2008).

[29] Zaripa Adanbekova et al., 'Features of an Electronic Transaction as Evidence in Court', *Law, State and Telecommunications Review* 14, no. 1 (2022): 98–112, https://doi.org/10.26512/lstr.v14i1.40374.

[30] Ezza Ali Mohammed Alhassan, 'Protection of Trademark Owners from Domain Name Registrants', *Majallat al-Huquq* 48, no. 4 (2024): 32–32, https://doi.org/10.34120/jol.v48i4.3361.

completing profitable transactions. Similarly, electronic contracts—including clickwrap agreements, browse-wrap agreements, and digitally executed licensing arrangements—create situations in which a party may lose a valuable contractual opportunity due to a technical malfunction that prevents timely acceptance of a legally binding offer.[31] In addition, digital governmental and financial services have become increasingly significant within the modern digital economy. Electronic procurement systems, online public tenders, internet banking platforms, digital payment services, and electronic securities trading all involve strict procedural requirements and time-sensitive operations.[32] Any disruption affecting these systems may deprive participants of substantial economic advantages or commercial opportunities, making this sector one of the most prominent areas in which claims for compensation based on loss of opportunity are likely to arise.

Civil Liability, Proof, and Assessment of Compensation for Loss of Opportunity in Electronic Transactions

The application of the doctrine of loss of opportunity in electronic transactions cannot be separated from the broader framework of civil liability governing digital legal relationships. As electronic commerce, online banking, digital platforms, and automated contractual systems continue to expand, civil liability increasingly serves as the principal legal mechanism for protecting parties who suffer economic losses caused by technological failures. Depending on the nature of the legal relationship, liability may arise either from breach of contract or from tortious conduct. Contractual liability arises when a party fails to perform obligations under an electronic agreement, particularly when internet service providers, digital marketplace operators, payment service providers, or financial institutions undertake contractual obligations to ensure the availability, reliability, security, and continuity of electronic services. The contractual relationship established through electronic service agreements imposes duties that extend beyond mere contract formation, requiring providers to maintain functional digital infrastructure capable of supporting secure, uninterrupted transactions. Consequently, where a trading platform promises immediate execution of financial transactions but a system malfunction delays execution, causing a trader to lose the opportunity to sell securities before a significant market decline,

[31] Khando et al., 'The Emerging Technologies of Digital Payments and Associated Challenges'.

[32] Mahmood Shaker Alaloosh et al., *Securing Digital Trade: A Techno-Legal Analysis of E-Commerce Safeguards in Iraq's Regulation No. 4/2025*, n.d., https://doi.org/10.5281/zenodo.18452737.

liability may arise for breaching contractual obligations relating to service quality and timely performance.[33]

Civil liability in electronic transactions, however, is not confined to contractual relationships. Tortious liability applies whenever digital harm is caused independently of any contractual relationship between the parties. This situation frequently occurs in cyberspace, where cyberattacks, distributed denial-of-service (DDoS) attacks, malicious software, unauthorised system intrusions, software defects, or negligent technological practices interfere with commercial activities and deprive individuals or businesses of valuable economic opportunities. A cyberattack turning off the servers of an electronic marketplace during peak commercial periods may prevent merchants from receiving customer orders, while defective software distributed by a third party may disrupt automated trading systems or destroy investment data, without any contractual relationship between the software developer and the injured party. In these circumstances, liability is established according to the traditional principles of fault, damage, and causation, thereby demonstrating that conventional civil liability doctrines remain applicable in digital environments despite their technological complexity.[34]

The establishment of liability for loss of opportunity nevertheless requires careful examination of each constituent element, all of which acquire distinctive characteristics in electronic transactions. The first requirement concerns an electronic fault, which may arise from both human negligence and technological malfunction. Human error may include inadequate cybersecurity management, failure to install security updates, weak authentication procedures, careless data management, or improper system administration, all of which expose digital infrastructure to unauthorised access or operational failure. Faults may also originate from software defects, programming errors, overloaded servers, communication network interruptions, or processing delays that prevent electronic systems from functioning as intended. Although providers often characterise such incidents as unavoidable technical failures, contemporary legal doctrine increasingly considers technological risks to be foreseeable consequences of operating digital services. Consequently, operators of electronic platforms are expected to anticipate these risks through appropriate technological safeguards, making failure to implement adequate preventive measures a legally actionable form of fault. This approach is particularly

[33] Veronica Tuturoong and Musleh Herry, 'The Legal Protection of Clickwrap Agreement In The Electronic Contract of Electronic Commerce Transactions', *Jurisdictie: Jurnal Hukum dan Syariah* 12, no. 2 (2021): 190–210, https://doi.org/10.18860/j.v12i2.12546.

