



Harmonization of International Commercial Law and Personal Data Protection in the Blockchain Era: Challenges and Regulatory Reconstruction in Indonesia

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Abstract: *This research examines the urgency of harmonizing international trade law with personal data protection in the blockchain era. The rapid adoption of blockchain technology in global trade transactions presents new legal challenges related to jurisdiction, privacy, and data security. The purpose of this paper is to analyze the legal vacuum in Indonesia regarding data protection within cross-border digital trade and to formulate reconstruction efforts for future regulations that align with international principles. The study employs a normative juridical method with a statutory, conceptual, and comparative approach to examine the synchronization between Indonesian law, international trade conventions, and data protection standards such as the GDPR. The results indicate that Indonesia's regulatory framework is still fragmented, requiring comprehensive harmonization to ensure legal certainty and international competitiveness. The implication of this research emphasizes the need for a unified regulatory model integrating trade law and data protection to support blockchain-based economic transformation.*

Keywords: *International Trade Law, Data Protection, Blockchain, Legal Harmonization, Regulation*

Introduction

The rapid development of digital technology has fundamentally changed the face of international trade. One of the most influential innovations of the last decade is blockchain technology, which offers a decentralized transaction system with a high level of transparency and authenticity (Li & Hui, 2024). Through a distributed ledger mechanism, blockchain enables data verification and cross-border transactions without intermediaries, which in the context of international trade law provides efficiency opportunities while posing challenges to established legal principles, such as jurisdiction, legal responsibility, and protection of privacy rights (Ganne, 2021). This technology has even begun to be applied in trade finance, global supply chains, and smart contracts used by various international business actors (Chen, 2025). Behind these advances, a complex new problem arises, namely how national and international laws can adapt to the characteristics of technology that are immutable and borderless.

In the Indonesian context, this issue is increasingly relevant with the presence of Law Number 27 of 2022 concerning Personal Data Protection (PDP Law), which is a major

milestone in protecting citizens' privacy rights in the digital era (Indonesia, 2022). The law explicitly regulates the rights of data subjects, the obligations of data controllers, and legal sanctions against personal data breaches. However, on the other hand, the application of blockchain technology presents a new dilemma, due to its nature that does not allow the deletion or modification of data, while the PDP Law and the General Data Protection Regulation (GDPR) demand the right of data subjects to be erased (right to erasure) (Belen-Saglam et al., 2023). This conceptual conflict indicates an urgent need to harmonize personal data protection law with international trade law so that there is no overlap in its application in the cross-border realm.

Various previous studies have attempted to answer some of these problems. Emmanuelle Ganne highlighted that blockchain has major implications for global trade, but faces legal gaps between countries and uncertainty regarding governing law. Michèle Finck also emphasized the tension between the principle of blockchain decentralization and the principle of centralization of data control in GDPR (Finck, 2019). In the national context, research on personal data protection in smart contracts concluded that Indonesian regulations are still limited to contractual aspects without explicit regulations regarding data protection in blockchain systems (Afandi, 2025). Meanwhile, Indonesia's legal framework has not been comprehensively integrated with international trade law standards on issues of digital trade and cross-border data protection (Pratiwi & colleagues, 2025).

However, it can be identified that most of the previous studies are still sectoral in nature and have not examined in depth the interaction between international trade law, personal data protection, and blockchain technology simultaneously (Yoon et al., 2020). This is the research gap in the field of contemporary Indonesian law. The absence of integrated regulations that regulate blockchain-based international trade by paying attention to aspects of personal data protection has resulted in legal uncertainty and potential jurisdictional conflicts between countries. This condition requires a reconstruction of national regulations that are able to answer global legal challenges while providing protection for the rights of data subjects and digital business actors (Shlapak et al., 2023).

Therefore, this study aims to analyze normatively the challenges of harmonization of international trade law and personal data protection in the blockchain era in Indonesia, evaluate the conformity of national regulations with international law principles, and formulate a regulatory reconstruction model that is adaptive to global digital technology developments. The main question posed in this study is: how can Indonesian law be reconstructed to harmonize international trade law and personal data protection in the blockchain era?

