

Rethinking the Functions and Digital Transformation of the Bill of Lading in Iranian Law and International Legal Regimes

1. Mohammad Mohebalizadeh[✉]: Department of Private Law, Ur.C., Islamic Azad University, Urmia, Iran

2. Hamid Talebzadeh^{✉*}: Department of Private Law, Ur.C., Islamic Azad University, Urmia, Iran

3. Adel Abbasi[✉]: Department of Private Law, Ur.C., Islamic Azad University, Urmia, Iran

*Correspondence: 27506330702@iau.ir

Abstract

The bill of lading has historically performed multiple interconnected functions in maritime and international trade, including serving as a receipt for goods, evidence of the contract of carriage, a transferable commercial document, a mechanism for controlling delivery, and, in certain contexts, a document of title. The transition from paper-based trade documentation to electronic systems challenges the traditional legal concepts through which these functions have been exercised, particularly originality, possession, endorsement, presentation, surrender, and transferability. This study examines the legal implications of the digital transformation of bills of lading and evaluates the extent to which their traditional functions can be reconstructed within electronic environments. Using a doctrinal, analytical, and comparative legal approach, the study considers the position of the bill of lading under Iranian maritime and contract law and compares it with broader developments in international commercial and electronic trade law. The analysis demonstrates that the central difficulty is not the electronic reproduction of documentary information but the creation of a legally authoritative electronic record capable of ensuring exclusivity, integrity, authentication, transferability, and finality. The study argues that the concept of electronic control should function as the legal equivalent of physical possession, while authenticated transfer of control should replace traditional endorsement and delivery mechanisms. It further finds that general recognition of electronic documents is insufficient to resolve the specialized legal issues associated with transferable bills of lading. Iranian law therefore requires a more explicit legal framework capable of recognizing electronic bills of lading as functionally equivalent to paper documents while addressing authoritative status, electronic transfer, surrender, technological reliability, cybersecurity, interoperability, and protection against duplicate claims. The study concludes that digital transformation should be understood not as the abandonment of the traditional bill of lading but as the reconstruction of its established legal functions through technology-neutral mechanisms based on functional equivalence, exclusive control, integrity, and cross-border legal certainty.

Keywords: Bill of Lading; Electronic Bill of Lading; Maritime Law; Digital Transformation; Electronic Transferable Records; Functional Equivalence; Iranian Law; International Trade Law

Received: 05 January 2026

Revised: 07 May 2026

Accepted: 15 May 2026

Published 30 May 2026



Copyright: © 2026 by the authors. Published under the terms and conditions of Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License.

Citation: Mohebalizadeh, M., Talebzadeh, H., & Abbasi, A. (2026). Rethinking the Functions and Digital Transformation of the Bill of Lading in Iranian Law and International Legal Regimes. *Legal Studies in Digital Age*, 5(3), 1-15.

1. Introduction

International trade depends not only on the physical movement of goods but also on the circulation of documents that represent, evidence, authorize, and facilitate that movement. Among these documents, the bill of lading occupies an exceptional position because its importance extends considerably beyond the operational relationship between a carrier and a shipper. Historically associated with maritime carriage, the bill of lading developed into a sophisticated legal and commercial instrument capable of connecting the contract of carriage with the sale of goods, financing arrangements, delivery obligations, transfer of commercial rights, and the disposition of goods while they remain in transit. Its legal significance therefore derives not from a single characteristic but from the simultaneous performance of several interconnected functions. In conventional maritime commerce, the bill acknowledges receipt or shipment of goods, provides evidence of the terms governing carriage, identifies the person entitled to claim delivery, and, in negotiable form, facilitates the transfer of rights relating to the cargo. Debattista explains the bill of lading within export trade as an instrument whose importance arises from its integration into the commercial chain rather than merely from its status as a transport document (Debattista, 2009). This multifunctional character also explains why commercial law has traditionally treated the bill of lading differently from ordinary receipts and administrative transport records. Goode situates transferable commercial documents within a wider system in which documentary mechanisms make it possible for rights relating to goods and transactions to circulate without requiring the physical goods themselves to accompany each commercial transaction (Goode, 2016). Consequently, the bill of lading became one of the principal legal techniques through which physical merchandise could remain aboard a vessel while commercial control over that merchandise changed during the voyage.

The central importance of the traditional bill of lading is particularly visible in transactions involving goods sold during maritime transit. The existence of a documentary mechanism enables a seller, buyer, bank, consignee, or subsequent transferee to deal with the commercial value of goods without physically possessing the cargo. The document therefore functions as a bridge between physical possession and juridical control. The traditional law surrounding bills of lading developed around this relationship between the tangible document and the intangible rights associated with it. Possession of an original bill could identify the person entitled to demand delivery, while endorsement and delivery of the document could participate in the transfer of commercial rights. Safaei and Rahimi emphasize the distinctive position of transport documentation within maritime law and its connection with the carrier's obligations and the rights of cargo interests (Safaei & Rahimi, 2019). In commercial doctrine, the importance of the bill is likewise inseparable from the principle that documentary control can substitute, for particular legal purposes, for immediate physical control over the goods. Goode's analysis of commercial documents demonstrates how this documentary structure supports negotiability, financing, security arrangements, and commercial certainty (Goode, 2016). The law has therefore constructed around the paper bill an elaborate architecture involving possession, originality, presentation, endorsement, surrender, authenticity, and the protection of lawful holders. These concepts became so deeply embedded in maritime commerce that the physical form of the document was often treated as an almost natural component of the rights it represented.

Digital transformation challenges precisely this assumption. Contemporary international trade increasingly operates through electronic communications, digital platforms, automated logistics, electronic financing arrangements, and integrated information systems. The continuation of paper documentation within such an environment may produce delays and transaction costs that are inconsistent with the speed of modern commercial operations. Yet replacing paper with an electronic file does not automatically reproduce the legal characteristics of the traditional bill of lading. Electronic commerce law has long confronted the broader problem of translating legal requirements developed for physical documents into digital environments. Reed observes that electronic transactions require legal systems to distinguish between rules whose objectives can be achieved electronically and rules that depend upon characteristics historically associated with tangible media (Reed, 2011). The problem is particularly difficult where the relevant document is transferable because digital information is ordinarily capable of being copied perfectly and simultaneously. Goldby identifies this problem as fundamental to the use of electronic documents in maritime trade, where legal effectiveness depends not merely on communication of information but on recreating functions traditionally associated with possession, transfer, uniqueness, and presentation (Goldby, 2013). Accordingly, the electronic bill of lading cannot adequately be understood as a scanned paper bill, a PDF attachment, or an ordinary electronic message.