[34] Dararida Fandra Mahira et al., 'Strengthening Multistakeholder Integrated through Shared Responsibility in the Face of Cyber Attacks Threat', *Lex Scientia Law Review* 4, no. 1 (2020): 1, https://doi.org/10.15294/lesrev.v4i1.38191.

important in electronic financial markets, where even milliseconds of processing delay may determine whether valuable commercial opportunities are successfully realised or permanently lost.

The second essential element concerns the existence of legally recognisable damage. Unlike conventional contractual claims, the damage in cases involving loss of opportunity is not the unrealised economic benefit itself but the deprivation of a genuine opportunity to obtain that benefit. Comparative jurisprudence consistently recognises that an opportunity possesses independent legal and economic value capable of compensation, provided that certain conditions are satisfied. The opportunity must be real and supported by objective evidence, rather than a purely speculative expectation. For example, an individual claiming compensation for losing the opportunity to participate in an electronic procurement process must establish that all registration requirements were met, that the individual possessed the financial and technical qualifications required to participate, and that the opportunity would likely have remained available absent the electronic fault. Furthermore, the deprivation must directly result from the defendant's conduct and must affect the claimant's own legally protected financial interests rather than hypothetical future expectations.[35]

Among the traditional elements of civil liability, causation presents the greatest challenge in electronic litigation because digital transactions typically involve numerous interconnected technological actors. A single electronic transaction may depend on the performance of internet service providers, cloud computing services, payment gateways, software developers, financial institutions, hosting companies, and cybersecurity infrastructure. Determining which technical malfunction actually caused the loss of opportunity, therefore, requires far more sophisticated analysis than conventional contractual disputes. Defendants frequently attempt to deny liability by invoking force majeure or foreign causes, including international network disruptions, unexpected cyberattacks, or failures in third-party technological infrastructure. Nevertheless, judicial practice increasingly adopts a restrictive approach toward such defences, recognising that many technological failures have become foreseeable operational risks which digital service providers are expected to anticipate and manage through appropriate technical measures.[36]

The complexity of electronic transactions also fundamentally transforms the rules governing proof. Unlike traditional litigation, which relies heavily on

[35] 'The Analysis of Financial Network Transaction Risk Control Based on Blockchain and Edge Computing Technology', accessed 22 May 2026, https://ieeexplore.ieee.org/abstract/document/10432773.

[36] Philipp Hacker, 'The European AI Liability Directives – Critique of a Half-Hearted Approach and Lessons for the Future', *Computer Law & Security Review* 51 (November 2023): 105871, https://doi.org/10.1016/j.clsr.2023.105871.

physical documents and written instruments, disputes involving electronic transactions depend almost entirely on digital evidence. Server logs, timestamp records, electronic correspondence, instant messaging records, electronic signatures, blockchain records, transaction histories, and authenticated digital screenshots collectively constitute the principal evidentiary foundation for establishing fault, causation, and the occurrence of lost opportunities. Contemporary electronic transaction legislation generally grants these forms of digital evidence legal validity equivalent to that of traditional documentary evidence, provided they satisfy statutory requirements regarding authenticity, integrity, reliability, and protection against unauthorised alteration. Their evidentiary significance has increased substantially because electronic systems automatically record every stage of digital transactions with precise chronological accuracy, allowing courts to reconstruct the sequence of events leading to the alleged loss.[37]

The probative value of digital evidence depends not only upon the information it contains but also upon the reliability of the technological system that generated and preserved it. Consequently, electronic evidence must originate from secure systems that ensure data integrity throughout the litigation process. Several jurisdictions, including Egypt, the United Arab Emirates, and Saudi Arabia, have enacted comprehensive electronic transaction legislation prescribing detailed technical standards governing the admissibility of electronic records and electronic signatures. Among the various forms of digital evidence, timestamp records occupy a particularly significant position because they establish the exact chronological relationship between system failure and the disappearance of the economic opportunity, enabling courts to determine whether the alleged electronic fault directly caused the claimant's loss.

