

## **Electronic Bills of Lading (Ebol) in International Trade: Current Status and Future Outlook**

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### **ABSTRACT**

*This review article provides an overview of the current state of e-Bills of Lading (eBOLs) adoption and highlights key trends and developments in this field. It explores the evolution of traditional paper-based bills of lading to eBOLs which now have emerged as a digital alternative, offering numerous potential benefits to facilitate international trade and logistics. This review explores the advantages, challenges, adoption factors, legal considerations, and future prospects associated with eBOLs. By examining a range of scholarly articles, industry reports, case studies and other relevant information, this review aims to present a comprehensive analysis of the current state and future potential of electronic bills of lading.*

**Keywords:** e-Bills of Lading (eBOLs), International trade and logistics, Technical infrastructure, Digitization

### **INTRODUCTION**

In the domain of global trade, efficient movement of goods is imperative for successful transactions. The conventional paper-based bill of lading (BOL) holds a pivotal role in facilitating and recording cross-border goods transportation.

#### ***Definition of Paper-Based Bills of Lading***

A BOL is a legal document issued by a goods carrier, evidencing a carriage contract and goods receipt. It details transported goods, their condition, and agreement terms between shipper and carrier. A paper-based BOL is a tangible document, typically on paper, signed by shipper, carrier, and consignee, used when shipping goods internationally.

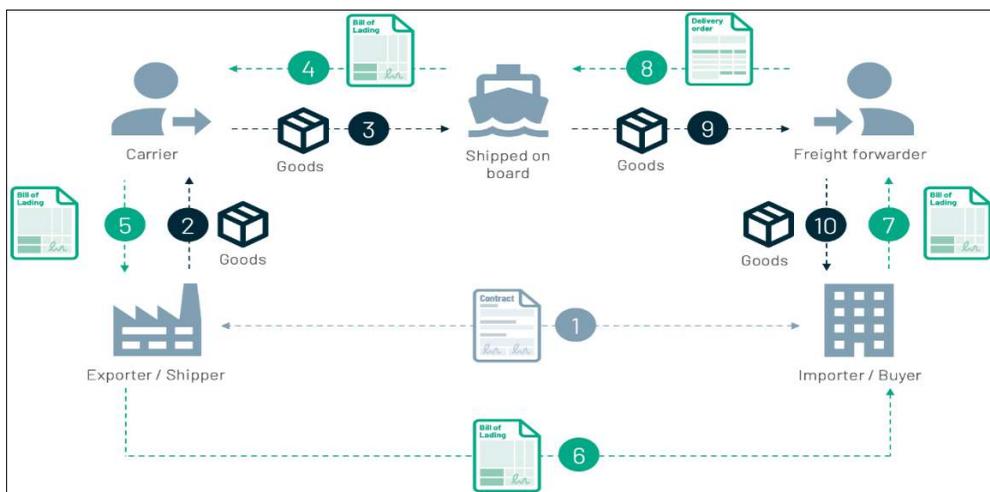
#### ***Purpose of Paper-Based Bills of Lading***

The functions and purpose of traditional paper based BOLs in global trade are summarized as follows.

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- a) Contract Evidence: A paper-based BOL substantiates a carriage contract between shipper and carrier. It outlines terms such as shipment origin, destination, nature of goods, and each party's responsibilities.
- b) Goods Receipt: The BOL acts as proof of goods receipt by the carrier. It confirms quantity, condition, and packaging, aiding insurance claims and dispute resolution.
- c) Title Document: A BOL is a negotiable instrument. Ownership transfers via endorsement of BOL and subsequent delivery, allowing buyers to claim goods and ensure release of goods at the destination port.
- d) Customs Clearance: Paper-based BOLs have vital customs data: goods description, value, origin, weight. Customs authorities verify cargo accuracy and ensure compliance.
- e) Risk Allocation: BOL specifies carrier and shipper duties, determining liability for loss, damage, or delay during transport, aiding dispute resolution.

**Figure 1:** Movement of bill of lading in a cross-border transaction



(Source: Enigio AB, Drottningholmsv. 10, 5 tr, 112 42 Stockholm, SWEDEN, n.d.)

### ***Functions of Paper-Based Bills of Lading***

- a) Document Control: As physical documents, paper BOLs grant authorized parties control over goods. Original documents are needed for cargo release.
- b) Financial Instrument: Paper BOLs can secure financing like letters of credit or loans. They prove transaction legitimacy and goods value, facilitating trade finance.

c) Compliance Proof: BOLs can show shipper compliance with regulations like hazardous materials handling. This helps ensure adherence to laws and regulations.

Despite trade digitalization, paper BOLs still play a vital role in global trade.

### ***Limitations, Inefficiencies, and Risks of Paper-Based Processes***

Paper-based systems have been conventional in international trade but suffer from inefficiencies, delays, and risks. Manual handling leads to processing delays, increased errors, and lacks transparency.

a) Delay and Inefficiency: Manual processing and document transit cause significant delays in trade operations. Errors in data entry further hamper efficiency.

b) Lack of Transparency: Paper-based systems lack real-time visibility, leading to disputes, delays, and cost hikes. Absence of an audit trail invites fraud and forgery risks.

c) High Costs: Printing, storage, and handling physical documents are costly. Manual data entry and verification increase costs, particularly affecting SMEs.

d) Compliance Risks: Evolving regulations pose compliance challenges. Manual processing increases errors, non-compliance, penalties, and reputational damage.

e) Environmental Impact: Paper-intensive processes harm the environment. Digitalization reduces paper use, waste, and carbon emissions. This issue is discussed in more detail below.

