



CADERNOS DE DEREITO ACTUAL

www.cadernosdedereitoactuales.es

© **Cadernos de Derecho Actual** Nº 33. Núm. Ordinario (2026), pp. 210-239

·ISSN 2340-860X - ·ISSNe 2386-5229

The evolution of contract law in the context of the digitalization of social relationships

Hanna Potapchuk^{1,*}

Institute of Legislation of the Verkhovna Rada of Ukraine

Yuliia Rud²

Kyiv National Economic University named after Vadym Hetman

Iurii Rega³

Institute of Humanities, National Academy of Security Service of Ukraine

Valentyna Medzhbel⁴

Interregional Academy of Personal Management

Nataliia Petrova⁵

Sumy National Agrarian University

Summary: 1. Intruduction. 2. Literature review. 3. Research objectives. 4. Materials and methods. 5. Results. 6. Discussion. 7. Conclusions. 8. References.

Abstract: The significance of this study lies in the rapid digitization of social relations, which is transforming traditional approaches to concluding, enforcing, and terminating contracts, and shaping new models of economic interaction in the digital environment. The expansion of e-commerce, digital platforms, electronic identification, and blockchain technologies necessitates a reconsideration of classical

¹ Candidate of Law Sciences, Doctoral Candidate, Attorney, Institute of Legislation of the Verkhovna Rada of Ukraine, Kyiv, Ukraine. ORCID: <https://orcid.org/0000-0002-7963-035X>. Email: anna.nakonechna@ujis.in.ua (Corresponding author).

² PhD, Docent, Professor, Department of Theoretical Jurisprudence, Kyiv National Economic University named after Vadym Hetman, Kyiv, Ukraine. ORCID: <https://orcid.org/0000-0001-7530-3151>

³ PhD, Director, Institute of Humanities, National Academy of Security Service of Ukraine, Kyiv, Ukraine. ORCID: <https://orcid.org/0000-0001-5838-7488>

⁴ PhD in International Law, Associate Professor, Associate Professor of the Department of Civil Law and International Law, Interregional Academy of Personal Management, Kyiv, Ukraine. ORCID: <https://orcid.org/0000-0001-8458-5808>

⁵ PhD in Law, Associate Professor, Associate Professor of Administrative and Information Law Chair, Law Faculty, Sumy National Agrarian University, Sumy, Ukraine. ORCID: <https://orcid.org/0000-0003-4242-2212>

legal constructs of contract law, originally developed within paper-based systems and geographically limited legal frameworks. In the digital economy, ensuring legal certainty of electronic transactions, protecting the rights of participants, and harmonizing national regulations with international standards become essential. The purpose of this study is to conduct a comparative doctrinal analysis of how international, European Union and Ukrainian legal frameworks regulate selected dimensions of digital contracting, namely electronic consent, digital identification, evidentiary mechanisms, automated contractual performance and algorithmic liability. The study does not seek to provide an exhaustive theory of the evolution of contract law as a whole. Instead, it focuses on a limited set of legal instruments and analytical criteria in order to identify regulatory convergences, gaps and directions for further legal development. It examines legal mechanisms governing electronic and smart contracts, as well as digital expressions of intent. The findings indicate that digitalization does not eliminate core principles of contract law but transforms their implementation through integration with digital infrastructures, enhancing legal efficiency and regulatory adaptability.

Keywords: Contract Law, Digitization, Electronic Contract, Smart Contract, e-Commerce, Digital Identification, Blockchain, Digital Economy, Legal Regulation

1. Introduction

This study examines selected legal dimensions of digital contracting within international, European Union and Ukrainian legal frameworks. The analysis focuses on five interrelated issues: electronic consent, digital identification, evidentiary value of electronic records, automated contractual performance and algorithmic liability. These dimensions are used as an analytical framework for comparing the degree to which different legal systems respond to the challenges of digital contractual relations. Rather than treating these elements in isolation, the article examines their combined effect in the development of an integrated regulatory framework for digital contract transactions.

As a rule, classical contract law has always been marked by freedom of contract and equality of parties as well as autonomy of will and the written form requirement. But the digital world is also changing the way in which we express our will, determine who the parties are and prove legally significant acts. The development of electronic signature, automated contracting mechanisms, online platforms and digital trading platforms raises new issues about the legal certainty, documentary evidence, protection of personal data and liability of parties. These developments call for the formation of a modern doctrinal framework in contract law that draws upon both classical civil law concepts and technological advances.

Existing studies have extensively examined smart contracts, blockchain-based transactions, electronic signatures and digital platforms. However, the current literature remains fragmented and lacks an integrated doctrinal analysis of how key legal elements — such as electronic consent, digital identification, evidentiary value, automated performance and algorithmic liability — interact within a unified model of digital contract law. Moreover, many studies focus either on technological aspects or on isolated legal issues, without addressing their systemic interdependence within cross-border digital environments. This article seeks to address this gap by developing a comprehensive legal framework that integrates international, European Union and Ukrainian legal instruments in order to assess the transformation of contract law in the digital economy.

This issue is particularly important in the context of the globalization of economic processes and the development of cross-border digital legal relationships, where contracts are concluded between entities located in different jurisdictions, and obligations are fulfilled in a digital environment, without the physical presence of the

parties. Therefore, harmonizing national regulations with international standards, improving electronic identification mechanisms, regulating digital assets, and defining the legal status of automated transactions is crucial. Academic motivation for studying the development of contract law also arises from the need to maintain balance between the progressive development of the economy of the digital space and the reasonable level of legal protection of the subjects of civil turnover. Under conditions of rapid technogenesis the law must not only be reactive to emerging phenomena, but also proactive in creating legal and other mechanisms that would prevent legal risks associated with cyberthreats, asymmetry of information and increasingly automated decision-making.

Therefore, the study of the development of contract law in the digitalization of social relations is important for the formation of a new legal paradigm enabling the efficient operation of contract in the digital economy, bringing an increase of legal certainty in a time of technological change, with positive effects for both the theoretical and practical side of the law.

The scientific contribution of this study lies in the development of a comparative analytical framework for assessing selected aspects of digital contracting regulation. The proposed framework is based on five criteria: electronic consent, digital identification, evidentiary mechanisms, automated contractual performance and algorithmic liability. This approach allows the study to identify regulatory similarities, differences and gaps within international, European Union and Ukrainian legal instruments without claiming to provide a comprehensive theory of digital contract law as a whole.

Existing legal scholarship primarily focuses either on isolated technological aspects of digital contracting or on separate regulatory instruments. However, insufficient attention has been paid to the systemic interaction between electronic consent, algorithmic execution, digital identification and liability allocation within a unified model of digital contractual regulation. The proposed model differs from traditional approaches by treating digital contracts not merely as electronic versions of classical agreements but as technologically integrated legal relationships operating through hybrid legal and algorithmic governance mechanisms.

This study proposes an integrated doctrinal model of digital contract law based on five analytical criteria: electronic consent, digital identification, evidentiary value of electronic records, automated contractual performance, and algorithmic liability. These criteria provide the methodological framework for the comparative analysis undertaken in this article.

2. Literature review

Over the past decades, digital technology development has radically altered the conception of contract law, resulting in a separate area dealing with the legal regulation of electronic dealings, digital identification, and the automated discharge of obligations. There are signs in the modern academic discourse of an evolving shift in the conception of contracts from the traditional notion as written legal documents to those as digital processes of interaction among parties, through specific information systems and online platforms. The ground for this approach was prepared in international law at the end of the 20th century in particular by the UNCITRAL Model Law on Electronic Commerce which introduced the principle of functional equivalence between electronic and paper documents,⁶ and the United Nations Convention on Contracts for the International Sale of Goods which contributed

⁶ UNCITRAL. *UNCITRAL Model Law on Electronic Commerce*. United Nations. 1996. Available at: https://uncitral.un.org/en/texts/ecommerce/modellaw/electronic_commerce (accessed on 26 August 2026).

towards the harmonization of contract law standards in international trade.⁷

The evolution of the legal framework for digital relationships finds expression in the European regulatory approach and more specifically the eIDAS Regulation, which grounded electronic identification and trust services as pan-European digital economy infrastructure.⁸ The European Digital Strategy further acknowledges the legal harmonization of digital services as a means to the end of establishing a digital single market and for trust in electronic transactions.^{9,10} In this regard, inter-governmental bodies have emphasized that e-commerce and digital platforms are reshaping economic relations, and that the legal framework must evolve accordingly.¹¹ In addition to the above-mentioned instruments, recent legal developments significantly affect the regulation of digital contractual relations. The United Nations Convention on the Use of Electronic Communications in International Contracts (2005) further clarifies the legal recognition of electronic communications in cross-border transactions. The UNCITRAL Model Law on Electronic Transferable Records (2017) expands the legal framework for digital trade by enabling the use of electronic transferable documents.

The legal effects of these international instruments go further than simply the acknowledgement of electronic communications. The United Nations Convention on the Use of Electronic Communications in International Contracts (2005) makes explicit the application of the formation of e-consent in international contract relations by stating the legal effect of the electronic communications sent and received by the contracting parties located in different jurisdictions. In the same vein, the UNCITRAL Model Law on Electronic Transferable Records promotes the modernization of means of proof by providing legal certainty for electronic transferable documents, facilitating digital trade and enhancing the trustworthiness of electronic evidence in international commercial transactions.

At the European Union level, Regulation (EU) 2024/1183 on European Digital Identity introduces a unified digital identity framework, strengthening trust in electronic identification and authentication. Furthermore, Regulation (EU) 2024/1689 on Artificial Intelligence (AI Act) establishes legal requirements for automated decision-making systems, which are directly relevant to algorithmic contracting and liability. The EU Data Act also contains provisions related to smart contracts, particularly regarding their design, accessibility and termination, thereby influencing the legal architecture of automated contractual relationships.

These most recent rules are a combined response to individual non-regulatory challenges under digital contractual interactions. The Regulation (EU) 2024/1183 reinforces the legal basis for the identification and authentication of the parties to a contract using interoperable digital identity solutions. The AI Act also addresses the regulatory challenge of automated decision-making, thereby directly affecting questions of algorithmic liability. The Data Act adds another layer to the legal

⁷ UNITED NATIONS. *United Nations Convention on Contracts for the International Sale of Goods (CISG)*. 1980. Available at: https://uncitral.un.org/en/texts/salegoods/conventions/sale_of_goods/cisg (accessed on 25 August 2026).

⁸ EUROPEAN PARLIAMENT AND COUNCIL. *Regulation (EU) No 910/2014 on Electronic Identification and Trust Services for Electronic Transactions in the Internal Market (eIDAS)*. 2014. Available at: <https://eur-lex.europa.eu/eli/reg/2014/910/oj> (accessed on 25 August 2026).

⁹ EUROPEAN COMMISSION. *eIDAS Regulation*. 2022. Available at: <https://digital-strategy.ec.europa.eu/en/policies/eidas-regulation> (accessed on 28 August 2026).

¹⁰ EUROPEAN COMMISSION. *Shaping Europe's digital future*. 2020. Available at: https://commission.europa.eu/system/files/2020-02/communication-shaping-europes-digital-future-feb2020_en_4.pdf (accessed on 29 August 2026).

¹¹ UNCTAD. *Digital Economy Report 2021*. United Nations. 2021. Available at: https://unctad.org/system/files/official-document/der2021_en.pdf (accessed on 25 August 2026).

framework by dealing with the access to, use, interoperability and deletion of smart contracts embedded in data sharing schemes whereas the UNCITRAL Model Law on Automated Contracting deals with principles of law relating to the formation and execution of automated contracts in international e-commerce. Collectively, these instruments mark a slow evolution from a regulation of legally binding electronic transactions towards technologically integrated contractual ecosystems.