Given the highly technical character of electronic systems, digital forensic experts have become indispensable participants in litigation concerning loss of opportunity. Judges generally lack the specialised expertise necessary to determine whether software defects, cybersecurity incidents, communication failures, or network disruptions directly caused the claimant's inability to obtain an anticipated commercial benefit. Digital forensic experts therefore examine electronic footprints, reconstruct transaction histories, identify technical failures, evaluate system performance, and determine whether the electronic infrastructure was functioning properly at the relevant time. Their technical findings assist courts in distinguishing losses genuinely attributable to electronic fault from losses caused by independent economic or commercial circumstances.

[37] Mahmood Alaloosh et al., 'Adapting Iraqi Law to Smart Contracts: A Comparative Analysis Incorporating Islamic Law Principles and Consumer Protection in the Contemporary Digital Era', *MILRev: Metro Islamic Law Review* 5, no. 1 (2026): 210–246, https://doi.org/10.32332/milrev.v5i1.13031.

In many instances, expert reports provide the principal evidentiary basis upon which judicial decisions concerning liability and compensation ultimately depend.

Once liability has been established, courts face the equally complex task of assessing appropriate compensation. The doctrine of loss of opportunity differs fundamentally from ordinary compensation because the claimant cannot recover the entire value of the anticipated benefit, which by definition remained uncertain. Conversely, denying compensation altogether would disregard the independent legal value of the lost opportunity itself. Comparative jurisprudence, therefore, adopts an intermediate approach by awarding compensation proportionate to the probability that the opportunity would have produced the expected benefit had the wrongful conduct not occurred. This probabilistic method has become particularly significant within electronic commerce, digital financial services, blockchain-based transactions, and smart contracts, where programming errors, software vulnerabilities, and technical failures frequently prevent contractual obligations from being properly executed.

Judicial assessment of compensation generally relies on the predominant probability standard, under which damages are calculated based on the likelihood that the anticipated opportunity would have been successfully realised. The closer the probability approaches certainty, the greater the proportion of compensation awarded. In electronic securities trading, for example, if a technical malfunction prevents an investor from selling shares immediately before a substantial market decline, courts may evaluate prevailing market conditions, historical trading patterns, and financial data to estimate the probability that the transaction would have been completed successfully in the absence of the system failure. Compensation is then awarded according to that probability rather than for the entire unrealised financial gain, thereby preserving proportionality between the interests of the injured party and the broader objectives of civil liability.[38]

Although probability is the primary criterion for assessing damages, courts retain broad discretion in determining the final amount of compensation. Comparative jurisprudence consistently maintains that compensation must reflect the value of the lost opportunity rather than the value of the unrealised benefit itself. Accordingly, judges are required to provide clear legal reasoning demonstrating how they evaluated the seriousness and economic significance of the lost opportunity. In exercising this discretion, courts increasingly rely on financial analysts, economists, actuaries, information technology specialists, and digital forensic experts capable of translating probabilistic opportunities into objective monetary values through financial modelling, simulation techniques,

[38] Ziyad bin Suwailm bin Mohammed Al-Olouni, 'The Validity of Electronic Documents, Electronic Signatures and Electronic Correspondence in Proof in Light of Islamic Jurisprudence and Saudi Judiciary A Compa', *Journal of Contemporary Islamic Studies and Arts*, ahead of print, 1 December 2024, https://doi.org/10.21608/jcia.2024.416273.

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and the technical reconstruction of digital events. These expert assessments enable courts to isolate the effects of electronic fault while excluding unrelated market fluctuations or external economic factors that may have influenced the claimant's financial position.[39]

The remedies available for loss of opportunity in electronic transactions likewise reflect the flexibility of modern civil liability. Monetary compensation remains the primary remedy because it provides financial redress for both the economic value of the lost opportunity and the non-economic harms associated with frustration or disappointment. In cross-border electronic commerce, courts must also consider issues related to transaction currency, exchange rate fluctuations, and international payment mechanisms when calculating damages. Nevertheless, monetary compensation is not always the most appropriate remedy. In certain circumstances, particularly those involving electronic public procurement or administrative digital systems, specific performance may restore the opportunity itself.[40] For example, where a qualified participant is prevented from submitting an electronic tender due to a proven system malfunction, a court may annul the procurement process and order a new tender, thereby restoring the claimant's opportunity to compete. Finally, many electronic service agreements and Service Level Agreements (SLAs) include contractual penalty clauses that establish predetermined compensation for service interruptions or system failures. Although such clauses are generally enforceable, courts retain the authority to modify them where they are manifestly excessive, grossly inadequate, or intended to exclude liability for fraud or gross negligence. Through this integrated framework of liability, proof, and compensation, the doctrine of loss of opportunity provides an effective legal mechanism for addressing emerging forms of economic harm within increasingly sophisticated digital environments while preserving the fundamental principles of fairness, proportionality, and legal certainty.