Its legal viability depends upon whether an electronic system can produce effects sufficiently equivalent to those generated by the controlled circulation of a unique paper document.

The transition also raises a deeper theoretical question concerning the relationship between law and technology. Legal modernization does not necessarily require the abandonment of traditional legal functions, but it may require the concepts through which those functions are expressed to be reconsidered. Brownsword argues that technological change places pressure on legal categories when regulatory assumptions formed in one technological environment are transferred into another (Brownsword, 2019). A rule requiring a document, signature, possession, or delivery may pursue an identifiable legal objective, yet the technological mechanism originally used to achieve that objective may cease to be indispensable. The challenge is consequently to identify what the law is actually protecting. If possession of a paper bill historically establishes exclusive entitlement to exercise particular documentary rights, an electronic environment must provide a reliable mechanism for establishing functional exclusivity even though there is no tangible object to possess. If endorsement communicates and effectuates a transfer, a digital system must provide an equivalent mechanism for authorizing and recording that transfer. If surrender of an original protects the carrier from competing demands for delivery, an electronic system must ensure that a person who has transferred or surrendered control can no longer exercise the same documentary entitlement. Goldby's examination of electronic maritime documentation demonstrates that digitalization succeeds legally only when these underlying functions are reproduced rather than when paper terminology is mechanically applied to electronic information (Goldby, 2013).

These issues have particular relevance to Iranian law. Iranian maritime law developed in an era in which paper bills of lading represented the normal documentary infrastructure of maritime trade. Its concepts concerning issuance, documentary content, delivery, the carrier's obligations, and the rights of cargo interests therefore operate against a predominantly physical documentary background. Safaei and Rahimi's treatment of Iranian maritime transport law reflects the continuing centrality of documentary relations in regulating maritime carriage (Safaei & Rahimi, 2019). At the same time, Iranian private law contains sufficiently general contractual principles to recognize that legal relationships must be interpreted according to their substantive juridical effects rather than merely their external form. Katouzian's analysis of contractual rules illustrates the importance of intention, legal effect, obligations, and the relationship between formal mechanisms and substantive contractual rights (Katouzian, 2012). Nevertheless, general contractual flexibility cannot by itself resolve every difficulty associated with an electronic transferable transport document. A conventional electronic contract involves communication and consent, whereas an electronic bill of lading may additionally require exclusivity, transferability, control, presentation, and protection against multiple inconsistent claims. The problem is therefore not simply whether Iranian law recognizes electronic communications, but whether its maritime and commercial framework can reproduce the specialized legal effects historically connected with a negotiable bill of lading.

Comparative experience demonstrates that this challenge is not unique to Iran. Jurisdictions seeking to facilitate electronic bills of lading have had to reconsider the conceptual vocabulary through which possession and transfer are legally expressed. Zhao's examination of electronic bills of lading in China illustrates the interaction between technological innovation, commercial practice, and the requirement for an adequate legal foundation capable of supporting electronic transferability (Zhao, 2020). The Chinese experience is especially instructive because it demonstrates that technological capacity does not automatically create legal certainty. Market participants may adopt electronic platforms, but banks, carriers, traders, insurers, and courts require confidence that the electronic instrument will have recognizable effects when disputes arise. Zhao therefore identifies legal and policy issues as integral to the development of electronic bills rather than secondary concerns to be addressed after technical implementation (Zhao, 2020). Similar considerations apply to Iran, where modernization of trade documentation must connect technological infrastructure with rules governing documentary rights, contractual obligations, evidence, transfer, and delivery.

The objective of this study is to rethink the legal functions of the bill of lading in light of its digital transformation and to determine how those functions can be preserved, reconstructed, or reformulated within Iranian law by reference to developments in international legal regimes. The central research question is whether the traditional functions of the bill of lading can survive the transition from paper documentation to electronic records without sacrificing the commercial certainty traditionally generated by originality, possession, endorsement, presentation, and surrender. The study argues that the most

appropriate analytical method is not to compare paper and electronic bills solely in terms of physical form. Instead, each traditional function should be isolated and its underlying legal purpose identified, after which the electronic mechanism proposed as its equivalent can be evaluated. This approach makes it possible to distinguish between characteristics of paper that are merely historical and legal functions that remain indispensable.

The study adopts a doctrinal, analytical, and comparative approach. It examines the conceptual foundations of bills of lading in commercial and maritime law, identifies the problems created when those concepts are translated into electronic environments, and evaluates the compatibility of Iranian law with broader international approaches to electronic maritime documentation. The research proceeds from the proposition that digital transformation is neither purely technological nor simply formal. It is an institutional and juridical transformation because it changes how commercial actors establish entitlement, demonstrate authenticity, exercise control, transfer rights, and obtain delivery of goods. The principal contribution of the study lies in constructing functional continuity as the basis for legal reform. Under this approach, the objective of modernization is not to imitate every material feature of the paper bill but to preserve the commercial and legal effects that gave the document its value. This perspective enables the transformation from possession to control, from physical endorsement to authenticated electronic transfer, and from surrender of paper to termination or transfer of electronic control to be analyzed as interconnected elements of a single legal modernization project.

2. Legal Nature and Traditional Functions of the Bill of Lading

The legal nature of the bill of lading has historically resisted reduction to a single doctrinal category because the instrument simultaneously participates in several legal relationships. It originates within the performance of a contract of carriage but may subsequently affect parties who did not participate directly in the formation of that contract. It contains statements relating to the goods, yet it is more than an ordinary evidentiary record. It may facilitate delivery, but its significance can arise long before the vessel reaches the destination. It may be transferred during the voyage and used in commercial transactions involving the goods, financing, or security. The bill consequently occupies the intersection of contract law, maritime law, commercial law, documentary trade, and aspects of property-related entitlement. Debattista emphasizes that the importance of the bill in export transactions arises from the manner in which its functions interact with the sale contract and the carriage relationship (Debattista, 2009). Commercial law similarly recognizes that documents connected to goods may perform functions that extend beyond proof of an underlying transaction. Goode explains that documentary arrangements in commerce are important precisely because legal systems attach consequences to control, transfer, and presentation of particular documents (Goode, 2016). The legal analysis of bills of lading must therefore begin with their multifunctionality rather than with an attempt to force the instrument into a single conceptual classification.