The UNCITRAL Model Law on Automated Contracting (2024) further contributes to the development of digital contract law by establishing legal principles governing automated contract formation and performance. The instrument recognizes the growing role of autonomous digital systems in commercial transactions and provides guidance concerning legal validity, attribution of automated actions and cross-border interoperability of automated contracting mechanisms.

The Ukrainian legal approach to digital contracts is largely the transposition of international standards. Ukrainian legislation in the areas of electronic document, e-commerce and electronic trust services has enabled the provision of a legal framework for electronic transactions, and has underpinned the establishment that an electronic signature is a legally accepted representation of the intentions of the signatories.^{12,13,14} At the same time, the electronic and traditional contract formal equivalence has been criticized for not taking into account the particularities of the digital environment, where many legal relations are executed autonomously and on digital platforms.

International legal instruments, particularly the UNCITRAL Model Law on Electronic Commerce, establish the principle of functional equivalence between electronic and paper documents. In contrast, EU law develops this principle further through the eIDAS Regulation by introducing a harmonized framework for electronic identification and trust services across Member States. Ukrainian legislation generally follows these approaches; however, it remains more focused on formal legal recognition than on the regulation of automated digital environments and algorithmic contracting.

Studies on smart contracts occupy an idiosyncratic niche in the modern legal literature since they are conceived as an evolutionary step in the development of contract law. The idea of automated contracts was initially proposed by Szabo¹⁵ who described a smart contract as a piece of software which secures the contract execution in a networked environment. Later on, research has further developed this concept by revealing that even obligations can be algorithmically enforced, which in turn, leads to lower transaction costs and higher efficiency of economic interactions.¹⁶ Raskin¹⁷ highlights that smart contracts can function as legally binding agreements

¹² VERKHOVNA RADA OF UKRAINE. *Law of Ukraine "On Electronic Documents and Electronic Document Flow" No. 851-IV*, Kyiv, 2003. <https://zakon.rada.gov.ua/laws/show/851-15> (accessed on 30 August 2026).

¹³ VERKHOVNA RADA OF UKRAINE. *Law of Ukraine "On Electronic Commerce" No. 675-VIII*. 2015. Available at: <https://zakon.rada.gov.ua/laws/show/675-19> (accessed on 30 August 2026).

¹⁴ VERKHOVNA RADA OF UKRAINE. *Law of Ukraine "On Electronic Trust Services" No. 2155-VIII*. 2017. Available at: <https://zakon.rada.gov.ua/laws/show/2155-19> (accessed on 30 August 2026).

¹⁵ SZABO, N. "Formalizing and securing relationships on public networks". *First Monday*, v. 2, n. 9. 1997. <https://doi.org/10.5210/fm.v2i9.548>

¹⁶ CLACK, C. D., BAKSHI, V. A., and BRAINE, L. "Smart contract templates: Foundations, design landscape and research directions". arXiv. 2016. <https://doi.org/10.48550/arXiv.1608.00771>

¹⁷ RASKIN, M. "The law and legality of smart contracts". *Georgetown Law Technology Review*, v. 1, n. 2, 2017, pp. 305-341. <http://dx.doi.org/10.2139/ssrn.2842258>

when integrated into a legal system. Whereas Savelyev¹⁸ treats them as a transformative instrument in classical contract model.

However, further inquiry is essential. Mik¹⁹ also analyzes the technical barriers of smart contracts and the challenges posed by their use in legal relations characterized by a high level of uncertainty, while Sklaroff²⁰ discusses the potential for excessive rigidity in automated contracting, which could hinder adaptation to changing circumstances. The same stance is held with regard to De Caria²¹ and Luesley,²² who specifically consider problems concerning the termination and variation of digital contracts where there has been a mistake or a change of will between the parties.

There is a strong wave of scholarly attention in the interaction of the law and 'technology-based' or 'technology-influenced' regulation. Lessig²³ introduced the idea of "code as law", where program code can function as social regulation. This notion was elaborated upon by De Filippi and Wright²⁴ to illustrate that blockchain technologies establish a novel trust model grounded on decentralized verification mechanisms. In the context of the wider literature on the legal governance of technology, law is conceptualised as a component of a multi-layered system of digitally mediated process governance comprising regulatory, technical, and ethical tools.²⁵

Another strand of research studies the standardization of digital contractual relations and the evolution in parties' expressions of intent. Radin²⁶ observes an increasing standardization of contract terms on digital platforms, reducing the space for the negotiation of transactions. Reijers et al.²⁷ study governance structures for blockchains, highlighting the requirement for both technical and institutional governance. Von Wendland²⁸ underlines that 'smart contracts can only be legal if they satisfy the conventional rules of contract law.

¹⁸ SAVELYEV, A. "Contract law 2.0: Smart contracts as the beginning of the end of classic contract law". *Information & Communications Technology Law*, v. 26, n. 2, 2017, pp. 116-134. <https://doi.org/10.1080/13600834.2017.1301036>

¹⁹ MIK, E. "Smart contracts: Terminology, technical limitations and real world complexity". *Law, Innovation and Technology*, v. 9, n. 2, 2017, pp. 269-300. <https://doi.org/10.1080/17579961.2017.1378468>

²⁰ SKLAROFF, J. M. "Smart contracts and the cost of inflexibility". *University of Pennsylvania Law Review*, 166, 2017, pp. 263-303. Available at: <https://access.heinonline.com/HOL/LandingPage?handle=hein.journals/pnlr166&div=8&id=&page=> (accessed on 20 August 2026).

²¹ DE CARIA, R. "The legal meaning of smart contracts". *European Review of Private Law*, v. 26, n. 6, pp. 731-751. <https://doi.org/10.54648/ERPL2018052>

²² LUESLEY, A. "Unravelling smart contracts: Smart contracts and the law of rescission in Canada". *Asper Review of International Business and Trade Law*, v. 19, 2019, pp. 155-173. Available at: <https://journals.library.ualberta.ca/asperreview/index.php/asperreview/article/view/223> (accessed on 29 August 2026).

²³ LESSIG, L. *Code: Version 2.0*. New York: Basic Books. 2006. <https://archive.org/details/Code2.0> (accessed on 27 August 2026).

²⁴ DE FILIPPI, P., and WRIGHT, A. *Blockchain and the law: The rule of code*. Cambridge, MA: Harvard University Press. 2018. <https://doi.org/10.2307/j.ctv2867sp>

²⁵ BROWNSWORD, R., YEUNG, K., and SCOTFORD, E. *The Oxford Handbook of Law, Regulation and Technology*. Oxford: Oxford University Press. 2017. Available at: <https://academic.oup.com/edited-volume/27999> (accessed on 26 August 2026).

²⁶ RADIN, M. J. *Boilerplate: The Fine Print, Vanishing Rights, and the Rule of Law*. Princeton: Princeton University Press. 2017. https://www.researchgate.net/publication/282678188_Boilerplate_The_fine_print_vanishing_rights_and_the_rule_of_law (accessed on 27 August 2026).

²⁷ REIJERS, W., WUISMAN, I., MANNAN, M., DE FILIPPI, P., WRAY, C., and RAE-LOOI, V., et al. "Now the code runs itself: On-chain and off-chain governance of blockchain technologies". *Topoi*, v. 40, n. 4, 2021, pp. 821-831. <https://doi.org/10.1007/s11245-018-9626-5>

²⁸ VON WENDLAND, M. "Smart contracts that are smart and can function as legal contracts". arXiv. 2018. <https://doi.org/10.48550/arXiv.1805.01279>

Latest analysis indicates a rapid expansion of e-signature and digital contract usage in the global economy. Reports by Deloitte,²⁹ SkyQuest Technology Consulting,³⁰ and Exploding Topics³¹ show the dynamic growth of the market for electronic signatures and the conclusion of contracts, among other things, indicating a structural change in contract conclusion. This confirms the findings of international organizations that the digitization of the contractual relations is a major engine of global economic growth.³²

Recent legal scholarship demonstrates that the digitalization of contractual relations has evolved beyond the mere recognition of electronic transactions and now involves a systemic transformation of legal regulation mechanisms. In particular, contemporary studies emphasize that digital contracts should be analysed not only as legal instruments but also as technological infrastructures embedded in data-driven environments.

A significant body of recent research focuses on the increasing role of artificial intelligence in contractual relations. The adoption of the AI Act (Regulation (EU) 2024/1689) reflects a shift towards the formal regulation of algorithmic decision-making, which directly affects automated contract formation and performance. The AI Act significantly transforms the regulation of digital contractual relations by introducing legal requirements for algorithmic transparency, risk management and human oversight in AI-assisted decision-making systems. Scholars argue that the use of AI systems challenges traditional concepts of liability and requires the development of new legal models capable of addressing algorithmic errors and autonomous decision-making.^{33,34}

Another important research direction concerns digital identity and electronic trust services. The introduction of the European Digital Identity framework (Regulation (EU) 2024/1183) represents a fundamental step in ensuring legal certainty in electronic transactions by strengthening authentication mechanisms and cross-border recognition of digital identities. This development confirms the growing importance of reliable identification systems as a prerequisite for the validity and enforceability of digital contracts³⁵. The legal regulation of smart contracts has also been significantly influenced by recent legislative developments. The EU Data Act (Regulation (EU) 2023/2854) introduces specific requirements for the design and termination of smart contracts, particularly in data-sharing environments. This reflects a broader trend towards the integration of technological and legal norms in order to ensure both efficiency and legal protection in automated contractual relationships.

²⁹ DELOITTE. *E-signing: The Market Size and Vendor Landscape*. 2021. Available at: <https://www.deloitte.com/ch/en/services/consulting/blogs/e-signing-market-size-and-vendor-landscape.html> (accessed on 26 August 2026).

³⁰ SKYQUEST TECHNOLOGY CONSULTING. *Digital Signature Market Report*. 2024. Available at: <https://www.skyquestt.com/report/digital-signature-market> (accessed on 20 August 2026).

³¹ EXPLODING TOPICS. *Electronic signature statistics and trends*. 2023. Available at: <https://explodingtopics.com/blog/esignature-stats> (accessed on 22 August 2026).

³² UNCTAD. *Digital Economy Report 2021*. United Nations. 2021. Ibid.

³³ FLORIDI, L., COWLS, J., BELTRAMETTI, M., CHATILA, R., CHAZERAND, P., and DIGNUM, V., et al. "AI4People—An ethical framework for a good AI society: Opportunities, risks, principles, and recommendations". *Minds and Machines*, v. 28, n. 4, 2018, pp. 689-707. <https://doi.org/10.1007/s11023-018-9482-5>

³⁴ VEALE, M., and ZUIDERVEEN BORGESIU, F. "Demystifying the draft EU artificial intelligence act — Analysing the good, the bad, and the unclear elements of the proposed approach". *Computer Law & Security Review*, v. 22, n. 4, 2021, pp. 97-112. <https://doi.org/10.9785/crl-2021-220402>

³⁵ EUROPEAN COMMISSION. *Shaping Europe's digital future*. 2020. Available at: https://commission.europa.eu/system/files/2020-02/communication-shaping-europes-digital-future-feb2020_en_4.pdf (accessed on 29 August 2026).