Judicial Applications of Loss of Opportunity in Electronic Transactions

Judicial practice demonstrates that the doctrine of loss of opportunity has become increasingly relevant in resolving disputes arising from electronic transactions, particularly where technological failures deprive individuals or businesses of genuine economic opportunities. One of the most common applications concerns electronic consumer transactions involving time-sensitive promotional offers. A typical case arises when a consumer successfully selects a

[39] Shatha Ismaeel et al., 'Evidentiary Challenges in AI-Mediated E-Commerce Disputes: Comparative Perspectives from the EU, US, GCC, and Islamic Law', *Justicia Islamica* 23, no. 1 (2026): 85–118, https://doi.org/10.21154/justicia.v23i1.11809.

[40] Enas Mohammed Alqodsi et al., 'The Role of Judicial Discretion in Commercial Disputes: Penalty Clause Issues', *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction* 16, no. 2 (2024): 04523062, https://doi.org/10.1061/JLADAH.LADR-1081.

discounted airline ticket or another promotional product and proceeds to the final payment stage, only for the transaction to fail due to a technical malfunction in the electronic payment gateway, banking system, or online platform. When the consumer attempts to complete the transaction again, the promotional period has expired, and the original price has substantially increased. In such circumstances, courts generally characterise the legal injury not as the loss of the contract itself but as the loss of the opportunity to conclude the transaction under the favourable promotional conditions.[41] Where the claimant can demonstrate that the technical failure was attributable to the service provider and that they possessed both the intention and financial capacity to complete the purchase, courts may award compensation corresponding to the economic value of the lost opportunity, commonly measured by the difference between the promotional price and the regular market price.

The doctrine has become even more significant in disputes involving electronic commerce, online financial markets, and digital investment platforms, where commercial opportunities are highly sensitive to timing and market fluctuations. Transactions involving foreign exchange (Forex), securities trading, cryptocurrencies, and other digital financial instruments often depend upon the immediate execution of electronically transmitted orders. Consequently, even minimal delays caused by software defects, network interruptions, or platform failures may prevent investors from executing stop-loss orders or profit-taking transactions at the intended moment, resulting in substantial financial losses. In adjudicating such disputes, courts undertake a detailed examination of electronic transaction records, server logs, and timestamp data to determine whether the trading platform failed to execute the order as instructed. Once the technical malfunction is established, judicial assessment focuses not on the unrealised profit itself but on the value of the opportunity that the investor lost to secure profits or minimise foreseeable losses. Compensation is therefore calculated in proportion to the probability that the transaction would have been completed had the electronic system functioned properly, thereby preserving the principle that damages should correspond to the value of the lost opportunity rather than the entirety of the expected financial gain.

Another important judicial application concerns participation in electronic tenders, public procurement systems, and online auctions, where opportunities are often announced within extremely short periods. In these environments, technical failures such as network latency, server interruptions, or platform malfunctions may prevent participants from submitting bids during the final moments before the bidding process closes. As a result, the affected party loses the opportunity to acquire valuable assets, secure government contracts, or win

[41] A. Obaid, 'Compensation for Loss of Opportunity in Electronic Contracts.', *Journal of Law and Technology*, 2015.

competitive procurement processes. The principal legal challenge in such cases lies in proving that the claimant would probably have succeeded had the technical failure not occurred, since the possibility always exists that another participant might have submitted a superior bid. Accordingly, courts generally require claimants to establish the seriousness of the lost opportunity by demonstrating their financial capability, legal eligibility, readiness to participate, and the competitiveness of their intended bid.[42] Where the available electronic evidence indicates that the claimant was in a favourable position to win the auction or procurement process immediately before the technical failure occurred, courts may recognise the loss of opportunity as an independent compensable injury and award damages proportionate to either the economic value of the transaction or the expected commercial profit that the claimant had a realistic probability of obtaining. These judicial developments illustrate the growing willingness of courts to adapt traditional principles of civil liability to technologically complex commercial environments while maintaining an appropriate balance between effective legal protection and the avoidance of speculative compensation.