In answering this question, this study uses the theoretical framework of international law harmonization and personal data protection. The theory of harmonization of international law is used to explain the process of alignment between national legal norms and international conventions such as the United Nations Convention on the Use of Electronic Communications in International Contracts. Meanwhile, the theory of personal data protection is used to analyze the basic principles of data management and the rights of data subjects, including the challenges of their application in blockchain technology that is decentralized and permanent. The integration of the two theories allows for a

comprehensive analysis of the interrelationship between international trade law and the protection of personal data in the digital age.

The systematics of writing in this article starts from the Introduction which discusses the background, urgency, literature review, research gaps, theories, and research objectives. Furthermore, the Research Methods section explains the normative juridical approach used with legislative, conceptual, and comparative methods. The Results and Discussion section outlines an analysis of Indonesia's positive legal conditions, the challenges of harmonizing international trade law with personal data protection, and recommendations for regulatory reconstruction in the blockchain era. Finally, the Conclusion section contains a summary of the research results and policy implications for the national legal system in dealing with global digital transformation.

Methodology

This research uses normative legal research methods, because the focus of the study departs from the emptiness and disharmony of norms between international trade law, personal data protection, and the application of blockchain technology in the Indonesian legal system. The approaches used include the statute approach, the conceptual approach, and the analytical approach. The legal materials used consist of primary legal materials in the form of national laws and instruments and international legal instruments, secondary legal materials in the form of scientific literature and the latest legal journals, and tertiary legal materials such as legal dictionaries and encyclopedias. The technique of collecting legal materials is carried out through literature studies by browsing through regulatory documents, academic publications, and related decisions. The analysis was carried out qualitatively through systematic interpretation and normative evaluation of the effectiveness of national laws in harmonizing international trade regulations and personal data protection in the blockchain era.

Result and Discussion

Legal Challenges in Blockchain Integration with International Trade Law

A. The Complexity of Blockchain Characteristics in Global Trade Transactions

Blockchain technology is a revolutionary innovation that brings a paradigm shift in the international trade transaction system. Unlike conventional systems that are centralized and require trusted third parties, blockchain creates a transaction recording mechanism that is decentralized, transparent, and immutable. This characteristic makes blockchain function as a global digital ledger that can be accessed by all network participants without intermediaries (Tresnawati & Fatmawati, 2021). In the context of international trade, blockchain allows the process of trade finance, documentary credit, and supply chain management to run faster, more efficiently, and is protected from the risk of document manipulation.

The use of blockchain in international trade is mainly applied in the digitization of documents such as bills of lading, letters of credit, and certificates of origin which previously required manual cross-border verification. With a smart contract system, transactions can be executed automatically if certain conditions are

met, thereby minimizing the potential for delays and fraud (Kusumaningsih, 2025). However, these advantages actually create new legal complexities. Blockchain is borderless because each node validating transactions can be in a different jurisdiction. This raises problems in determining the governing law, choice of forum, and enforcement of the rights and obligations of the parties involved.

In international commercial law, the jurisdiction and applicable law are usually determined based on where the contract is made or performed. But in blockchain systems, transactions are carried out in a digital space that has no physical location, so classic principles such as *lex loci contractus* (the law under which contracts are made) and *lex loci solutionis* (the law under which contracts are executed) become blurred (Musthafa et al., 2024). This condition has implications for the weak dispute resolution mechanism, as it is difficult to determine the authorized legal forum when the parties are in different countries but interact through a global blockchain network.

A. Fragmentation of National Regulations in the Face of Cross-Border Digital Trade

In the Indonesian context, there are a number of regulations that partially touch on aspects of digital trade and data protection, including Law Number 7 of 2014 concerning Trade (Indonesia, 2014), Law Number 11 of 2008 concerning Information and Electronic Transactions (ITE) and its amendments (Indonesia, 2008), as well as Law Number 27 of 2022 concerning Personal Data Protection (PDP Law) (Indonesia, 2022). However, there is no norm that explicitly governs the application of blockchain technology in international trade activities. This creates a disharmony between the importance of personal data protection and legal certainty for digital business actors.