In parallel, the issue of electronic evidence has gained increasing attention in recent literature. The transition from paper-based to digital documentation requires the adaptation of evidentiary standards, as electronic records, digital traces and platform-generated data become central elements in dispute resolution. Recent studies highlight the need to ensure the reliability, authenticity and admissibility of electronic evidence in civil proceedings. Consumer protection in digital contracting environments also remains a critical concern. The widespread use of click-wrap and platform-based contracts has led to a significant imbalance between contracting parties, limiting the real autonomy of users. Contemporary research suggests that legal systems must introduce additional safeguards, including transparency requirements, fairness control mechanisms and accessible dispute resolution procedures.

Overall, the literature indicates a transition from a traditional contract law paradigm to a hybrid legal-technological model. This model is characterized by the coexistence of legal norms and algorithmic systems, requiring new approaches to liability, regulation and enforcement in the digital economy.

A review of the literature shows several open questions for scholarly enquiry. First, none of the existing studies presents a cohesive conception of the interplay between automated contract execution and traditional legal control. Second, the question of liability for errors in algorithms or an autonomous digital system still needs to be explored. Third, at the level of national law, particularly in Ukraine, there is a hiatus between the formal legal recognition accorded to electronic transactions, and the practical means of facilitating them. This underscores the potential for further research into the formation of contract law as a multilayered legal-technological system that could mediate between supporting the innovative development of the digital economy and providing guarantees of legal certainty.

The comparative analysis of international, EU, and Ukrainian legal acts indicates that each level of regulation responds to the five analytical questions emerging from the methodology with varying level of legal detail. International instruments contain only general statements about the legal effect of electronic consent and the functional equivalence of electronic communications, whereas the European Union law also addresses institutional aspects concerning digital identity, evidentiary reliability and automated contractual mechanisms. Ukrainian law generally acknowledges electronic transactions and trust services but is less advanced in terms of algorithmic liability and autonomously contract execution. Therefore, the following analysis takes these five methodological principles as one conceptual lens through which to examine the development of digital contract law within national legal systems.

3. Research objectives

The purpose of this study is to conduct a comparative doctrinal analysis of selected legal dimensions of digital contracting in international, European Union and Ukrainian law. The study focuses on five analytical criteria: electronic consent, digital identification, evidentiary value of electronic records, automated contractual performance and algorithmic liability.

4. Materials and methods

This study is based on a doctrinal legal research method, which focuses on the analysis and interpretation of primary legal sources. The research examines international legal instruments, European Union regulations and Ukrainian legislation governing digital contractual relations.

This study is limited in scope. It does not examine all aspects of contract law digitalization, nor does it provide empirical generalizations about all types of digital contractual relations. Instead, it focuses on selected international, European Union

and Ukrainian legal instruments that are directly relevant to electronic consent, digital identification, electronic evidence, automated performance and algorithmic liability.

The sample of legal instruments was selected according to their relevance to the five analytical criteria of the study. International instruments were examined because they establish general principles for the recognition of electronic communications and automated contracting. European Union acts were analyzed because they provide a more detailed regulatory framework for digital identity, trust services, artificial intelligence and smart contracts. Ukrainian legislation was included in order to assess the extent to which national regulation corresponds to international and European approaches.

The analysis is structured around five key legal criteria: (1) the validity and formation of electronic consent, (2) the identification and authentication of contracting parties, (3) the evidentiary value of electronic records and signatures, (4) the legal implications of automated contract performance, including smart contracts, and (5) the allocation of liability for failures in digital and algorithmic systems.

A comparative legal approach is applied to identify similarities, differences and gaps between international, European Union and Ukrainian legal frameworks. This allows for a systematic assessment of how digital contract law evolves across different legal systems and how effectively these systems address the challenges of digitalization.

The research also incorporates elements of analytical and critical legal analysis in order to evaluate the adequacy of existing regulation and to identify areas requiring further legal development, particularly in relation to cross-border contracting, jurisdiction, algorithmic decision-making and consumer protection in digital environments.

The comparative analysis is conducted according to five analytical criteria:

The first analytical criterion examines how different legal systems recognise and regulate electronic consent as the foundation of digitally concluded contracts.

The second analytical criterion focuses on digital identification mechanisms, assessing their legal significance for authenticating contractual parties and ensuring legal certainty in electronic transactions.

The third analytical criterion evaluates the evidentiary value of electronic records and digital documents in international, European Union and Ukrainian contract law.

The fourth analytical criterion examines the legal implications of automated contractual performance, including smart contracts and algorithm-based execution mechanisms.

The fifth analytical criterion analyses the allocation of legal responsibility where contractual decisions or performance are influenced by artificial intelligence or automated systems.

The analytical criteria established in this study constitute the framework for the subsequent comparative legal analysis. Each stage of the Results and Discussion sections evaluates international, European Union and Ukrainian legal approaches according to the dimensions of electronic consent, digital identification, evidentiary value, automated contractual performance and algorithmic liability.

The study has several limitations. First, it is based on doctrinal and comparative legal analysis and does not include empirical interviews, case-law statistics or quantitative assessment of judicial practice. Second, the analysis is limited to selected international, European Union and Ukrainian legal instruments that are directly related to digital contracting. Third, the conclusions of the study should be understood within the boundaries of the five selected analytical criteria and should not be interpreted as comprehensive generalizations concerning the entire field of contract law. These limitations define the scope of the research and ensure that the conclusions remain proportionate to the evidence analyzed.

5. Results

Applying the five analytical criteria makes it possible to examine digital contract law as a coherent legal system rather than as a collection of isolated regulatory developments. The proposed integrated doctrinal model demonstrates how different legal instruments jointly regulate the essential legal components of digital contracting.

The development of the contract law is based on the modern social relations, economic relations and the way such relations are conducted in today's technology among the entities. Historically, a contract is a legal method for exercising autonomy of will of the parties, allowing for party autonomy in the exchange of commodities. The classical law of contracts is rooted in Roman private law and is founded on the principles of freedom of contract, *pacta sunt servanda*, and equality before the law. These principles have traditionally governed contractual relationships and continue to influence contemporary contract law.³⁶

The evolution of contract law has always followed and been dependent on developments in the economic environment. The era of industrialism was conducive to the homogenization of contracts and the rise of mass contract forms, so-called adhesion contracts. In this scope, scholars point out that the progressive complexification of economic activities entailed a dissolution of contracts' individualistic character and an increasing prominence of standard contract terms.³⁷ Concurrently, digitalization has emerged as one of the primary drivers of contemporary contractual transformation. In the development of contractual relationship which affects not only the manner of concluding contract but also the very substance of the legally manifested intention of the parties.

The digitalization of society has brought with it a new domain of interaction, in which contracts are increasingly formed without the physical presence of the contracting parties. The development of electronic documents and electronic commerce has made it necessary to provide legal recognition for electronic transactions. So, international legal instruments were the first to adapt to the challenges of electronic contracting to technological development with the adoption of the UNCITRAL Model Law on Electronic Commerce which introduced the principle of functional equivalence between electronic and paper documents.³⁸ These approaches were later adopted in the national legislation, particularly within the Ukrainian legal system, with the enactment of laws on electronic documents, e-commerce, and electronic trust services.³⁹

The literature on law highlights that digitalisation is modifying the classical concept of the moment of contract conclusion, with the expression of intent being issued by the pressing of a button on an electronic device, through automated processing of data or the application of algorithms. This context raises questions in terms of borders of parties autonomy, since some choices are actually delegated to IT systems. As Lessig⁴⁰ has argued, in the digital age software code assumes an increasingly regulatory function, shaping the conduct of those engaged in legal relations together with legal rules. This change in phase signifies a textual contract reflecting to a technologically mediated contract.

The following analysis examines how the eIDAS Regulation and related instruments affect the legal recognition of electronic consent. The eIDAS Regulation fundamentally changes the legal framework of digital contracting by establishing a harmonized system of electronic identification and trust services across the European

³⁶ DZERA, O. V. *Civil Law of Ukraine: General Part*. Kyiv: Yurinkom Inter. 2018.

³⁷ RADIN, M. J. *Boilerplate: The Fine Print, Vanishing Rights, and the Rule of Law*. 2017. Ibid.

³⁸ UNCITRAL. *UNCITRAL Model Law on Electronic Commerce*. United Nations. 1996. Ibid.

³⁹ VERKHOVNA RADA OF UKRAINE. *Law of Ukraine "On Electronic Documents and Electronic Document Flow" No. 851-IV. 2003*. Ibid.

⁴⁰ LESSIG, L. *Code: Version 2.0*. New York: Basic Books. 2006. Available at: <https://archive.org/details/Code2.0> (accessed on 27 August 2026).

Union. Unlike earlier approaches based primarily on formal recognition of electronic signatures, eIDAS creates an institutional infrastructure for cross-border digital authentication, thereby increasing legal certainty in electronic transactions.

The development of smart contracts represented an innovation in contract law. The concept of automatic contract enforcement was proposed by N. Szabo, who defined smart contracts as software protocols that enforce contracts without need for trusted intermediaries.⁴¹ Modern literature states that smart contracts are not substitutes for regular contracts but the way of their performance is altered in a way that enforcement is moved from the legal to the technological realm.⁴² This fusion of law and software “takes place”, introducing new challenges for contract law theory.

Scientists notice that smart contracts are highly automated contracts, however, their utilization is constrained due to the difficulty of transformation between legal categories and program language.⁴³ He observes real world contractual relations often contain concepts that carry value judgments that are not algorithmic and real world contractual relations often contain “close to ideal” contracts. For this reason, the digital transformation of contract law does not occur via the elimination of traditional models but through the integration of traditional models.

At the same time, the development of e-commerce has contributed to the globalization of contractual relations. Digital platforms allow parties to conclude contracts regardless of their geographical location, which raises issues related to conflicts of laws and jurisdictions. The United Nations Convention on Contracts for the International Sale of Goods has become one of the fundamental instruments for harmonizing international contractual relations, providing uniform rules for cross-border contracts.⁴⁴ Its importance is even greater in the digital environment, as e-commerce blurs traditional boundaries between legal systems.

Reform of the means of evidence is also under way. Electronic proof, electronic signatures and electronic means of identification are modifying the way of proving the conclusion of a contract. The principle of mutual recognition regarding electronic identification was enshrined in the European Union’s eIDAS Regulation, a considerable step towards realising a digital single market.^{45,46} This shows the slow institutionalization of digital contract law at the supranational level.

The development of blockchain- based smart contracts illustrates the shift from legal to technological enforcement of obligations. Blockchain technology has emerged as the next generation of contract relationships, offering record immutability and enhancing the trust among parties without any centralized authority.^{47,48,49} They

⁴¹ SZABO, N. “Formalizing and securing relationships on public networks”. 1997. Ibid.

⁴² WERBACH, K., and CORNELL, N. “Contracts ex machina”. *Duke Law Journal*, v. 67, n. 2, 2017, pp. 313-382. Available at: <https://scholarship.law.duke.edu/dlj/vol67/iss2/2/> (accessed on 30 August 2026).

⁴³ MIK, E. “Smart contracts: Terminology, technical limitations and real world complexity”. 2017. Ibid.

⁴⁴ UNITED NATIONS. *United Nations Convention on Contracts for the International Sale of Goods (CISG)*. 1980. Ibid.

⁴⁵ EUROPEAN PARLIAMENT AND COUNCIL. *Regulation (EU) No 910/2014 on Electronic Identification and Trust Services for Electronic Transactions in the Internal Market (eIDAS)*. 2014. Available at: <https://eur-lex.europa.eu/eli/reg/2014/910/oj> (accessed on 25 August 2026).