The most immediate function of a bill of lading is its function as a receipt. When goods are placed in the custody of the maritime carrier, commercial parties require reliable evidence of what has been received or shipped. The bill identifies the cargo and ordinarily records information concerning matters such as description, quantity, marks, apparent condition, loading, and destination. The receipt function performs an obvious evidentiary role between shipper and carrier, but its significance becomes greater when the document is transferred to a third party who was not physically present when the carrier received the goods. Debattista's analysis demonstrates the importance of documentary representations in export trade, particularly because subsequent commercial actors must often rely on the document rather than independently inspect the cargo (Debattista, 2009). Safaei and Rahimi likewise identify transport documentation as an important component of the legal relationship between the carrier and persons interested in the cargo (Safaei & Rahimi, 2019). The reliability of the bill as a receipt therefore supports the wider documentary economy of maritime trade. A bank considering documents under a financing arrangement, a buyer awaiting goods abroad, or a transferee acquiring an interest during transit may all depend on statements made in a document generated at the beginning of carriage.

The receipt function cannot, however, be separated completely from evidentiary consequences. The commercial usefulness of the bill would be weakened if statements contained in it could always be disregarded or contradicted without limitation. Documentary reliability is particularly important where the bill has circulated beyond the original shipper. Commercial parties who acquire documents in reliance upon their apparent regularity require a degree of legal predictability concerning the representations they contain. Goode connects commercial documentary mechanisms with the broader need for certainty and

reliance in transactions involving parties who may be separated geographically and institutionally (Goode, 2016). This characteristic becomes particularly relevant when considering digital transformation because an electronic bill must preserve not only information but also the ability to establish who issued it, whether the information has been altered, and whether the electronic record relied upon is authoritative. The traditional receipt function thus already contains the conceptual seeds of later digital requirements relating to authenticity and integrity.

A second major function is evidencing the contract of carriage. The bill of lading should not be simplistically equated with the contract in every circumstance because the carriage agreement may arise before the bill is issued and may involve arrangements not immediately visible on the face of the document. Nevertheless, the bill becomes an essential documentary expression of the terms according to which the carrier undertakes to transport and deliver the goods. Safaei and Rahimi discuss maritime carriage through the obligations and rights arising between carriers and cargo interests, with transport documentation providing an important basis for determining those relationships (Safaei & Rahimi, 2019). Debattista similarly shows that bills of lading perform a contractual evidentiary role that becomes particularly significant when the document circulates in export transactions (Debattista, 2009). For the original shipper, the bill may evidence a contract already concluded; for a subsequent holder, the document may become the principal source through which the terms governing carriage are identified. The contractual function therefore illustrates how documentary transfer can alter the practical importance of the instrument even when the physical goods and the carrier remain unchanged.

This characteristic is closely connected to the doctrine of contractual relativity and the position of third-party holders. Ordinary contract principles begin from the relationship between the parties who create contractual obligations. Katouzian's discussion of general contractual rules emphasizes the importance of consent, intention, legal effects, and the identification of persons upon whom obligations operate (Katouzian, 2012). The transferable bill of lading complicates this model because commercial practice requires subsequent holders to obtain enforceable documentary rights even though they may not have been parties to the initial negotiation between shipper and carrier. Commercial law consequently developed specialized mechanisms through which transfer of the bill can affect the entitlement to demand performance and delivery. Goode treats such mechanisms as part of the distinctive legal structure of transferable commercial documents (Goode, 2016). This feature is especially important for digitalization because any electronic substitute must provide a legally recognizable method for identifying the person who has acquired documentary rights and distinguishing that person from previous holders.

The document-of-title function represents the most distinctive and conceptually demanding characteristic of the traditional bill of lading. The expression does not mean that the document mechanically creates ownership in every transaction or that every transfer of a bill necessarily transfers property in the goods regardless of the parties' intentions and applicable law. Rather, its significance lies in the legal relationship between control of the document and the ability to control disposition or delivery of the represented goods. Goode explains that commercial documents of title enable rights in relation to goods to be dealt with through documentary mechanisms while the goods themselves remain in the possession of a carrier or another intermediary (Goode, 2016). Debattista similarly emphasizes the role of the bill in enabling commercial dealings in goods during export transactions (Debattista, 2009). The documentary mechanism thus allows symbolic or constructive control to operate where physical possession is commercially impossible or undesirable.

This function is central to the sale of goods in transit. A cargo may remain aboard the same vessel while the commercial interest associated with it changes hands repeatedly. The bill makes such transactions practicable because the parties can transfer the relevant documentary entitlement without interrupting transportation or physically delivering the goods at each stage. In this sense, the bill separates the movement of commercial entitlement from the movement of physical possession. Safaei and Rahimi recognize transferability as one of the characteristics giving maritime transport documents their particular significance in trade (Safaei & Rahimi, 2019). Goode's broader commercial analysis explains why transferable documents can support transactions involving sale and security interests while goods remain under the control of a third-party custodian or carrier (Goode, 2016). This ability is one of the principal reasons that the problem of electronic bills cannot be solved merely by recognizing electronic writing. An electronic record must support a controlled transfer of documentary entitlement capable of replacing the legally significant transfer of the paper bill.

Negotiability and transferability also need to be distinguished carefully from mere communicability. A paper document can be photocopied, emailed as an image, or reproduced for information without transferring the legal position associated with the original. What matters in the traditional structure is that the law recognizes a particular act or sequence of acts as capable of changing the person entitled to exercise the documentary rights. Debattista explains how endorsement and delivery operate within the commercial use of bills of lading (Debattista, 2009). Goode situates such transfer mechanisms within the broader doctrine of transferable commercial instruments (Goode, 2016). The juridical effect does not arise because information about the cargo has been communicated to another person; it arises because the legally authoritative document has been transferred in a recognized manner. This distinction becomes decisive in the digital environment, where sending an electronic copy is technically simple but establishing that only the transferee retains the relevant authority requires a more sophisticated system.

The presentation and surrender function completes this architecture. At the destination, the carrier must determine whether the person demanding the goods is entitled to receive them. The traditional bill provides a documentary mechanism for connecting delivery with presentation. The requirement to present or surrender an appropriate original reduces the risk that goods will be delivered to a person lacking the relevant documentary entitlement. Safaei and Rahimi's treatment of maritime carriage underscores the significance of delivery within the carrier's performance of the transport obligation (Safaei & Rahimi, 2019). Debattista shows that possession and presentation of bills have consequences that extend into the broader structure of export transactions (Debattista, 2009). The presentation rule also performs a risk-allocation function because delivery without appropriate documentary authority may expose the carrier to competing claims. Thus, the traditional "original" is not valuable merely because it is physically distinctive; its value lies in its role as the exclusive or authoritative token whose presentation permits performance.

The paper bill additionally performs a financing function derived from the interaction of its other characteristics. A bank financing an international sale may be willing to provide credit because documents relating to the goods offer a degree of control over the transaction. Goode emphasizes the importance of documentary control and security mechanisms within commercial finance (Goode, 2016). Debattista likewise connects bills of lading to the documentary structure through which export sales are performed and financed (Debattista, 2009). The capacity of the bill to function within documentary credit, security, and payment arrangements depends heavily on confidence in its authenticity, transferability, and connection to the goods. The document's financial function therefore does not stand independently; it is generated by the combination of its receipt, contractual, title-related, transfer, and presentation functions.