Table 3. Liability, Proof, Compensation, and Judicial Application in Electronic Transactions

Legal Stage	Legal Element	Digital Application	Evidentiary / Judicial Standard
Civil Liability Type	Contractual liability	Failure of ISP/platform to ensure execution or system stability	Breach of service agreement or SLA
Civil Liability Type	Tortious liability	Cyberattacks, malware, and software defects	General duty not to cause harm
Fault	Human error, system failure, latency	Negligence in cybersecurity, bugs, and overload	Presumed fault in technical malfunction cases
Damage	Loss of opportunity itself	Lost trading, bidding, or contractual chance	Must be real, serious, and personal
Causation	Direct link between fault and loss	Platform crash, delay, or outage	Proven via technical and forensic analysis
Proof Methods	Digital evidence	Logs, emails, blockchain, timestamps, screenshots	Must be secure, authentic, and tamper-proof
Expert Role	Digital forensic analysis	Tracing failure and responsibility	Expert reports are often decisive for judges

[42] Christina Ramberg, *Internet Marketplaces: The Law of Auctions and Exchanges Online* (2002), https://doi.org/https://doi.org/10.1093/oso/9780199254293.001.0001.

Compensation Standard	Probability-based valuation	e.g., 90% chance = 90% compensation	Courts apply proportional economic logic
Forms of Compensation	Monetary, specific performance, and penalty clauses	Financial reparation or re-tendering	SLA clauses are valid unless excessive
Judicial Applications	Trading, e-commerce, auctions	Failed bookings, trading losses, and bid interruptions	Compensation based on lost opportunity value

Source: Prepared by the authors

CONCLUSION

This study concludes that the doctrine of compensation for loss of opportunity provides an appropriate legal framework for addressing the increasingly complex forms of harm arising from electronic transactions in the contemporary digital economy. The findings demonstrate that the loss of opportunity should be recognised as an independent and compensable form of damage whenever a genuine and substantial probability of obtaining a benefit or avoiding a loss is interrupted by an electronically attributable fault. A comparative analysis further reveals that modern civil liability no longer requires certainty of the realisation of the expected benefit; instead, compensation is determined by the objective value of the lost opportunity itself. This approach maintains an equitable balance between protecting injured parties and preventing excessive or speculative liability. The study also confirms that digital evidence—including electronic records, server logs, timestamps, blockchain data, and digital forensic analysis—plays a decisive role in establishing fault and causation and in quantifying damages. These developments illustrate the continuing evolution of comparative civil liability law in adapting traditional legal doctrines to the realities of technologically sophisticated electronic transactions while strengthening legal certainty and confidence in digital commerce.

Despite these contributions, the study recognises several limitations, particularly the limited availability of judicial precedents on loss of opportunity in electronic transactions across many Arab jurisdictions and the ongoing disparity among national legal frameworks governing digital liability. Moreover, the rapid evolution of emerging technologies often outpaces legislative reform, creating new legal challenges that remain insufficiently addressed by existing civil liability doctrines. Future research should therefore examine judicial applications involving blockchain-based transactions, artificial intelligence-driven contracts, smart contracts, decentralised digital platforms, and other emerging technologies that increasingly shape electronic commerce. Further comparative studies are also needed to develop harmonised legal standards governing electronic liability, digital evidence, and compensation for loss of opportunity, thereby promoting greater legal consistency, enhancing cross-border legal protection, and reinforcing public trust in the expanding digital economy.

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AUTHOR CONTRIBUTIONS STATEMENT

Ibrahem Ali Hammadi conceptualised the study, developed the research framework, supervised the research process, and contributed to manuscript review and final approval. Salman Ali Humadi was responsible for the research methodology, formal analysis, data interpretation, and drafting the initial manuscript. Husham Hamed contributed to data collection, investigation, literature review, and validation of the research findings. Sameer Aboud Farhan participated in data curation, visualisation, manuscript editing, and critical revision for important intellectual content. Kamil Sulaiman contributed to project administration, resource management, quality assurance, and final manuscript review. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

AI USAGE STATEMENT

The authors declare that artificial intelligence (AI)-assisted tools were used solely to improve the readability, grammar, language quality, and overall clarity of the manuscript during the writing process. No AI system was used to generate the research ideas, study design, data collection, data analysis, interpretation of findings, or scientific conclusions presented in this article. The authors carefully reviewed, edited, and verified all AI-assisted outputs and take full responsibility for the accuracy, originality, integrity, and content of the manuscript.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests, personal relationships, institutional affiliations, or other conflicts of interest that could have appeared to influence the work reported in this manuscript. All authors confirm that the research was conducted objectively, independently, and in accordance with accepted standards of academic integrity and ethical research practice.

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