⁴⁶ EUROPEAN PARLIAMENT AND COUNCIL. *Regulation (EU) 2023/2854 (Data Act)*. 2023. Available at: <https://eur-lex.europa.eu/eli/reg/2023/2854/oj> (accessed on 30 August 2026).

⁴⁷ EUROPEAN PARLIAMENT AND COUNCIL. *Regulation (EU) 2024/1183 on European Digital Identity*. 2024a. Available at: <https://eur-lex.europa.eu/eli/reg/2024/1183/oj> (accessed on 30 August 2026).

⁴⁸ DE FILIPPI, P., and WRIGHT, A. *Blockchain and the law: The rule of code*. Cambridge, MA: Harvard University Press. 2018. <https://doi.org/10.2307/j.ctv2867sp>

⁴⁹ EUROPEAN PARLIAMENT AND COUNCIL. *Regulation (EU) 2024/1689 on Artificial Intelligence (Artificial Intelligence Act)* 2024b. Available at: <https://eur-lex.europa.eu/eli/reg/2024/1689/oj>

highlight that the blockchain brings a new model of decentralized legal regulation – obligation performance is guaranteed by the technical architecture of the network. This alters the classical understanding of the state as the guarantor of contract performance.

Meanwhile, digitalization brings new challenges including cybersecurity, algorithmic discrimination and information asymmetry.^{50,51} He stresses that automation of contracts restricts the scope for recourse to the courts, thereby diminishing the flexibility of legal norms. However, Raskin⁵² also comments on how the smart contract 'will also need to look to a mix of technical implementation and more traditional legal structures to protect rights. Consequently, a new contract law paradigm is emerging due to digital transformation, classical principles are coexisting with technological tools. The law is slowly being displaced by ex post regulation by anticipating and programmatic regulation where compliance is assured automatically. Brownsword et al.⁵³ characterize this as the transition to a technology integrated legal order, in which regulation takes place through a mix of legal rules, technical standards and digital platforms.

The present level of development of the contract law is the stage of digital convergence, in which the legal institutions are catching up with the data economy. International organizations reports prove that the digital economy is fostering new exchange models rooted on- line in digital platforms and ecosystems.⁵⁴ Under such conditions, a contract is a legal instrument and IT infrastructure component.

In the study of the evolution of the law of contract in the digitalization of society, revealing the historical stages of development of this legal institution is especially important. An analysis of the scientific positions reveals that the transformation of contract law would not take place in a day, but rather it was in the process of formation under the influence of economic, social, and technological factors. Each historical period was characterized by a specific legal model governing the formation, execution and enforcement of contractual obligations. Major changes took place in the 20th and 21st centuries as digital technologies began to directly impact the legal nature of contracts altering their form and content, and redefining their functional role. 1 In order to sum up the processes described, it will be useful to organize the developmental stages of contract law.⁵⁵

Table 1. Contextual stages relevant to the emergence of digital contracting.

Historical stage	Time frame	Key characteristics of a contract	Technological environment	Legal changes	Source
Roman-classical	Antiquity – Middle Ages	Personal nature of agreements, formalized obligations	Lack of technological means	Formation of the principles of pacta sunt servanda and freedom of contract	(Dzera, 2018; Radin, 2017)

lex.europa.eu/eli/reg/2024/1689/oj (accessed on 30 August 2026).

⁵⁰ SAVELYEV, A. "Contract law 2.0: Smart contracts as the beginning of the end of classic contract law". 2017. Ibid.

⁵¹ POHORETSKYI, M. "The impact of the legal positions of The Supreme Court on the formation of the doctrine and practice of criminal procedural evidence law in Ukraine". *Journal of the National Academy of Legal Sciences of Ukraine*, v. 4, n. 32, 2025, pp. 260-290. <https://doi.org/10.31359/1993-0909-2025-32-4-260>

⁵² RASKIN, M. "The law and legality of smart contracts". 2017. Ibid.

⁵³ BROWNSWORD, R., YEUNG, K., and SCOTFORD, E. *The Oxford Handbook of Law, Regulation and Technology*. Oxford: Oxford University Press. 2017. Ibid.

⁵⁴ UNCTAD. *Digital Economy Report 2021*. United Nations. 2021. Ibid.

⁵⁵ DZERA, O. V. *Civil Law of Ukraine: General Part*. Kyiv: Yurinkom Inter. 2018.

Historical stage	Time frame	Key characteristics of a contract	Technological environment	Legal changes	Source
Classical civil law	17th–19th centuries	Individual negotiated agreements	Paper document flow	Codification of private law, autonomy of will	(Brownsword et al., 2017)
Industrial	Late 19th – mid-20th century	Standardized contracts, adhesion contracts	Telegraph, telephone	Strengthening protection for the weaker party	(Radin, 2017; Lessig, 2006)
Information	End of the 20th century	Remote conclusion of contracts	Internet communications	Recognition of electronic messages as legal facts	(UNCITRAL, 1996)
Electronic commerce	2000–2015	Online transactions, electronic signatures	Web platforms	Legislative consolidation of electronic contracts	(Verkhovna Rada of Ukraine, 2003, 2015; European Parliament & Council, 2014)
Digital integration	2015–2020	Automated electronic contracts	Cloud services, digital ecosystems	Legal recognition of electronic identification	(World Bank, 2022; UNCTAD, 2021)
Blockchain stage	Since 2020	Smart contracts, software execution	Blockchain	Self-executing obligations	(Szabo, 1997; Werbach & Cornell, 2017; De Filippi & Wright, 2018)
Post-digital (forecast)	Promising	Hybrid AI contracts	Artificial intelligence, IoT	Rethinking legal liability	(Mik, 2017; Brownsword et al., 2017)

Source: Constructed by the author.⁵⁶

The table reveals that the evolution of contract law is evolutionary and closely linked to technological developments in the society. On the one hand, legal regulation rested upon personal trust and specified procedures of form in premodern times, while modern industrialization fostered the standardization of contracts and state supervision. Subsequent developments in information technology led to the introduction of electronic contracts, which were given legal recognition by international and national instruments. The present era is marked by the convergence of software code and the mechanism of obligation performance, which alters the dynamic between legal and technological regulation. The above table, therefore, shows that digitalization does not undermine classical principles of contract law but the manner of their application. The transition from paper contracts to performance via code mirrors the overall movement in law to a digital mode of operation in which legal standards come into closer contact with technological tools for accomplishing obligations.

In studying the evolution of contract law, it is not enough to define temporal phases of its historical development, but also, changes should be traced in the

⁵⁶ Ibid.

internal structure of contract as a legal concept. Digitization has transformed each core component of the contract model, including how the parties' wills are formed, manifested, and ascertained as well as how contracts are executed, evidenced, and adjudicated. Whereas the traditional contract paradigm was based on written form and physical appearance of the parties, the emerging digital context is giving rise to new legal constructs that rely on electronic identities, algorithms, and decentralized technologies. The homogenization of the transformation of core contract elements emerged from a review of literature in digital contract law, international norms and policies, and academic work in the areas of smart contract and blockchain regulation.

Table 2. Transformation of key elements of a contract in the context of the digitalization of social relations.

Contract element	Traditional legal model	Digital model	Nature of transformation	Legal consequences	Source
Expression of will by the parties	Personal signing of the document	Click-wrap, electronic consent, algorithmic confirmation	Dematerialization of will	Simplification of contract conclusion	(UNCITRAL, 1996; Verkhovna Rada of Ukraine, 2015)
Identification of parties	Passport or physical verification	Electronic signature, digital identification	Transition to digital authentication	Growing role of trust services	(European Parliament & Council, 2014)
Form of contract	Paper document	Electronic document, code	Technological form	Legal equality of paper and electronic contracts	(Verkhovna Rada of Ukraine, 2003; UNCITRAL, 1996)
Process of agreeing on terms	Negotiations between the parties	Automated agreement by platforms	Algorithmization of the contractual process	Standardization of terms	(Radin, 2017; Lessig, 2006)
Performance of obligations	Voluntary fulfillment or enforcement	Self-executing smart contracts	Automation of performance	Reduced role of intermediaries	(Szabo, 1997)
Control of execution	Judicial or contractual control	Blockchain verification	Technical assurance of trust	Immutability of records	(De Filippi & Wright, 2018)
Evidence	Paper evidence	Electronic journals, digital traces	Digitization of evidence	Simplification of evidence	(Pohoretskyi, 2025)
Territoriality	National jurisdiction	Cross-border online transactions	Deterritorialization of the contract	Conflict of laws issues	(United Nations, 1980; UNCTAD, 2021)
Role of intermediaries	Banks, notaries, agents	Platforms, decentralized networks	Disintermediation	Change in institutional structure	(De Filippi & Wright, 2018)

Contract element	Traditional legal model	Digital model	Nature of transformation	Legal consequences	Source
Protection of parties' rights	Court proceedings	Combined online dispute resolution mechanisms	Digitization of law enforcement	New models of liability	(Mik, 2017; Brownsword et al., 2017)

Source: Constructed by the authors.

The transformation portrayed in Table 2 confirms that digital contract law is contemporaneously evolving along all five dimensions of analysis predicated in the methodology. Electronic consent alters the process of contract formation; digital identity enhances authentication mechanisms; electronic evidence transforms traditional evidentiary rules; automated performance (auto-fulfillment of obligations through technological infrastructure) alters performance of contractual obligations; and algorithmic liability (liability for erroneous or harmful algorithms) introduces novel considerations of responsibility allocation in digital contract environments. The interplay of these dimensions reveals that the modern contract law is fluid and shaped continuously within a legal-technological system in contrast to distinct regulatory amendments in isolation. The transformation of contractual relations can be further analyzed through five interconnected dimensions: electronic consent, digital identification, evidentiary mechanisms, automated performance and algorithmic liability. Together, these dimensions form the core analytical structure of digital contract law and provide the basis for evaluating contemporary regulatory developments. The change dynamics shown in the table highlight the multifaceted transformation of contract law because the process of digitalization affects not just one aspect but the overall setup of the contract mechanism. The representation of the parties will be moving from written interaction to electronic interaction and the performance of obligations is more and more guaranteed by software code. This also implies that the traditional model, where law was the only enforcer of contract performance, is evolving into its counterpart in which technology assumes some enforcer functions. The conducted analysis demonstrates that the digital environment does not abolish classical principles of contract law principles but rather transforms their application. Freedom of contract, good faith and the need to perform obligations are still there, but are somewhat reshaped by electronic identification, automated contract execution, and the global reach of digital platforms. Therefore, the modification of essential elements of a contract confirms the development of a new contract law model where legal regulation is embedded in the technological infrastructure of the digital society.

The adoption of the AI Act extends the scope of contract law regulation beyond traditional contractual autonomy by introducing mandatory compliance obligations for AI-assisted decision-making systems. This creates a hybrid regulatory model in which contractual freedom becomes increasingly conditioned by technological governance requirements. The EU Data Act introduces an important shift in the regulation of smart contracts by establishing legal requirements concerning accessibility, interoperability and termination mechanisms. As a result, automated contractual systems are no longer treated solely as technical tools but increasingly as objects of direct legal regulation.

The digitalization of the economy has brought about substantial changes in the process of forming, performing and terminating contracts, witnessed by an increasing number of contracts concluded, performed and terminated electronically, signed using electronic signatures, and offered on digital platforms. In order to have an unbiased view on how digital technologies have influenced the evolution of the contracting landscape, statistics may be analyzed dynamically with respect to years.