These traditional functions reveal that the physical bill of lading is best understood as a legal technology developed before digital technology. Paper, signatures, endorsement, possession, and surrender constitute a technological arrangement through which the legal system historically created exclusivity, traceability, transferability, and commercial certainty. Brownsword's analysis of law and technological change is useful because it demonstrates that established legal mechanisms should not be mistaken for the regulatory objectives they serve (Brownsword, 2019). The paper bill is therefore not valuable simply because it is paper. It is valuable because the legal system uses the characteristics of paper to achieve functions essential to maritime commerce. Once this distinction is made, digital transformation can be analyzed more precisely. The relevant inquiry becomes whether electronic systems can reproduce an authoritative record, reliable identification, exclusive control, effective transfer, integrity, and final surrender. If they can, the transition from paper need not destroy the legal architecture of the bill of lading; it can reconstruct that architecture through different technical mechanisms.

3. Digital Transformation of the Bill of Lading: From Possession to Electronic Control

Digital transformation of the bill of lading begins with a distinction between digitizing information and digitizing legal functionality. A traditional bill can easily be converted into digital information by scanning it, photographing it, entering its contents into a database, or generating an electronic document containing the same textual terms. Such practices improve communication but do not necessarily create an electronic bill of lading in the legally significant sense. Goldby demonstrates that the central difficulty of electronic maritime documents is not the electronic reproduction of written information but the replication of functions attached to transferable paper documentation (Goldby, 2013). Reed similarly explains that electronic commerce law frequently relies on functional approaches because legal requirements concerning writing, signature, originality,

and documentation were historically framed by reference to physical media (Reed, 2011). The electronic bill must consequently be understood as a digital legal instrument rather than simply a digital image of a conventional document. The decisive question is whether the electronic record can operate as the authoritative medium through which documentary rights are exercised and transferred.

The first obstacle is the problem of originality. A sheet of paper has material characteristics that enable parties to distinguish an original from a photocopy or reproduction, even though fraud and forgery remain possible. Digital data, by contrast, can normally be reproduced without degradation, and two technically identical copies may contain exactly the same information. Goldby identifies this feature as one of the reasons electronic transferable documentation requires specialized legal and technical structures (Goldby, 2013). If an electronic bill could simply be copied and each copy treated as independently effective, several persons might simultaneously claim the same cargo, defeating the fundamental requirement of exclusive documentary entitlement. Reed's analysis of electronic commerce illustrates why digital law must often replace physical concepts of originality with requirements concerning integrity, authoritative records, reliable systems, and identifiable control (Reed, 2011). The solution is therefore not necessarily to create a digital object that is metaphysically impossible to copy. Rather, the system must establish which electronic record is legally authoritative and ensure that duplicated informational copies cannot independently generate the same legal entitlement.

This transformation requires a reconsideration of possession. Traditional private and commercial law associates possession with physical control over a tangible object. The holder of a paper bill can place it in a vault, deliver it to a bank, endorse it to a purchaser, hand it to an agent, or surrender it to the carrier. Each act has a physical dimension. An electronic record cannot be possessed in exactly the same manner because digital information does not occupy a single physical location in the sense relevant to documentary possession. Goldby's analysis of maritime electronic documentation demonstrates that "control" provides a more appropriate conceptual substitute where an electronic system enables one person to exercise the relevant powers associated with a transferable record (Goldby, 2013). The critical element is exclusivity: the system must identify the person entitled to exercise control and prevent a transferor from continuing to exercise the same rights after an effective transfer. This transformation from possession to control is not merely terminological. It represents a shift from physical exclusivity to legally and technologically constituted exclusivity.

Control should therefore be defined functionally. The person in control must be capable of using the electronic record in ways equivalent to those available to the lawful holder of a paper bill, including transferring the record, presenting or surrendering it, and exercising the documentary entitlement to demand delivery where appropriate. Reed's broader treatment of electronic transactions supports the principle that legal effectiveness should depend upon the reliability of electronic processes rather than formal imitation of physical acts (Reed, 2011). Goldby similarly emphasizes the importance of systems capable of reproducing the transfer and control characteristics of maritime documents (Goldby, 2013). A legally adequate system must therefore establish not only who currently controls the record but also whether control has been transferred, whether prior control has been terminated, whether unauthorized alteration has occurred, and whether the record remains effective or has been surrendered.

Electronic transfer is the corresponding substitute for endorsement and delivery. In a paper environment, transfer of a negotiable bill ordinarily requires dealings with the authoritative physical document. In a digital environment, the relevant act must occur through a trusted process capable of recording the transferor's authorization and establishing the transferee as the new person in control. Zhao's analysis of electronic bills of lading highlights the importance of legal rules capable of giving electronic transfer mechanisms effects comparable to traditional documentary transactions (Zhao, 2020). Goldby likewise shows that the viability of electronic maritime trade depends on mechanisms that reproduce the commercial consequences of transfer rather than merely transmit information (Goldby, 2013). An email attachment is insufficient because the sender ordinarily retains an identical copy and may be technologically capable of forwarding it again. A genuine electronic transferable record must instead operate through a system in which the transfer changes the legally recognized state of control.

Authentication is equally important. A paper bill commonly bears signatures, stamps, endorsements, or other physical indications that allow commercial actors to evaluate its provenance and apparent regularity. Digital systems require alternative mechanisms for identifying issuers, transferors, transferees, carriers, and other authorized persons. Reed treats electronic

signatures and authentication as central components of the legal infrastructure supporting digital transactions (Reed, 2011). Brownsword's broader analysis of technological regulation also demonstrates that confidence in technologically mediated transactions depends upon institutional arrangements that establish accountability and trust (Brownsword, 2019). For electronic bills, authentication must be sufficiently robust to prevent unauthorized persons from creating or transferring records in the name of legitimate commercial actors. Yet legal rules should avoid requiring a single technological method because authentication technologies evolve rapidly. The preferable approach is to require a level of reliability appropriate to the function and risk of the transaction.

Integrity performs the electronic equivalent of confidence that a paper document has not been impermissibly altered. The contents of a bill may determine the description of goods, identities of parties, destination, contractual terms, and documentary entitlement. Unauthorized modification could therefore have substantial commercial consequences. Goldby emphasizes integrity as a central concern in electronic maritime documentation (Goldby, 2013). Reed similarly connects the legal recognition of electronic records with the ability to demonstrate reliability and protection from unauthorized alteration (Reed, 2011). Integrity need not mean that no technical change of any kind can occur, because electronic records may require authorized endorsements, amendments, or transfers. Instead, the system should make legitimate changes identifiable and traceable while preventing undetectable unauthorized modification. The legal requirement is therefore controlled mutability rather than absolute immutability.