The PDP Law, for example, requires a mechanism for the deletion of personal data (right to erasure) and access control by data subjects. This provision is technically difficult to apply to blockchains that are permanent and cannot be removed. In the context of global trade, this situation has the potential to create a conflict of norms with international provisions, especially the GDPR in the European Union which applies high standards to data privacy rights. Therefore, Indonesia needs regulations that are more responsive to the characteristics of new technologies, without sacrificing the principle of legal protection for data subjects (Afandi, 2025).

Disharmony between Data Protection Principles and Principles of International Trade Law

A. The Tension between the Right to Privacy and Transaction Transparency

International trade law basically prioritizes the principles of openness and accountability in cross-border trade. On the other hand, personal data protection laws demand restrictions on access and confidentiality of individual information. Tensions arise when blockchains that record all transactions openly and indestructibly come face to face with the principle of data privacy. In this case, the

concept of "transparency by design" of blockchain often conflicts with the "privacy by design" mandated in the GDPR and the PDP Law (Batubara & Prayogo, 2023).

According to the theory of personal data protection, the rights of data subjects include the right to know, correct, and even delete personal data (Jusić, 2024). But in a blockchain system, any data that has been validated and stored in blocks will be permanent because it is designed to prevent manipulation. Therefore, the main challenge for Indonesia is to find a legal mechanism that can balance the privacy rights of individuals with the need for transparency of international transactions.

B. Implications for Legal Certainty and Parties' Responsibilities

The absence of a clear mechanism regarding legal liability in blockchain creates uncertainty about who should be held accountable in the event of a data breach. In a decentralized system, there is no single data controller as stipulated in Article 1 number 4 of Law Number 27 of 2022 concerning Personal Data Protection (PDP Law), which defines a personal data controller as a party who determines the purpose and control of the processing of personal data. In the context of blockchain, this function cannot be attached to a single entity because the network structure is peer-to-peer, so responsibility is distributed among the nodes that carry out validation and data storage. This creates a normative vacuum in determining the legal subjects who are directly responsible for personal data breaches that occur on the network. In international trade law, the principle of *pacta sunt servanda* requires contractual certainty between the parties, but blockchain presents an automatic legal relationship without negotiation space after the contract is executed (self-executing contract). Therefore, the application of national positive laws to blockchain systems requires adaptation to a model of collective responsibility and code-based oversight mechanisms (Kusumawardani & Hawin, 2024).

Reconstruction of National Regulations Towards Harmonization of International Commercial Law and Personal Data Protection

Efforts to harmonize international trade law and personal data protection in the context of the application of blockchain technology demand comprehensive legal reforms that are comprehensive and adaptive to technological developments (Ganne, 2021). To achieve this goal, it is necessary to reconstruct national regulations based on the principles of technology-neutral law and cross-border data protection. This principle is important so that the law is not tied to one particular form of technology, but is able to adapt to the ever-evolving innovations. In this case, the Government of Indonesia needs to expand the scope of Law Number 27 of 2022 concerning Personal Data Protection (PDP Law) (Indonesia, 2022) and Law Number 11 of 2008 concerning Information and Electronic Transactions (ITE Law) by adding norms that regulate data processing mechanisms in distributed systems, such as blockchain, as well as clarifying the legal responsibilities of the parties involved in the system.

In addition to internal reforms, strengthening international cooperation is an important element to ensure the convergence of legal standards between Indonesia and its major trading partners (Zhao, 2024). Member countries of the Organisation for Economic Co-

operation and Development (OECD) and the European Union have implemented cross-border data protection principles that are in line with the GDPR, so Indonesia needs to adjust its legal policies so that the personal data of Indonesian citizens remains protected when processed by foreign entities in blockchain-based international trade transactions (Wu, 2024). Strengthening international legal diplomacy through bilateral and multilateral cooperation in the field of data governance will encourage the creation of harmonious global standards and minimize the risk of jurisdictional conflicts.

In the context of national implementation, the legal harmonization model proposed in this study consists of three main dimensions that are interrelated and form a comprehensive policy framework. The first dimension is normative integration, namely the alignment of national regulations with the principles of international law through amendments to the ITE Law and the drafting of new implementing regulations for the PDP Law that explicitly regulate data processing in the blockchain system (Khan et al., 2021). This integration aims to ensure that national norms do not conflict with international legal instruments such as the General Data Protection Regulation (GDPR), the WTO Trade Facilitation Agreement, and the UNCITRAL Model Law on Electronic Commerce.