The data presented in the table are taken from international analytical reports, which demonstrate an increase in e-commerce as a means for the conclusion of contracts, in the use of electronic signatures as an instrument for the legal confirmation of the parties', and in the provision of digital contract services as a form of executing contracts which represent the execution of contracts in the digital realm. The comparison demonstrates that international legal instruments primarily establish general principles for the recognition of electronic communications, whereas EU regulation introduces more detailed institutional mechanisms for digital trust and interoperability. Ukrainian legislation partially implements these standards but still lacks comprehensive regulation of automated contractual systems. The statistical data presented in Table 3 were compiled from international institutional reports and market analytics publications in order to illustrate general trends in the digitalization of contractual relations. The indicators were systematized and comparatively analyzed based on publicly available estimates concerning global e-commerce volumes, online retail trade and the electronic signature market.

The processes of contract formation, performance and termination have been substantially altered by the digitalization of the economy and an ever growing penetration of electronic signatures, through online platforms and automated digital services. To present the general technological environment in which such legal transformations take place, some statistics and data from the reports of international institutions and the market analysis literature in the public domain are introduced below. These chosen indicators are not intended to be a standalone empirical foundation for the legal findings of this study, but rather serve as contextual evidence of global developments that support the legal analysis of digital contractual relations. Therefore, this table 3 has an explanatory and illustrative purpose, to show the increasingly practical relevancy of electronic commerce, digital authentication technologies and automated contracting within the digital economy of today. The statistical data presented in Table 3 are used only as contextual background illustrating the growing practical relevance of digital contracting technologies. They do not constitute an empirical basis for broad causal conclusions concerning the evolution of contract law. The data in Table 3 are drawn from publicly available institutional and market reports and serve only as background context. They do not constitute an empirical foundation for the legal conclusions of this study.

Table 3. Dynamics of the spread of digital tools for concluding and performing contracts worldwide.

Year	Global e-commerce volumes (trillion US dollars)	Share of online retail trade (%)	Electronic signature market volume (USD billion)	Impact on contractual relationships	Source
2018	25.6	13.9	1	Start of active transition to electronic contracts	(UNCTAD, 2021)
2019	26.7	14	1	Prevalence of remote transactions	(UNCTAD, 2021)
2020	24	18	2.3–2.8	Rapid growth of online contracts during the pandemic	(Deloitte, 2021; UNCTAD, 2021)
2021	25	19	3	Widespread use of electronic	(European Commission,

Year	Global e-commerce volumes (trillion US dollars)	Share of online retail trade (%)	Electronic signature market volume (USD billion)	Impact on contractual relationships	Source
				signatures	2022)
2022	27	20.4	5	Electronic transactions are becoming the norm in business	(World Bank, 2022; UNCTAD, 2022)
2023	27	21	7	Contract management automation	(Exploding Topics, 2023)
2024	28.4	22–23	9.0–10.5	Transition to digital and smart contract models	(SkyQuest Technology Consulting, 2024)

Source: Compiled and systematised by the authors.

Table 3 provides contextual statistical information illustrating the global expansion of digital contracting technologies and the growing practical relevance of electronic transactions. The table is intended solely to support the doctrinal discussion and does not constitute an independent empirical basis for the legal conclusions of this study.

Table 3 presents contextual statistical information intended to illustrate the practical development of digital contracting technologies and related digital markets. These data serve exclusively as background information supporting the comparative doctrinal analysis conducted in this study and should not be interpreted as an independent empirical basis for the legal conclusions.

The statistical trends outlined above show the systemic character of the digitization of contract relations in the period 2018–2024. The strongest shifts happened post-2020 when global economic trends were catalyzing adoption of remote modes of engagement between contracting partners. E-commerce development proves the increasing use of electronic transactions, the booming of electronic signature market illustrates the digital expression of intent is institutionally consolidated as a legally significant means. The effect of the combination of the above mentioned trends is that we see the emergence of a transitional phase from the classical paper based contract towards a digital contract, where the technological infrastructure will be part of the legal regulation of the contractual obligations.⁵⁷ Institutional reports were used to identify macroeconomic trends in digital commerce, while market analytics publications were additionally employed to assess the development of electronic signature technologies and digital contracting services.

The contextual indicators presented in Table 3 demonstrate the practical significance of the legal issues analysed throughout this study. The rapid expansion of electronic transactions, digital identity systems, artificial intelligence applications, and automated contracting technologies confirms that traditional contractual doctrines increasingly operate within a technologically mediated environment. Consequently, contemporary legal regulation must ensure not only the legal validity of digital contracts but also legal certainty regarding electronic consent, digital

⁵⁷ EUROPEAN COMMISSION. *Shaping Europe's digital future*. 2020. Available at: https://commission.europa.eu/system/files/2020-02/communication-shaping-europes-digital-future-feb2020_en_4.pdf (accessed on 29 August 2026).

identification, evidentiary reliability, automated contractual performance, algorithmic accountability, and cross-border recognition of digitally concluded agreements.

UNCITRAL instruments established the doctrinal foundation for the legal recognition of electronic transactions by introducing the principle of functional equivalence between electronic and paper-based communications. This principle later became central to both European and national approaches to digital contract regulation.

The identified statistical trends confirm the institutionalization of digital contracting mechanisms within the global economy and demonstrate the increasing dependence of contractual relations on digital authentication technologies.

The level of development of the digital economy is accompanied by the deep transformation of contractual relations under the influence of information and communication technologies, business process reengineering, and the globalization of economic activity. The contract – as a product and process of software development – is redefining itself as a digital, algorithmic, or code based contract. This process provides new possibilities for the further development of civil law contracts, but also leads to legal issues concerning the legal reality of digital contracts, the liability of the parties, jurisdiction and possibilities for protecting rights of the parties of a contract in the digital environment. International bodies highlight that the pace of development of the digitised economy is outstripping that of legal systems, leading to a regulatory void with technological development being ahead of legal regulations.⁵⁸

A first set of issues relates to the legal certainty of electronic contracts. Although there are several rules to the effect that electronic documents and electronic signatures can be validly used for legal transactions, the application in practice of these rules is often problematic, particularly when it comes to proving and ascertaining the identity of the parties. The Ukrainian legislator has regulated the principle of legal equivalence between the electronic and the paper document, but case law shows that the procedures for the confirmation of declarations of intent need to be further harmonized.⁵⁹ Some of the same challenges undermine international solutions, contributing to the creation of the UNCITRAL Model Law on Electronic Commerce, which invokes the principle of functional equivalence as between electronic communications and conventional documents.

Another major difficulty is to establish correct electronic identification of the contracting parties. The physical presence of parties in the digital environment is substituted with technical authentication mechanisms, raising the risk of fraud and unauthorized access. Among others, the EU eIDAS Regulation was one of the earliest comprehensive instruments addressing this challenge by guaranteeing the mutual recognition of electronic identification and trust services.⁶⁰ But even this approach does not completely remove the issue of trust because digital systems still depend on technical infrastructure and cyber security. The question of whether smart contracts, which are legal agreements written in software code, should be considered as contracts is a topic of lively controversy. The idea proposed by N. Szabo was that homes, cars, and commerce could rely upon the automatic execution of obligations without middlemen,⁶¹ but it is documented in recent research that software code cannot capture all facets of legal agreements.⁶² It is important to stress that smart

⁵⁸ UNCTAD. *Digital Economy Report 2021*. United Nations. 2021. Ibid.

⁵⁹ VERKHOVNA RADA OF UKRAINE. *Law of Ukraine "On Electronic Commerce" No. 675-VIII*. 2015. Ibid.

⁶⁰ EUROPEAN PARLIAMENT AND COUNCIL. *Regulation (EU) No 910/2014 on Electronic Identification and Trust Services for Electronic Transactions in the Internal Market (eIDAS)*. 2014. Available at: <https://eur-lex.europa.eu/eli/reg/2014/910/oj> (accessed on 25 August 2026).

⁶¹ SZABO, N. "Formalizing and securing relationships on public networks". 1997. Ibid.

⁶² WERBACH, K., and CORNELL, N. "Contracts ex machina". 2017. Ibid.

contracts are so effective only because they work in tandem with traditional law, to which numerous contractual terms are value-based. Automated contracts are also inflexible. Sklaroff⁶³ observes that self-executing contracts can lead to outcomes where the technically correct execution is at odds with the principles of fairness or good faith. This is especially true for bugs in the source code or changes of situation after the contract is signed. Savelyev⁶⁴ goes so far as to suggest that smart contracts might constitute a threat to classical contract law, as they substitute technical execution for judicial review.

Digitalization also gives rise to questions of jurisdiction and choice of applicable law. Online platforms enable parties to conclude contracts from all over the world, and it is difficult to identify the competent court. The United Nations Convention on Contracts for the International Sale of Goods had been a major movement in unifying international contractual relations but was negotiated prior to the development of digital platforms and does not consider the specifics of algorithmic transactions.⁶⁵ There seems to be a need, therefore, to craft supranational rules for the digital economy.

Standardization of contract terms in the platform economy is still a problem. The ubiquity of standard contracts results in reduced real autonomy of the parties, a point examined at length by Radin,⁶⁶ who draws attention to the risk of an incremental dissolution of the contract nature of contracts. Digital platforms in fact define the terms of interaction and thus distort the balance of private autonomy and corporate regulation.

In particular, the relationship between law and technology as systems of regulation has been the focus of scholarly attention. Lessig⁶⁷ suggests that software code can regulate conduct similar to legal rules. De Filippi and Wright⁶⁸ further develop this notion by arguing that blockchain develops a novel, decentralized, trust model where contract enforcement becomes a matter of network architecture. But this paradigm provokes questions as to who is responsible in case of technical malfunctioning or software faults.

One major aspect to be developed is the design of hybrid regulations that merge automatic contract enforcement with the availability of judicial redress. Reijers et al.⁶⁹ observe that successful governance of blockchain networks entails a mixture of governance forms on- as well as off-network. This method allows for regulatory agility while preserving the advantages of automation. The unification of contract law is just as important. Von Wendland⁷⁰ points out that the future of digital contracts hinges on the development of global standards that are accepted by multiple jurisdictions. Here, the task of international bodies is to formulate harmonised rules for digital transactions.

⁶³ SKLAROFF, J. M. "Smart contracts and the cost of inflexibility". 2017. Ibid.

⁶⁴ SAVELYEV, A. "Contract law 2.0: Smart contracts as the beginning of the end of classic contract law". 2017. Ibid.

⁶⁵ UNITED NATIONS. *United Nations Convention on the Use of Electronic Communications in International Contracts*. 2005. Available at: <https://uncitral.un.org> (accessed on 25 August 2026).

⁶⁶ RADIN, M. J. *Boilerplate: The Fine Print, Vanishing Rights, and the Rule of Law*. 2017. Ibid.

⁶⁷ LESSIG, L. *Code: Version 2.0*. New York: Basic Books. 2006. <https://archive.org/details/Code2.0> (accessed on 27 August 2026).

⁶⁸ DE FILIPPI, P., and WRIGHT, A. *Blockchain and the law: The rule of code*. Cambridge, MA: Harvard University Press. 2018. <https://doi.org/10.2307/j.ctv2867sp>

⁶⁹ REIJERS, W., WUISMAN, I., MANNAN, M., DE FILIPPI, P., WRAY, C., and RAE-LOOI, V., et al. "Now the code runs itself: On-chain and off-chain governance of blockchain technologies". 2021. Ibid.