The question of surrender illustrates the importance of functional thinking. Physical surrender of the original bill to the carrier has historically served as evidence that the person exercising documentary entitlement is relinquishing the document in exchange for delivery of the goods. In an electronic environment, surrender cannot mean physically handing over data. The equivalent process must terminate, transfer, or otherwise disable the holder's control in a manner associated with delivery. Goldby's analysis demonstrates that electronic systems must address precisely this transition from documentary control to final performance (Goldby, 2013). The carrier should be able to verify that the person requesting delivery currently controls the record and that, after delivery, the record cannot continue circulating as though the cargo remained available for documentary disposition. This requirement is essential for preventing double claims and preserving the finality traditionally produced by surrender of an original paper bill.

Digitalization also introduces cybersecurity risks that differ from conventional documentary risks. Paper bills can be stolen, forged, lost, destroyed, or fraudulently altered, but digital systems introduce threats involving unauthorized access, credential theft, cyberattacks, compromised platforms, malicious code, database corruption, and failures of technological infrastructure. Brownsword's discussion of technological governance emphasizes that law must consider not merely the adoption of innovative systems but also the risks created by dependency on technological architectures (Brownsword, 2019). Zhao similarly identifies policy and legal concerns surrounding electronic bills that cannot be resolved solely through technological optimism (Zhao, 2020). Legal recognition should therefore be linked to standards of system reliability, security, traceability, continuity, and accountability. The purpose is not to demand perfect security, which is unattainable in either paper or electronic commerce, but to ensure that the chosen system is sufficiently reliable for the legal functions it performs.

Interoperability presents an additional challenge. International maritime trade rarely occurs within a single closed institutional network. A shipment may involve exporters, importers, carriers, freight forwarders, ports, customs authorities, banks, insurers, brokers, and other intermediaries situated in different jurisdictions. Goldby explains that the effectiveness of electronic maritime documentation depends on its ability to operate within the wider architecture of international trade (Goldby, 2013). Zhao's examination of national legal policy likewise illustrates the problems arising when electronic practices develop within one jurisdiction but must interact with foreign legal systems (Zhao, 2020). A technologically effective electronic bill may have limited commercial utility if it is recognized by one platform but rejected by another, accepted by a carrier but not by a bank, or legally effective in one country but uncertain in the destination jurisdiction. Digital transformation therefore requires both technical interoperability and legal interoperability.

Blockchain and distributed-ledger technologies have often been proposed as possible solutions to problems of uniqueness, traceability, and transfer. Their potential lies in creating shared records of transactions that are resistant to unauthorized alteration and capable of documenting successive transfers. Nevertheless, the legal concept of an electronic bill should not be

tied to blockchain or any particular technology. Brownsword warns more generally against regulatory approaches that allow technological design to displace careful examination of legal objectives and institutional safeguards (Brownsword, 2019). Goldby's functional analysis likewise suggests that what matters is whether a system reproduces the relevant documentary effects, not whether it employs a particular technical architecture (Goldby, 2013). A centralized registry, secure platform, distributed ledger, tokenized system, or future technology may all potentially satisfy the same legal requirements if they provide adequate authenticity, integrity, exclusive control, transferability, traceability, and finality.

The digital transformation of the bill of lading can therefore be summarized as a transformation of legal techniques rather than of legal purposes. The paper document becomes an authoritative electronic record; physical possession becomes exclusive control; handwritten or physical endorsement becomes authenticated electronic transfer; delivery of the document becomes transfer of control; presentation becomes reliable demonstration of control; surrender becomes termination or relinquishment of control; physical originality becomes integrity and authoritative status; and documentary chains become electronic audit trails. The continuity lies in the functions, while the transformation lies in the means through which those functions are performed. This functional continuity provides the most coherent basis for evaluating Iranian law and international legal models because it avoids two opposite errors: treating paper concepts as permanently indispensable and treating technological innovation as sufficient by itself to produce legal equivalence.

4. Electronic Bills of Lading in Iranian Law and International Legal Regimes: Comparative Analysis and Reform

The transition to electronic bills of lading exposes a structural tension within legal systems whose maritime rules were drafted around the assumptions of paper documentation. Iranian maritime law belongs to this category. Its legal architecture developed when physical issuance, possession, presentation, and transfer of transport documents represented the ordinary commercial environment. Safaei and Rahimi describe the bill of lading within Iranian maritime transport law as a central document governing important aspects of the relationship among carrier, shipper, consignee, and cargo interests (Safaei & Rahimi, 2019). The traditional doctrinal structure is therefore capable of explaining the legal consequences of paper bills with considerable sophistication, but digital transformation presents a different question: whether those consequences can attach to an electronic record when the statutory or doctrinal language presupposes tangible documentary practices. The existence of technologically capable electronic platforms does not by itself answer this question because private actors require confidence that courts and other institutions will recognize electronic control, transfer, and surrender as legally equivalent to their paper counterparts.

Iranian contract law provides an important starting point but not a complete solution. General principles of contractual validity are capable of accommodating considerable variation in the form through which parties express intention and structure obligations. Katouzian's treatment of general contract law emphasizes substantive concepts such as intention, consent, obligations, interpretation, and legal effects rather than reducing contractual legitimacy to a single material form (Katouzian, 2012). This flexibility supports the argument that electronic communications need not be considered inherently incompatible with contractual relationships surrounding maritime carriage. However, a transferable bill of lading performs functions that exceed the bilateral contract between shipper and carrier. The electronic record may circulate among persons who were not parties to the original agreement, may affect entitlement to delivery, may be relied upon by banks, and may be transferred in connection with the sale or financing of goods. General freedom of contract cannot necessarily impose the intended documentary effects on all relevant third parties or resolve priority disputes among competing claimants.

This distinction between contractual validity and transferable-document validity is fundamental. An electronic contract may be effective because the parties consent to deal electronically. An electronic bill of lading, by contrast, requires a legal framework determining which electronic record is authoritative, who controls it, how control is transferred, what happens after transfer, how competing claims are resolved, and when the carrier is discharged by delivery. Reed's analysis of electronic commerce demonstrates that general recognition of electronic communications constitutes only one component of a broader legal infrastructure (Reed, 2011). Goldby makes the point more specifically in maritime trade by demonstrating that transferable electronic documents require solutions to problems that do not arise in the same form for ordinary electronic

contracts (Goldby, 2013). Iranian legal modernization should therefore avoid assuming that rules validating electronic writings and signatures automatically provide a comprehensive regime for electronic bills of lading.