The second dimension is institutional coordination, namely strengthening synergy between government agencies such as the Ministry of Trade, the Ministry of Communication and Information, and the Personal Data Protection Authority which will be formed based on the mandate of the PDP Law. This coordination is needed to establish clear technical guidelines regarding the application of blockchain technology in cross-border trade, including oversight of data security, transaction validation, and enforcement of legal responsibility (Karisma et al., 2023). Cross-agency collaboration is also important to build a governance framework that allows the application of accountability and transparency principles in every digital transaction.

The third dimension is the application of the principle of accountable technology in the national legal system (Strawn & Berg, 2022). This principle emphasizes that every entity participating in a blockchain network, whether developers, platform providers, or users, must have legal responsibilities proportionate to its functions and roles (Conti & De Filippi, 2024). In this case, it is necessary to formulate legal provisions that expressly determine who is responsible for data misuse or privacy violations in the blockchain system. Thus, national laws are not only reactive to violations, but also preventive in encouraging the responsible application of technology (Tang et al., 2023).

Through this approach, Indonesia's national law is expected to be able to transform towards a regulatory framework that is adaptive, inclusive, and in line with the principles of international trade law (Islam Khan, 2025). This harmonization is not only needed to provide legal certainty and protection of the rights of personal data subjects, but also a strategic step to increase Indonesia's competitiveness in the global digital trade ecosystem. Ultimately, this legal update is expected to create a balance between technological innovation, privacy protection, and legal certainty in the implementation of blockchain-based cross-border transactions.

Table 1: Comparison of Personal Data Protection Principles and Blockchain Systems

| Aspects | Data Protection Principles (PDP/GDPR LAW) | Blockchain Features | Potential Legal Conflicts |
|------------------------------|---|-----------------------------|----------------------------------|
| Data Handling | Centralised by data controller | Inter-node decentralization | It is unclear who is responsible |
| Right to Delete | Data may be deleted at the request of the subject | Data immutable | Technically conflicting |
| Transparency | Limited, as per the data subject's permissions | Public and permanent | Privacy vs openness |
| Jurisdiction | Border-bound | Global cross-border | Law enforcement conflicts |
| Audit and Supervision | Conducted by a data protection authority | Automated by system | Supervisory vacancies |

Source: Processed from GDPR 2016/679, Law No. 27 of 2022, and the study of Finck (2019), Ganne (2021).

The analysis of the table above shows that there is a fundamental contradiction between the legal principles of data protection which are centralistic and the blockchain mechanism which is decentralized. This conflict demands regulatory innovation that is able to bridge the need for legal certainty and privacy protection in a balanced manner (Belen-Saglam et al., 2023). From the perspective of the theory of international law harmonization, this regulatory reconstruction step shows a form of vertical adjustment between international norms and national law (vertical harmonization), as well as horizontal integration between domestic legal sectors (horizontal harmonization) to create a unified legal system that is responsive to digital globalization. Meanwhile, based on the theory of personal data protection, the resulting legal policy must place humans as the main subject of protection, not just the object of technological processing (Conti & De Filippi, 2024). Thus, Indonesia's legal approach going forward not only adjusts the technical aspects of blockchain, but also affirms the values of justice, privacy, and social responsibility in the global digital trade ecosystem.

Conclusion

This study concludes that the harmonization between international trade law and the protection of personal data in the blockchain era is an urgent need to answer legal challenges in the cross-border digital era. The complexity of blockchain characteristics that are decentralized and immutable raises jurisdictional issues, legal responsibilities, and conflicts of norms with the principles of personal data protection regulated in the PDP Law and international standards such as GDPR. For this reason, it is necessary to reconstruct national regulations based on technology-neutral principles and cross-border data protection through normative integration, institutional coordination, and the application of accountable technology principles. This harmonization effort is expected to be able to create an Indonesian legal system that is adaptive to technological developments, ensure the protection of individual privacy rights, and strengthen Indonesia's position in global digital trade.

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