⁷⁰ VON WENDLAND, M. "Smart contracts that are smart and can function as legal contracts". 2018. Ibid.

So, the modern challenges of the legal regulation of digital contract relations are a consequence of the fact that traditional legal forms are incompatible with the new technology based forms of interaction. Concurrently, the international experience shows that these problems can be overcome through the development of electronic identification, by harmonizing legal norms and introducing hybrid regulatory mechanisms, as well as by adapting contract law to the data-driven economy. Digital transformation does not eliminate traditional contractual principles. However, it changes the mechanisms through which these principles are implemented in digital environments.

While studying the digital transformation of contractual relations, the focus should be on the systematization of major legal problems which are arising due to the application of electronic transaction, digital platform, blockchain technology, and smart contract. In contrast to the traditional contractual framework, digital relations take place in a context in which legal rules are increasingly implemented by software codes, algorithms, and transnational data infrastructures. Hence, it challenges the traditional civil law rules which are not capable to cope with those new developments. By reviewing those issues, it is possible to recognize systemic regulatory gaps and to define the direction that contracting law should pursue according to the diverging trends of the digital economy. Table 4 focuses on the analysis of international legislative documents, domestic laws and contemporary academic studies in the area of digital contract law.^{71,72}

Table 4. Current issues in the legal regulation of digital contractual relations.

Issue	Nature of the problem	Causes	Practical manifestations	Legal risks	Consequences for contract law	Source
Identification of parties	Absence of physical interaction between counterparties	Remote conclusion of contracts	Use of electronic signatures and digital accounts	Fraud, digital identity theft	Need for standardized eID systems	(European Parliament & Council, 2014)
Proving electronic transactions	Difficulty in confirming the expression of will	Different technical data formats	Legal disputes regarding the authenticity of documents	Uncertainty of evidentiary value	The need to standardize electronic evidence	(Verkhovna Rada of Ukraine, 2003; UNCITRAL, 1996)
Legal nature of smart contracts	Combination of program code and legal agreement	Lack of a single definition	Automatic execution without the participation of the parties	Complexity of transaction classification	Formation of new contract doctrines	(Szabo, 1997; Werbach & Cornell, 2017; De Caria, 2018)
Inflexibility of automated execution	The code executes the conditions regardless of circumstances	Algorithmic logic	Impossibility of stopping execution	Violation of principles of fairness	Need for court intervention mechanisms	(Sklaroff, 2017; Mik, 2017)

⁷¹ UNCITRAL. *UNCITRAL Model Law on Electronic Commerce*. United Nations. 1996. Ibid.

⁷² BEDRATYI, I., SHEVCHSYHYN, O., and ASTAKHOV, V. "Legal aspects of intellectual property rights violation in the digital environment: Prospects of recodification". *Social Development: Economic and Legal Issues*, 2025, pp. 4. <https://doi.org/10.70651/3083-6018/2025.4.09>

Issue	Nature of the problem	Causes	Practical manifestations	Legal risks	Consequences for contract law	Source
Jurisdictional uncertainty	Cross-border nature of online contracts	Global digital platforms	Disputes over applicable law	Conflicts of jurisdiction	Need for international harmonization	(United Nations, 1980; UNCTAD, 2021)
Standardized platform agreements	Terms imposed on users	Dominance of digital platforms	Click-wrap agreements	Restrictions on freedom of contract	Weakening of autonomy of will	(Radin, 2017)
Cybersecurity and data protection	Use of large amounts of personal data	Digitization of transactions	Data leaks, system breaches	Breaches of confidentiality	Strengthening of data regulation	(Brownsword et al., 2017)
Responsibility for algorithm errors	Automated decisions without human oversight	Use of AI and blockchain	Incorrect contract execution	Uncertainty of the responsible entity	Need for new liability models	(De Filippi & Wright, 2018; Reijers et al., 2021)
Deterritorialization of contracts	Lack of geographical reference	Cloud services and online platforms	Virtual transactions	Complexity of law enforcement	Formation of supranational regulation	(European Commission, 2020)

Source: Developed by the authors.⁷³

The study of present-day problems in the legal regulation of digital contract relations allows us to characterize these problems as complex and cross-cutting. Many of the challenges arise not so much from an absence of legal norms, as from the fact that traditional legal frameworks do not align with new technological forms of interaction. Classical contract law was based on the written form and on face-to-face communication, the Internet is creating templates for automated contracting, where a significant part of the contractual functions are performed by software. This skews the balance of freedom of contract, State regulation and technical control.

Together, these legal instruments demonstrate the gradual transformation of contract law from a paper-based regulatory model toward a technologically integrated legal framework. While early international instruments focused primarily on legal recognition of electronic communications, contemporary European regulation increasingly addresses algorithmic governance, digital identity infrastructures and automated contractual execution. It is especially important to note that, in the vast majority of cases, the problems concern not the conclusion of the contract but its performance and enforcement. Smart contracts and other digital platforms, enabled by blockchain, are creating a context in which execution of obligations is guaranteed technically rather than legally, necessitating new concepts of liability and means of judicial recourse. Meanwhile, the international experience demonstrates a trend toward harmonizing legal rules, advancing electronic identification, and drafting technology-neutral laws.

Hence, present developments in contract law display a movement away from a normative-text based model towards a hybrid legal-technological modality of regulation, where the efficacy of the legal machinery largely depends on its capacity to be aligned with the digital infrastructure of the economy through the reconceptualization of legal principles. The conceptual model proposed in Figure 1 constitutes the central theoretical contribution of this study by demonstrating the

⁷³ UNCITRAL. *UNCITRAL Model Law on Electronic Commerce*. United Nations. 1996. Ibid.

transition from traditional documentary contract regulation toward a multilayered legal-technological governance framework.

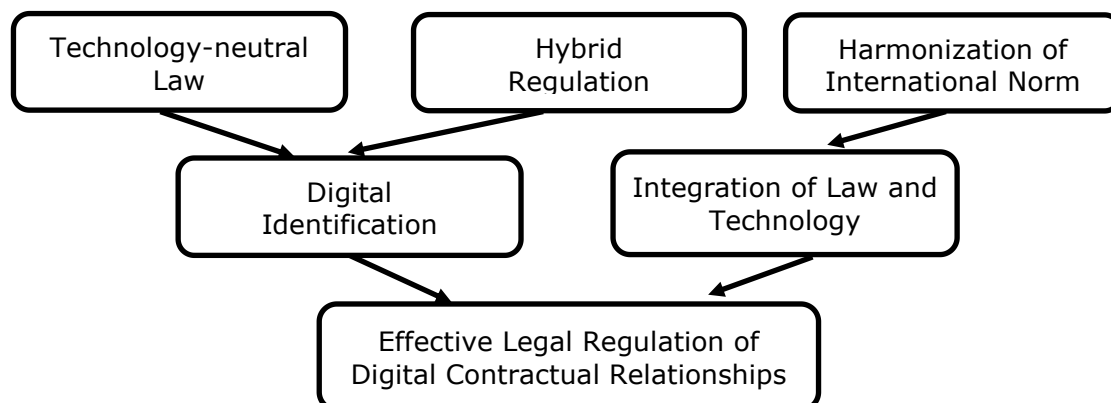


Figure 1. Conceptual model for improving the legal regulation of digital contracts.

Source: Developed by the authors.

The model illustrates that digital contract regulation increasingly operates as a hybrid legal-technological system. Electronic consent, digital identification, evidentiary mechanisms, automated performance and algorithmic liability are not isolated legal categories but functionally interconnected components of this emerging governance framework.

Figure 1 illustrates the transition from traditional text-based contractual regulation toward a technologically integrated legal framework based on hybrid governance, digital identification and international standardization.

The conceptual model for enhancing the regulation of digital contract relations outlines the systemic transformation of contract law in the context of the digital economy and shows that the development of legal regulation needs to be systemic and should not be the result of isolated legislative responses but the result of a comprehensive, multifold, institutional, technological and international solution. The given model reflects the nested character of legal development from strategic levels to concrete applications, culminating in a new quality of legal support for contractual relations.

The top tier of the model is the fundamental principles of regulation that shape the logic of transformation of contract law. Technology-neutrality in legislation is an essential instrument in adjusting law to the speed of development of digital technologies, as means of specific technical implementations become obsolete very quickly; particular technical solutions become part of technical standards, not of legal norms. Hence contemporary international approaches are directed to the technology related legal effects rather than the technology itself which allows a more mature legal system within the innovative solutions. Hybrid regulation, conversely, mirrors the imperative to integrate traditional legal tools with automated contract enforcement mechanisms, thereby benefiting from the efficiency of digital legal procedures with the assurances of legal protection for the involved parties. International standardization is responding to the deterritorialization of digital transactions in that it is building levels of coherence across which most new contracts now travel, that is, the transnational where national law is less and less able to provide an comprehensive solution.

The middle tier of the model corresponds to the instrumental means of application of the principles at the above level. The development of digital identity also enhances confidence in the digital environment as a trusted identification of the parties to a transaction is one of the requirements for legal certainty in contract. However, the convergence of law and technology marks the birth of a new regulatory

paradigm where software code, algorithms and digital platforms engage in activities previously the exclusive domain of legal institutions. The convergence does not mean to replace law with technology, but their complementarity: the law makes the technical solutions viable and is complemented by them to ensure viability and the law ensures the legality and the fairness.

The foundational level of the model corresponds to the output: an effective legal regulation of digital contract relations, which manifests in enhanced legal certainty, decreased transaction costs, shortened contracting time, and widened cross-border market opportunities. Its distinctive feature is that efficiency is reached not by expanding state control but through the establishment of a balanced system of co-regulation between the state, international organizations, and technology platforms.

The evolution of contract law in the digital economy demonstrates that legal regulation can no longer operate independently from technological infrastructure. Digital contractual relations increasingly emerge within hybrid environments where legal norms, algorithmic systems and digital platforms function simultaneously as mechanisms of governance. Consequently, the future development of contract law will depend not only on legislative modernization but also on the ability of legal systems to integrate technological regulation while preserving legal certainty, contractual fairness and effective protection of rights.

6. Discussion

The proposed model extends previous doctrinal approaches by integrating recent international and European regulatory developments into a unified comparative analytical framework.

The conceptual framework used in this paper enables the development of contract law to be reviewed through five related legal rules. The comparative assessment reveals that e-consent and e-identification are already subject to a fairly high degree of legal harmonization at the international and the European levels, while evidentiary tools, automated contractual execution and algorithmic liability are still subject to further harmonization. If these methodological parameters are rigorously applied in the study it becomes evident that a gradual shift away from traditional contractual regulation and towards hybrid legal-technological regulation in digital spaces can be observed.

Applying the five criteria, it becomes apparent that international law provides foundational principles for electronic consent and evidence, while EU law advances digital identification and automated performance, and Ukrainian law remains primarily focused on formal recognition rather than on algorithmic liability.

The conclusion derived from the study is that the changes taking place in contract law in the digitalization of economy are systemic and that they do not only lead to the emergence of new technical means for the formation of contracts but more fundamentally, to the reconsideration of the very model of legal regulation relating to contract. The results of the research confirm that traditional forms of regulation, arising from exchanges of paper-based documents and territorially bounded legal relations, prove to be less effective in an environment where transactions are performed at a distance and are automated and, in many cases, outside of a single jurisdiction. This is consistent with the principles enshrined in the international instruments, in particular the UNCITRAL Model Law on Electronic Commerce, which recognized the principle of functional equivalence of electronic documents and traditional documents in year 1996, and the UNC on Contracts for the International Sale of Goods which has been a foundational for the harmonization of contract law in international economic environment.⁷⁴

⁷⁴ UNITED NATIONS. *United Nations Convention on the Use of Electronic Communications in International Contracts*. 2005. Ibid.