A function-by-function comparison clarifies the nature of the gap. The receipt function is relatively easy to digitalize. An electronic record can describe goods, record quantities, identify the vessel or carrier, state the destination, and reproduce other information conventionally contained in a paper bill. Electronic authentication can also connect the record with its issuer. Reed's account of electronic transactions demonstrates that digital records can perform evidentiary and informational functions traditionally associated with writing where authenticity and reliability are established (Reed, 2011). The contractual evidentiary function is similarly adaptable because contractual terms can be incorporated into or linked with an electronic record. The most serious difficulties emerge with the document-of-title and transfer functions, because these require exclusivity rather than simple information preservation. Goldby identifies the reproduction of negotiability and control as one of the central problems in transforming maritime documents electronically (Goldby, 2013).

The traditional international regimes of maritime carriage illustrate why this difficulty emerged. Earlier legal structures surrounding bills of lading were developed during periods when paper documents were commercially dominant. Debattista's analysis of conventional export trade reflects a documentary system in which the physical bill performs its functions through possession, endorsement, presentation, and delivery (Debattista, 2009). Goode's commercial-law account likewise places paper-based documents of title within a broader doctrinal framework of transferability and commercial rights (Goode, 2016). The Hague and Hague-Visby tradition therefore emerged from a world in which the bill was naturally conceived as a physical instrument, even though the underlying commercial functions were not conceptually dependent on paper in the abstract. The Hamburg framework modernized important aspects of maritime carriage but did not, by itself, eliminate the broader legal challenges created by electronic negotiability. These regimes remain significant for understanding carrier obligations and documentary practices, but digital transformation requires concepts more explicitly adapted to electronic records.

The Rotterdam approach represents a conceptual movement toward integration of electronic documentation within maritime carriage. Its importance lies less in any single technical rule than in the recognition that electronic transport records can perform legally meaningful functions within the carriage relationship. Goldby treats such international developments as evidence of the gradual movement from paper-specific documentary assumptions toward functional equivalence in maritime law (Goldby, 2013). This movement is consistent with the broader evolution of electronic-commerce law described by Reed, in which legal systems increasingly ask whether electronic methods satisfy the purpose underlying traditional formal requirements (Reed, 2011). For Iranian law, the significance of this development is methodological. Reform need not discard the traditional functions of the bill; rather, legislation can expressly recognize electronic techniques capable of performing them.

The international movement toward electronic transferable records further strengthens this functional approach. The critical conceptual innovation is the substitution of reliable electronic control for physical possession. Goldby's analysis provides the doctrinal foundation for understanding why control can serve as the electronic counterpart of possession when it is exclusive, identifiable, and transferable (Goldby, 2013). Reed's work supports the wider principle that functional equivalence allows electronic procedures to satisfy legal requirements where they achieve comparable reliability and legal purpose (Reed, 2011). In an electronic bill-of-lading regime, control should therefore carry the legal significance traditionally attached to possession only when the system reliably identifies the person exercising that control and ensures that an effective transfer deprives the former controller of the ability to continue exercising the same documentary rights.

The experience of China provides a useful comparative example because it demonstrates the interaction between commercial modernization and legal uncertainty. Zhao observes that the development of electronic bills of lading requires not only technical platforms but also a supportive legal and policy environment (Zhao, 2020). A jurisdiction may possess highly developed digital infrastructure while still encountering uncertainty regarding the proprietary, documentary, evidentiary, or transferable effects of electronic records. Zhao's analysis indicates that harmonization between technological practice and legal doctrine is essential if electronic bills are to achieve widespread commercial acceptance (Zhao, 2020). This lesson has direct relevance to Iran. Digital trade initiatives will remain incomplete if electronic bills are recognized operationally by some participants but their legal effect remains uncertain in disputes involving carriers, banks, consignees, transferees, or third-party claimants.

A major area requiring clarification in Iranian law concerns the authoritative electronic record. In the paper environment, commercial actors understand the legal importance of the original bill, even though several originals may sometimes be issued as part of a set subject to established documentary practices. Digital records require a different conceptual method because informational copies cannot reliably be distinguished merely by their appearance. Goldby explains that electronic systems must identify the record that carries the relevant transferable function and maintain its integrity throughout the transaction (Goldby, 2013). Iranian legislation should therefore avoid defining originality by reference to physical uniqueness. The appropriate criterion is authoritative status: a reliable system should identify which electronic record is legally operative, record its current controller, and ensure that informational reproductions cannot independently be used to exercise the documentary entitlement.

A second area concerns electronic endorsement and transfer. Traditional terminology may be retained for continuity, but its legal meaning should be functionally reformulated. Transfer should require an authenticated act by the person currently entitled to control the record, followed by a system-level change establishing the transferee as the new controller. Goldby's analysis of electronic maritime documents demonstrates the importance of connecting transfer with exclusive control rather than merely with electronic communication (Goldby, 2013). Zhao similarly identifies secure and legally recognizable transfer mechanisms as important to the practical development of electronic bills (Zhao, 2020). The law should make clear that after an effective transfer, the transferor cannot continue to exercise the same documentary power, even if copies or historical records remain visible in the system.

Electronic surrender requires corresponding recognition. A carrier must be able to deliver goods with confidence that the person claiming them holds the relevant documentary entitlement and that delivery will terminate the record's further circulation. Safaei and Rahimi's analysis of maritime transport emphasizes the legal importance of proper delivery within the carrier's obligations (Safaei & Rahimi, 2019). Goldby shows why electronic documentation must recreate the finality traditionally associated with presentation and surrender (Goldby, 2013). Iranian reform should accordingly define an electronic process through which control is relinquished or transferred for the purpose of delivery, after which the record is marked as discharged, surrendered, cancelled, or otherwise incapable of supporting another demand for the same cargo.

Reliability standards should be technology-neutral. Requiring a particular software system, cryptographic technique, platform provider, or distributed-ledger architecture would risk making legislation obsolete as technology changes. Brownsword's analysis of technology regulation demonstrates the importance of designing legal standards around regulatory objectives rather than embedding transient technical solutions into law (Brownsword, 2019). Reed similarly supports functional legal standards that allow different technological methods to satisfy equivalent requirements when their reliability is adequate (Reed, 2011). Iranian law should therefore identify the functions to be secured—identity, integrity, exclusive control, transfer, traceability, security, and finality—while allowing commercial and technological innovation to determine how those functions are achieved.