The increasing integration of algorithmic systems into contractual performance challenges the traditional understanding of contractual autonomy, since contractual obligations may increasingly be shaped by platform architecture and automated decision-making processes rather than solely by the direct will of the parties.

The findings also confirmed that the national legislation of Ukraine is on the whole in line with the main international directions of the regulation of digital transactions, but further the adjustment to the challenges of modern technology is required. Ukrainian legislation on e-document, e-commerce and e-trust service has worked out the rules for the circulation of digital contracts and provides for legal recognition for electronic transaction and electronic identification.⁷⁵ The study also reveals that the mere legal recognition of such procedures cannot solve the problem of legal certainty, since the most pressing problems begin with the performance and confirmation of electronic contracts, as it is further evidenced by the international experience in regulating electronic trust service under eIDAS Regulation.⁷⁶ The transformation of contract law in digital environments reflects a broader shift from text-based legal formalism toward technologically mediated governance structures.

The findings are in line with the stance of digital contract law scholars, who conceive smart contracts as a further stage of contractual relations evolution. The idea of automated enforcement of obligations⁷⁷ was elaborated on in a series of papers by Werbach and Cornell,⁷⁸ who claim that program code can take on some of the traditional legal institutions. At the same time, the results of the research support the findings of Mik⁷⁹ and Sklaroff⁸⁰ about the shortcomings of algorithmic approaches as smart contracts are inflexible and cannot account for complex socio-economic situations as these exist in legal relations of everyday life. Future legal regulation will likely require the development of hybrid liability models capable of addressing autonomous algorithmic interaction in decentralized contractual ecosystems.

A key unresolved issue concerns the nature of liability for algorithmic errors in automated contract execution. It remains unclear whether such liability should be based on fault (developer negligence), strict liability, or a hybrid model combining elements of both. Given the increasing autonomy of algorithmic systems, a purely fault-based approach may be insufficient, as it is often difficult to identify a specific human actor responsible for the malfunction.

Another important issue relates to consumer protection in digital environments, particularly in the context of click-wrap and platform-based contracts. The standardization of contractual terms and the asymmetry of information between platforms and users significantly limit the real autonomy of the contracting parties. Therefore, additional legal safeguards, such as enhanced transparency requirements, fairness control of standard terms and accessible dispute resolution mechanisms, are necessary to ensure the protection of weaker parties in digital contractual relationships.

The focal point of the analysis was on the coexistence of law and technology as two convergent modalities of regulation. These results are consistent with the notion

⁷⁵ VERKHOVNA RADA OF UKRAINE. *Law of Ukraine "On Electronic Trust Services" No. 2155-VIII*. 2017. Ibid.

⁷⁶ EUROPEAN PARLIAMENT AND COUNCIL. *Regulation (EU) No 910/2014 on Electronic Identification and Trust Services for Electronic Transactions in the Internal Market (eIDAS)*. 2014. Available at: <https://eur-lex.europa.eu/eli/reg/2014/910/oj> (accessed on 25 August 2026).

⁷⁷ SZABO, N. "Formalizing and securing relationships on public networks". 1997. Ibid.

⁷⁸ WERBACH, K., and CORNELL, N. "Contracts ex machina". 2017. Ibid.

⁷⁹ MIK, E. "Smart contracts: Terminology, technical limitations and real world complexity". 2017. Ibid.

⁸⁰ SKLAROFF, J. M. "Smart contracts and the cost of inflexibility". 2017. Ibid.

by Lessig⁸¹ that program code is a regulator of conduct by itself and with the narrative De Filippi and Wright⁸² that blockchain establishes a new trust model (disintermediation) not grounded on institutional control but on the technical infrastructure of the network. Simultaneously, it is shown that a total substitution of legal rules with technological rules is not feasible, which reconfirms the requirement for hybrid governance models as outlined in the work.⁸³

Analysis of the results with international research on the digital economy shows that they are aligned with the worldwide trend of development. In particular, the reports by the United Nations Conference on Trade and Development (UNCTAD) and the World Bank illustrate that the fast growth of e-commerce and digital services is contributing to a rising number of electronic contracts, and new types of economic interrelations are emerging. The analytics data also suggest wide spread adoption of e-signatures, which are revolutionizing the way consent of parties to a contract is confirmed and are doing so at a pace that is replacing paper-based contract forms.

At the same time, this research contributes to existing academic approaches by showing that the main challenge for digital contractual relationships is not only the technical complexity of new tools, but that law's role is also radically transformed in institutional terms. While the classical contract paradigm was grounded in the parties' will autonomy, the contemporary platform economy determines standardized conditions of interaction, substantiating the findings Radin⁸⁴ concerning the dawning demise of contractuality in contracts. Point up that the digital context is altering the relation between private regulation and state governance.

Examination of European digital policy shows that only through a move away from reactive law-making towards strategic steering of the digital transformation can regulation be successful. This fits with the idea of creating a EU digital single market, where law has a coordinating function in the development of the digital.⁸⁵ The findings add to these approaches, indicating that the convergence of digital identification, technology-neutral regulation and international harmonization enables for the formation of a new paradigm of contract law.

The adoption of the UNCITRAL Model Law on Automated Contracting (2024) demonstrates the increasing international recognition of automated contractual systems as a distinct regulatory domain. Unlike earlier instruments focused primarily on electronic communications, the Model Law addresses the legal consequences of automated decision-making and automated contract execution.

Specifically, the 2005 Convention directly addresses the formation of electronic consent in cross-border contracts (criterion 1). The eIDAS Regulation and Regulation (EU) 2024/1183 strengthen digital identification and authentication (criterion 2). The UNCITRAL Model Law on Electronic Transferable Records and the general principle of functional equivalence underpin the evidentiary value of electronic records (criterion 3). The Data Act and the UNCITRAL Model Law on Automated Contracting provide regulatory frameworks for automated contractual performance (criterion 4). Finally, the AI Act contributes to the emerging rules on algorithmic liability (criterion 5). This explicit mapping confirms that the analysed instruments collectively cover all five dimensions of digital contracting.

⁸¹ LESSIG, L. *Code: Version 2.0*. New York: Basic Books. 2006. <https://archive.org/details/Code2.0> (accessed on 27 August 2026).

⁸² DE FILIPPI, P., and WRIGHT, A. *Blockchain and the law: The rule of code*. Cambridge, MA: Harvard University Press. 2018. <https://doi.org/10.2307/j.ctv2867sp>

⁸³ REIJERS, W., WUISMAN, I., MANNAN, M., DE FILIPPI, P., WRAY, C., and RAE-LOOI, V., et al. "Now the code runs itself: On-chain and off-chain governance of blockchain technologies". 2021. Ibid.

⁸⁴ RADIN, M. J. *Boilerplate: The Fine Print, Vanishing Rights, and the Rule of Law*. 2017. Ibid.

⁸⁵ EUROPEAN COMMISSION. *Shaping Europe's digital future*. 2020. Available at: https://commission.europa.eu/system/files/2020-02/communication-shaping-europes-digital-future-feb2020_en_4.pdf (accessed on 29 August 2026).

Thus, the results of the study are in general alignment with the main assumptions of modern international and national theoretical literature and prove that the digitalization of contracts does not question classical contract law principles but changes the instrumental means for their realization. Enhancement of legal regulation of digital contractual relationship is seen as adaptation of legislation in response to technological development and as formation of a uniform model of legal-tech regulation that would adequately represent an innovative solution, achieve legal certainty and protect the rights of participants in the digital market.

The conducted comparison demonstrates that international law mainly provides foundational principles for the legal recognition of digital transactions, while EU regulation increasingly focuses on institutional and technological integration. Ukrainian legislation generally follows international standards; however, it still remains insufficiently adapted to algorithmic contracting, AI-assisted decision-making and blockchain-based contractual execution.

Despite these developments, important legal uncertainties remain unresolved, particularly regarding liability allocation for autonomous algorithmic decisions and the legal qualification of AI-generated contractual acts.

Taken together, these legal instruments no longer operate as isolated regulatory measures. Instead, they collectively establish an integrated legal framework governing the principal components of digital contracting, including electronic consent, digital identification, evidentiary reliability, automated contractual performance, algorithmic liability and cross-border legal recognition. Their combined effect demonstrates the gradual transformation of contract law from a paper-based transactional model towards a digitally integrated legal environment. Compared with international instruments, European Union legislation develops these principles further by introducing directly applicable regulatory mechanisms that ensure greater legal harmonisation across Member States. Ukrainian legislation generally follows the international and European approaches; however, several areas remain insufficiently harmonised, particularly regarding automated contracting, algorithmic liability and the legal treatment of AI-assisted contractual decision-making.

The comparative analysis reveals that today, international and European legal standards no longer address digital contracts in the context of fragmented legal spheres, but rather converging configurations of rules at different levels of specificity serving to cope with certain legal questions. Electronic consent is regulated. Electronic consent is mainly subject to the UNCITRAL instruments and the international conventions on the carriage of electronic communications, the European Digital Identity framework and eIDAS enhance digital identification, electronic trust services and electronic transferable records provide evidentiary certainty, the Data Act and the UNCITRAL Model Law on Automated Contracting regulate automated contractual performance, algorithmic liability is emerging as a significant matter in the AI Act. Hence the development of contract law reflects a growing convergence of technological governance and traditional legal governance rather than one of straightforward expansion of the existing contractual doctrines.

7. Conclusions

It was shown in our study that the development of contract law in terms of the digitalization of social interaction, is indeed complex, multi-layer process, which includes transformation of legal forms, methods of conclusion, performance, and termination of contracts and a general change of the role of the law in regulating of economic relations. The results of the investigation suggest that the digital technologies are not simply updating the tools of contractual trade but are also delineating a new pattern of legal regulation, in which legal rules are implemented through IT systems, algorithms and digital platforms.

The comparative analysis demonstrates that all three legal frameworks recognise electronic consent as legally valid, although they differ regarding formal requirements and evidentiary safeguards. The comparison shows a gradual convergence towards legally recognised digital identity systems, particularly following the adoption of Regulation (EU) 2024/1183. The examined legal systems increasingly acknowledge the evidentiary reliability of electronic records, although procedural approaches remain partially harmonised. The comparative analysis indicates that automated contractual performance is progressively recognised, while legal regulation still seeks to balance automation with contractual autonomy and legal certainty. The comparison reveals that legal approaches to algorithmic liability remain under development, particularly regarding responsibility for autonomous decision-making systems.

The comparison of the norm elements of international legal instruments and the national legislation of Ukraine, their detailed analysis allowed to determine that the current legislation has already created the legal basis for electronic transactions; it granted equal legal status to electronic and paper contracts, as well as it enabled the use of electronic identification and trust services. However, the findings also suggested that even the existence of legal guidelines for the prevention of legal risks in software cannot entirely address such risks, where the digital world brings about challenges, such as how to prove one's intent, how to establish jurisdiction, how to protect personal data, and how to attribute liability for decisions made by automated means. This stresses the importance of a further legislation evolution that considers the evolving technology landscape of the digital economy.

It is recognized that one of the trends in current contract law development is the move from a text-based contractual model to a legal technological model in which many of the functions of securing the performance of obligations are delegated to a digital infrastructure. Smart contracts, electronic signatures and digital platforms reduce transaction costs, speed up contract conclusion and broaden the opportunities for cross-border economic cooperation. At the same time, the flexibility of legal regulations is restricted and there is a risk that contracts are formalized without taking into account the principles of fairness and bona fides.

The comparison of the results with the international practice allowed us to conclude that the regulation of the digital contracts in a balanced way is achievable only by the harmonization of legal standards at a supranational level. The cross-border nature of digital economic relations requires harmonized supranational regulation. In this regard, the state is increasingly shifting its role from that of regulator solely to that of coordinator and facilitator of development of a trusted digital ecosystem.

The analysis also found that the further evolution of the contract law should be informed by the principles of technological neutrality, hybrid regulation as well as techno-legal standardisation. Integrating automated contract execution with legal supervision can provide a tradeoff between the efficiency-oriented feature of digital processes and the legal protection-oriented feature of civil transaction participants. Of particular relevance is the development of digital identification and trust services which constitute the basis for legal certainty in the digital environment.

To sum up the results of the study, the following conclusions can be drawn: digitalization of contract does not eliminate the basic principles of contract law – freedom of contract, equality between the contracting parties and the duty of performance – but it substantially modifies the manner of their execution. Modern contract law seems, step by step, to be evolving into a multifaceted legal-technical infrastructure that can adequately support the functioning of economic transactions in the digital economy. More research should be undertaken in developing general models for the regulation of digital transactions, for determining the legal status and effects of algorithmic decisions, and for establishing enduring mechanisms of accountability in a landscape of automated contractual relations.

The main scientific novelty of this work is the elaboration of a doctrinal model of digital contract law, which integrates electronic consent, digital ID, evidentiary rules, automated contract performance and algorithmic liability under one single techno-legal umbrella. This contribution reveals that the regulation of digital contractual relations is to be interpreted as a hybrid of law and technology at the governance level and not solely as a question of existing legal constructs, providing a point of departure for further reforms in the harmonization of contract law for the digital economy.

The integrated doctrinal model developed in this study provides a systematic framework for analysing the evolution of digital contract law across international, European Union and Ukrainian legal systems. Its principal contribution lies in demonstrating how the five analytical criteria collectively explain the legal transformation of contractual relations within the contemporary digital environment.

The conclusions of this study are limited to the selected legal instruments and five analytical criteria examined in the article. Therefore, the findings should not be interpreted as a comprehensive assessment of all aspects of contract law digitalization. Rather, they demonstrate specific regulatory tendencies concerning electronic consent, digital identification, evidentiary mechanisms, automated contractual performance and algorithmic liability in international, European Union and Ukrainian law.

8. References

- BEDRATYI, I., SHEVCHSYHYN, O., and ASTAKHOV, V. "Legal aspects of intellectual property rights violation in the digital environment: Prospects of recodification". *Social Development: Economic and Legal Issues*, 2025, pp. 4. <https://doi.org/10.70651/3083-6018/2025.4.09>
- BROWNSWORD, R., YEUNG, K., and SCOTFORD, E. *The Oxford Handbook of Law, Regulation and Technology*. Oxford: Oxford University Press. 2017. Available at: <https://academic.oup.com/edited-volume/27999> (accessed on 26 August 2026).
- CLACK, C. D., BAKSHI, V. A., and BRAINE, L. "Smart contract templates: Foundations, design landscape and research directions". arXiv. 2016. <https://doi.org/10.48550/arXiv.1608.00771>
- DE CARIA, R. "The legal meaning of smart contracts". *European Review of Private Law*, v. 26, n. 6, pp. 731-751. <https://doi.org/10.54648/ERPL2018052>
- DE FILIPPI, P., and WRIGHT, A. *Blockchain and the law: The rule of code*. Cambridge, MA: Harvard University Press. 2018. <https://doi.org/10.2307/j.ctv2867sp>
- DELOITTE. *E-signing: The Market Size and Vendor Landscape*. 2021. Available at: <https://www.deloitte.com/ch/en/services/consulting/blogs/e-signing-market-size-and-vendor-landscape.html> (accessed on 26 August 2026).
- DZERA, O. V. *Civil Law of Ukraine: General Part*. Kyiv: Yurinkom Inter. 2018.
- E XPLODING TOPICS. *Electronic signature statistics and trends*. 2023. <https://explodingtopics.com/blog/esignature-stats> (accessed on 22 August 2026).
- EUROPEAN COMMISSION. *Shaping Europe's digital future*. 2020. Available at: https://commission.europa.eu/system/files/2020-02/communication-shaping-europes-digital-future-feb2020_en_4.pdf (accessed on 29 August 2026).
- EUROPEAN COMMISSION. *eIDAS Regulation*. 2022. Available at: <https://digital-strategy.ec.europa.eu/en/policies/eidas-regulation> (accessed on 28 August 2026).
- EUROPEAN PARLIAMENT AND COUNCIL. *Regulation (EU) No 910/2014 on Electronic Identification and Trust Services for Electronic Transactions in the Internal Market (eIDAS)*. 2014. Available at: <https://eur-lex.europa.eu/eli/reg/2014/910/oj> (accessed on 25 August 2026).
- EUROPEAN PARLIAMENT AND COUNCIL. *Regulation (EU) 2023/2854 (Data Act)*. 2023. Available at: <https://eur-lex.europa.eu/eli/reg/2023/2854/oj> (accessed on 30 August 2026).
- EUROPEAN PARLIAMENT AND COUNCIL. *Regulation (EU) 2024/1183 on European Digital Identity*. 2024a. Available at: <https://eur-lex.europa.eu/eli/reg/2024/1183/oj> (accessed on 30 August 2026).

- EUROPEAN PARLIAMENT AND COUNCIL. *Regulation (EU) 2024/1689 on Artificial Intelligence (Artificial Intelligence Act)* 2024b. Available at: <https://eur-lex.europa.eu/eli/reg/2024/1689/oj> (accessed on 30 August 2026).
- FLORIDI, L., COWLS, J., BELTRAMETTI, M., CHATILA, R., CHAZERAND, P., and DIGNUM, V., et al. "AI4People—An ethical framework for a good AI society: Opportunities, risks, principles, and recommendations". *Minds and Machines*, v. 28, n. 4, 2018, pp. 689-707. <https://doi.org/10.1007/s11023-018-9482-5>
- LESSIG, L. *Code: Version 2.0*. New York: Basic Books. 2006. <https://archive.org/details/Code2.0> (accessed on 27 August 2026).
- LUESLEY, A. "Unravelling smart contracts: Smart contracts and the law of rescission in Canada". *Asper Review of International Business and Trade Law*, v. 19, 2019, pp. 155-173. Available at: <https://journals.library.ualberta.ca/asperreview/index.php/asperreview/article/view/223> (accessed on 29 August 2026).
- MIK, E. "Smart contracts: Terminology, technical limitations and real world complexity". *Law, Innovation and Technology*, v. 9, n. 2, 2017, pp. 269-300. <https://doi.org/10.1080/17579961.2017.1378468>
- POHORETSKYI, M. "The impact of the legal positions of The Supreme Court on the formation of the doctrine and practice of criminal procedural evidence law in Ukraine". *Journal of the National Academy of Legal Sciences of Ukraine*, v. 4, n. 32, 2025, pp. 260-290. <https://doi.org/10.31359/1993-0909-2025-32-4-260>
- RADIN, M. J. *Boilerplate: The Fine Print, Vanishing Rights, and the Rule of Law*. Princeton: Princeton University Press. 2017. https://www.researchgate.net/publication/282678188_Boilerplate_The_fine_print_vanishing_rights_and_the_rule_of_law (accessed on 27 August 2026).
- RASKIN, M. "The law and legality of smart contracts". *Georgetown Law Technology Review*, v. 1, n. 2, 2017, pp. 305-341. <http://dx.doi.org/10.2139/ssrn.2842258>
- REIJERS, W., WUISMAN, I., MANNAN, M., DE FILIPPI, P., WRAY, C., and RAE-LOOI, V., et al. "Now the code runs itself: On-chain and off-chain governance of blockchain technologies". *Topoi*, v. 40, n. 4, 2021, pp. 821-831. <https://doi.org/10.1007/s11245-018-9626-5>
- SAVELYEV, A. "Contract law 2.0: Smart contracts as the beginning of the end of classic contract law". *Information & Communications Technology Law*, v. 26, n. 2, 2017, pp. 116-134. <https://doi.org/10.1080/13600834.2017.1301036>
- SKLAROFF, J. M. "Smart contracts and the cost of inflexibility". *University of Pennsylvania Law Review*, 166, 2017, pp. 263-303. Available at: <https://access.heinonline.com/HOL/LandingPage?handle=hein.journals/pnlr166&div=8&id=8&page=> (accessed on 20 August 2026).
- SKYQUEST TECHNOLOGY CONSULTING. *Digital Signature Market Report*. 2024. Available at: <https://www.skyquestt.com/report/digital-signature-market> (accessed on 20 August 2026).
- SZABO, N. "Formalizing and securing relationships on public networks". *First Monday*, v. 2, n. 9. 1997. <https://doi.org/10.5210/fm.v2i9.548>
- UNCITRAL. *UNCITRAL Model Law on Electronic Commerce*. United Nations. 1996. Available at: https://uncitral.un.org/en/texts/ecommerce/modellaw/electronic_commerce (accessed on 26 August 2026).
- UNCTAD. *Digital Economy Report 2021*. United Nations. 2021. Available at: https://unctad.org/system/files/official-document/der2021_en.pdf (accessed on 25 August 2026).
- UNITED NATIONS. *United Nations Convention on Contracts for the International Sale of Goods (CISG)*. 1980. Available at: https://uncitral.un.org/en/texts/salegoods/conventions/sale_of_goods/cisg (accessed on 25 August 2026).
- UNITED NATIONS. *United Nations Convention on the Use of Electronic Communications in International Contracts*. 2005. Available at: <https://uncitral.un.org> (accessed on 25 August 2026).
- VERKHOVNA RADA OF UKRAINE. *Law of Ukraine "On Electronic Documents and Electronic Document Flow" No. 851-IV*. 2003. Available at: <https://zakon.rada.gov.ua/laws/show/851-15> (accessed on 30 August 2026).
- VERKHOVNA RADA OF UKRAINE. *Law of Ukraine "On Electronic Commerce" No. 675-VIII*. 2015. Available at: <https://zakon.rada.gov.ua/laws/show/675-19> (accessed on 30 August 2026).

- VERKHOVNA RADA OF UKRAINE. *Law of Ukraine "On Electronic Trust Services" No. 2155-VIII*. 2017. Available at: <https://zakon.rada.gov.ua/laws/show/2155-19> (accessed on 30 August 2026).
- VEALE, M., and ZUIDERVEEN BORGESIOUS, F. "Demystifying the draft EU artificial intelligence act — Analysing the good, the bad, and the unclear elements of the proposed approach". *Computer Law & Security Review*, v. 22, n. 4, 2021, pp. 97-112. <https://doi.org/10.9785/cr-2021-220402>
- VON WENDLAND, M. "Smart contracts that are smart and can function as legal contracts". arXiv. 2018. <https://doi.org/10.48550/arXiv.1805.01279>
- WERBACH, K., and CORNELL, N. "Contracts ex machina". *Duke Law Journal*, v. 67, n. 2, 2017, pp. 313-382. Available at: <https://scholarship.law.duke.edu/dlj/vol67/iss2/2/> (accessed on 30 August 2026).