The question of reliability also requires allocation of responsibility for system failures. Electronic bills depend upon technological intermediaries in ways that conventional paper documents may not. Platform operators may authenticate users, store records, execute transfers, maintain audit trails, and determine whether a record remains active. A system failure may therefore affect the ability to transfer or present the bill. Brownsword emphasizes that technologically mediated legal environments require attention to institutional responsibility and accountability rather than exclusive focus on technical efficiency (Brownsword, 2019). Zhao similarly demonstrates that policy questions concerning infrastructure and legal responsibility accompany the development of electronic bills (Zhao, 2020). Iranian reform should consequently clarify the responsibilities associated with unauthorized access, negligent system administration, inaccurate records, loss of control credentials, and failures preventing legitimate exercise of documentary rights.

Cross-border recognition constitutes another critical issue. Maritime trade is inherently international, and the legal effectiveness of an electronic bill may need to be recognized in the jurisdiction of issuance, ports of transit, destination states, banking jurisdictions, and places where commercial disputes are litigated. Goldby demonstrates that electronic maritime documents cannot achieve their full commercial potential without legal interoperability across jurisdictions (Goldby, 2013). Zhao's comparative experience reinforces the difficulty of using electronic bills where national rules differ concerning legal recognition or transferability (Zhao, 2020). Iran should therefore pursue reform in a manner compatible with widely accepted

international principles of functional equivalence and electronic control. An idiosyncratic national model might establish domestic validity while reducing the usefulness of Iranian electronic bills in international transactions.

Banks and trade-finance institutions represent another reason harmonization is essential. The commercial value of a bill of lading depends partly on whether financial institutions will accept it within documentary transactions. Goode's treatment of commercial law demonstrates the importance of transferable documentation to financing structures involving goods (Goode, 2016). Debattista similarly links bills of lading with the performance and financing of export sales (Debattista, 2009). Banks will hesitate to treat an electronic bill as equivalent to paper if questions remain concerning transfer, priority, authenticity, control, or enforceability. Legal reform should therefore ensure that electronic bills can participate in security and financing arrangements without requiring financial institutions to assume materially greater legal risk solely because the medium has changed.

The comparative analysis ultimately indicates that the most significant deficiency is not the absence of digital technology but the absence of a sufficiently explicit bridge between traditional maritime doctrine and electronic transferable records. Iranian law already possesses maritime concepts governing transport documents and general private-law principles capable of supporting electronic transactions. The reform task is to connect these fields through a specialized functional framework. Such a framework should recognize an electronic bill of lading as capable of performing the same legally relevant functions as paper where a reliable method establishes the authoritative record, preserves integrity, identifies the person in control, enables exclusive transfer of control, authenticates relevant acts, maintains traceability, permits surrender or termination, and protects carriers and third parties against duplicate claims. It should also facilitate conversion between paper and electronic media where commercial circumstances require such substitution, provided that conversion does not leave two simultaneously operative instruments representing the same documentary entitlement.

The broader normative implication is that digital transformation should not be conceptualized as deregulation. Eliminating paper does not eliminate the need for legal safeguards; in some respects it increases their importance. Brownsword's examination of law and technology demonstrates that innovation can redistribute risks, institutional power, and dependency even where it increases efficiency (Brownsword, 2019). Electronic bills may reduce delays, courier expenses, lost-document problems, and administrative burdens, but they simultaneously create reliance on digital identity systems, platform governance, cybersecurity, and technological continuity. Legal reform should therefore pursue equivalence of protection as well as equivalence of function. The electronic holder should receive a level of legal certainty comparable to that enjoyed by the lawful holder of a paper bill, while carriers and third parties should receive comparable protection against fraudulent or competing claims.

Accordingly, a coherent Iranian reform model should proceed from functional equivalence, technology neutrality, exclusive electronic control, integrity, authentication, traceability, interoperability, and legal finality. These concepts should not be viewed as isolated technical requirements. Together, they reconstruct the legal architecture historically produced by possession of the paper original. Such reform would allow Iranian maritime law to preserve the commercial logic of the bill of lading while removing unnecessary dependence on its material form. It would also position Iranian trade law more effectively within the increasingly digital infrastructure of international commerce, where the competitiveness of legal systems will depend partly on their ability to support reliable cross-border electronic documentation without sacrificing the certainty upon which documentary trade has historically depended.

5. Conclusion

The bill of lading is one of the clearest examples of a legal institution whose apparent dependence on material form conceals a deeper functional structure. For centuries, paper served as the technological medium through which maritime and commercial law organized the receipt of goods, evidence of carriage, transfer of documentary entitlement, control over goods in transit, financing, presentation, and delivery. Because these functions developed through physical possession, endorsement, presentation, and surrender, the paper form gradually appeared inseparable from the legal institution itself. Digital transformation demonstrates that the relationship is more contingent. The essential functions of the bill do not logically require paper, but abandoning paper requires the law to identify precisely what each traditional mechanism accomplished and to create an electronic equivalent capable of producing comparable certainty.

The analysis undertaken in this study shows that some functions are relatively easy to reproduce electronically. An electronic record can identify the carrier, shipper, consignee, cargo, voyage, destination, and contractual terms with at least the same informational capacity as paper. It can also preserve a detailed audit trail and provide sophisticated methods of authentication. The difficult functions are those that historically depended on exclusivity. A transferable bill is not merely information concerning goods; it is an authoritative documentary mechanism through which a particular person can exercise rights unavailable simultaneously to every recipient of the same information. Digital replication therefore creates a problem that conventional paper doctrine largely solved through possession of the original. An electronic legal framework must reconstruct that exclusivity through control.

The transition from possession to control is consequently the conceptual center of the digital bill of lading. Electronic control should not be treated as an abstract technological concept but as a juridical condition in which an identifiable person has the exclusive ability to exercise the transferable functions associated with an authoritative electronic record. Effective transfer requires the existing controller to cease holding that exclusive legal position and the transferee to acquire it. Electronic surrender similarly requires the record to cease functioning as an independently transferable entitlement when the goods are delivered. In this manner, the sequence historically expressed through possession, endorsement, transfer, presentation, and surrender can be translated into a digital sequence based on authoritative records, exclusive control, authenticated transfer, verification of control, and termination or relinquishment of control.

This functional reconstruction also clarifies the meaning of originality in the digital environment. The law does not need to pretend that electronic data cannot be copied. What it requires is a means of distinguishing between informational copies and the electronic record that carries legal authority. A reliable system can therefore preserve the concept underlying the original without reproducing its physical characteristics. Integrity, authoritative status, traceability, and exclusivity together perform the function historically served by possession of an original paper bill. This approach prevents the legal system from becoming trapped by technological terminology while preserving the safeguards that made transferable documentation commercially viable.

For Iranian law, the principal challenge is the coexistence of a traditional maritime documentary framework with the realities of contemporary electronic commerce. The existing maritime structure provides a substantial doctrinal foundation for understanding the rights and obligations historically associated with bills of lading. General contract principles likewise provide flexibility in recognizing agreements and legally significant acts performed through evolving commercial practices. Yet neither body of rules, considered independently, fully answers the questions raised by an electronic transferable bill. The principal unresolved issues concern authoritative electronic status, exclusive control, transfer, priority, surrender, conversion between media, protection against duplicate claims, system reliability, and cross-border recognition.

The appropriate response is not to construct an entirely separate institution unrelated to the traditional bill of lading. Such an approach would unnecessarily fragment commercial doctrine and might weaken the continuity required by carriers, traders, banks, insurers, and courts. Nor should reform simply declare that an electronic document is equivalent to paper without specifying how transferable functions operate. Formal recognition without functional infrastructure would produce apparent modernization while leaving the most important commercial risks unresolved. The preferable approach is to establish legal equivalence conditionally: an electronic bill should receive the legal effects associated with its paper counterpart when the electronic system reliably performs the functions for which traditional documentary requirements existed.

This framework requires explicit recognition of electronic control as the counterpart of possession. It also requires a reliable method for identifying the person in control, authenticating transfers, preserving the integrity of the record, ensuring that previous controllers cannot continue exercising transferred rights, and providing a final mechanism for surrender or discharge. The law should additionally recognize that the technical architecture through which these objectives are achieved may change. Centralized platforms, distributed ledgers, cryptographic systems, digital identity infrastructures, and technologies not yet developed may all potentially perform the relevant functions. Legislation should therefore regulate legal outcomes and reliability rather than prescribe a permanent technological solution.

Technology neutrality is especially important because maritime trade involves long-term investments and international transactions. A technologically prescriptive statute may become outdated rapidly or inadvertently privilege one commercial platform. A functional framework allows innovation while preserving common legal standards. The relevant questions remain stable even when technology changes: Can the authoritative record be identified? Can its integrity be verified? Can the person

entitled to control it be established? Can control be transferred exclusively? Can unauthorized alterations and competing transfers be detected? Can the carrier safely determine who is entitled to delivery? Can the electronic record be discharged so that it cannot support a second claim after delivery? If the system can reliably answer these questions, the legal purpose of the traditional documentary mechanisms can be preserved.

Legal modernization must also account for the international character of maritime transactions. A national electronic bill of lading has limited value if its validity ends at the border. Iranian reform should therefore be designed with cross-border interoperability as an essential objective rather than a secondary consideration. Legal concepts should be formulated in terms capable of recognition within international electronic-trade practice. Harmonization does not require complete replication of foreign law, nor does it require surrender of domestic private-law principles. It requires a vocabulary of functional equivalence sufficiently compatible with international commerce that foreign carriers, banks, traders, and courts can understand the juridical effect of an Iranian electronic bill.

The relationship between paper and electronic systems should also remain flexible during the transitional period. International trade will not become entirely paperless at the same moment in every jurisdiction, industry, port, or financial institution. Commercial transactions may therefore require conversion from paper to electronic form or from electronic to paper form. The legal framework should permit this transformation while ensuring that only one operative documentary entitlement exists at any particular time. Conversion should extinguish the legal effectiveness of the previous medium when the replacement becomes operative. Without this safeguard, hybrid documentation could create precisely the risk of duplicate claims that digital reform is intended to prevent.

Institutional responsibility will be equally important. The electronic bill of lading shifts part of the infrastructure of legal trust from physical custody toward technological systems. Platform operators and authentication providers may consequently acquire considerable practical influence over commercial rights. The law must ensure that technological intermediaries do not become unaccountable gatekeepers. Rules concerning system reliability, unauthorized transfers, cybersecurity incidents, errors, loss of access, preservation of records, and evidentiary transparency should accompany recognition of electronic transferable records. Commercial efficiency should not be purchased at the expense of an opaque allocation of risk.

The study therefore concludes that digital transformation should be understood as a reconstruction of the bill of lading rather than its disappearance. The receipt remains a receipt, but it becomes an authenticated electronic record. Evidence of carriage remains necessary, but it is preserved digitally. The document-of-title function remains commercially significant, but documentary possession is reconstructed as exclusive control. Transferability remains essential, but physical endorsement and delivery are replaced by authenticated transfer of control. Presentation remains important, but entitlement is verified electronically. Surrender remains necessary, but it operates by termination, relinquishment, or transfer of electronic control. The material techniques change while the legal purposes remain substantially continuous.

For Iranian law, this approach offers a path between conservatism and technological determinism. Maintaining exclusive reliance on paper would increasingly disconnect maritime law from the infrastructure of international digital trade. Treating technology alone as capable of solving legal problems would be equally inadequate because commercial actors need enforceable rights, predictable priorities, and reliable rules governing delivery and liability. Functional equivalence provides a principled middle path. It preserves the legal achievements of traditional documentary commerce while allowing those achievements to be expressed through modern technological systems.

Ultimately, the future of the bill of lading should not be framed as a choice between paper and technology. The more important question is whether the legal system can preserve trust while changing the medium through which trust is organized. The historical success of the bill of lading resulted from its ability to transform possession of goods into manageable documentary rights capable of circulation across distances and among strangers. The electronic bill represents the next stage of that development. Its success will depend on whether law can transform documentary possession into reliable digital control with the same degree of commercial intelligibility and legal certainty. If Iranian law expressly recognizes this functional transformation and integrates it into a coherent maritime and commercial framework, digitalization can strengthen rather than weaken the traditional role of the bill of lading in facilitating trade, financing, transfer, and secure delivery.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

Acknowledgments

Authors thank all who helped us through this study.

Conflict of Interest

The authors report no conflict of interest.

Funding/Financial Support

According to the authors, this article has no financial support.

References

- Brownsword, R. (2019). *Law, Technology and Society*. Routledge.
- Debattista, C. (2009). *Bills of Lading in Export Trade* (4th ed.). Tottel Publishing.
- Goldby, M. (2013). *Electronic Documents in Maritime Trade*. Oxford University Press.
- Goode, R. (2016). *Commercial Law* (5th ed.). Penguin Books.
- Katouzian, N. (2012). *General Rules of Contracts* (Vol. 1). Sherkat-e Sahami-ye Enteshar.
- Reed, C. (2011). *Electronic Commerce Law* (2nd ed.). Oxford University Press.
- Safaei, S. H., & Rahimi, H. (2019). *Maritime Transport Law*. Mizan.
- Zhao, Y. (2020). Electronic Bill of Lading in China: Legal and Policy Issues. *Journal of Maritime Law*, 73.