The paper-intensive nature of traditional trade processes contributes to deforestation, resource depletion, and carbon emissions. The widespread adoption of digital alternatives can help reduce the environmental footprint of international trade by minimizing paper usage and associated waste. Duval and Hardy (2021) consider four main channels through which paperless trade implementation affects greenhouse gas emissions:

- i. Elimination of physical documents, requiring Paper, Ink and Electricity for printer.
- ii. Reduced number of deliveries required to complete trade transactions. Elimination of physical delivery, and consequently fuel for courier transport, packing (e.g. envelopes)

- iii. Reduced productive hours required to complete procedures. This affects emissions associated with office activities (e.g. commute, office equipment operations, lighting, temperature control, etc.)
- iv. Reduced storage time for cargo, affecting emissions from temperature control, lighting, cargo handling etc.

### ***Digitalization and Automation of Trade Processes***

Digitalization and automation revolutionize international trade. Digitalization integrates technology into trade processes, transitioning from paper to electronic formats for efficient and secure document exchange. Automation involves making use of technology and algorithms to replace manual tasks. Customs, trade finance, and compliance processes can be streamlined. Trade Facilitation Platforms are online platforms that link traders, provide secure payments, contract management, allow consignment traceability, and ease of access to finance services, thereby reducing costs.

### ***Need for and Emergence of Electronic Bills of Lading (eBOLs)***

Traditional paper BOLs face challenges in efficiency and security. eBOLs emerged as digital alternatives, addressing these issues.

- a) Efficiency and Cost Savings: eBOLs reduce administrative burden, enabling faster documentation and cargo release, cutting costs.
- b) Security and Fraud Prevention: eBOLs offer encryption, digital signatures, and authenticity, preventing fraud and unauthorized alterations.
- c) Sustainability: eBOLs reduce paper usage, transportation, and storage, contributing to environmental sustainability.

Emergence of eBOLs has resulted from increasing legal recognition, technological advancements, and industry collaboration.

### ***Objectives and Scope of Literature Review***

This literature review aims to assess eBOL's status and future potential in global trade. It explores eBOL's evolution, advantages, limitations and challenges, adoption status, and future prospects. It provides insights for stakeholders to make informed decisions.

This review paper also contributes to the advancement of the following Sustainable Development Goals (SDGs)

SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation

SDG 13: Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy

SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development

## **ADVANTAGES OF ELECTRONIC BILLS OF LADING (EBOLS):**

### ***Reduction of paperwork and administrative costs***

The adoption of eBOLs eliminates the need for physical paper handling, reduces the risk of document loss or damage, and facilitates faster document transmission across borders. This tool not only expedites the cargo clearance process but also contributes to a greener environment by significantly reducing paper usage.

DCSA (2020) indicates the total cost of processing paper bills is almost three times that of eBLs

DCSA (2023, January) research forecasts that the industry can potentially save more than \$4 billion per year if 50% eBOL adoption is achieved.

### ***Enhanced accuracy in trade documentation***

One of the critical aspects in trade documentation is achieving enhanced accuracy, which directly influences the efficiency, reliability and compliance of global trade operations. The adoption of eBOLs offers a promising avenue for improving accuracy, reducing errors, and enhancing overall trade efficiency.

Traditionally, paper-based Bills of Lading (BoL) have been prone to errors, fraud, and physical mishandling, all of which can result in delays and disputes. eBOLs, on the other hand, offer numerous advantages. They are electronically generated, transmitted, and stored, reducing the likelihood of human transcription errors. This digital format enhances the accuracy of information.

### ***Increased processing efficiency and speed of transactions***

One of the key advantages offered by eBOL is the significant enhancement in processing efficiency and the acceleration of transaction speeds. Historically, the manual processing of paper-based bills of lading has been a time-consuming and error-prone procedure. The need for physical documents to be mailed, verified, and

physically handled by various parties in the supply chain resulted in delays and inefficiencies. eBOLs streamline this process by digitizing the documentation, allowing for swift transmission and verification of information across the involved stakeholders.

Modifying details on a Tradition paper BOL is not an immediate process; it usually entails manual adjustments within a database followed by resending the revised information to the relevant stakeholder. Moreover, when adjustments are needed by shippers and consignees as shipments are nearing port arrival, this circumstance can lead to expensive disruptions or demurrage fees. With the utilization of an electronic Bill of Lading (eBOL), the transfer of goods' ownership and other documentary changes can occur within seconds, mitigating potential complications and hindrances throughout the supply chain.

### ***Improved transparency and traceability in supply chains***

Transparency and traceability have long been essential components of supply chain management, ensuring that goods' movement and transactions are accurately documented and monitored. Traditional paper-based bills of lading often posed challenges in this regard, as they were susceptible to loss, forgery, and delays in transmission, which could lead to information asymmetry and disruptions in the supply chain.

eBOLs, on the other hand, leverage digital technologies to enhance transparency and traceability. The inherent digital nature of eBOLs allows for secure sharing of relevant information among stakeholders involved in the trade transaction. By offering improved transparency and traceability, eBOLs empower stakeholders with real-time insights into the movement of goods, reducing inefficiencies, enhancing accountability, and contributing to smoother trade processes.

### ***Enhanced security and fraud prevention measures***

Ensuring the integrity, authenticity, and confidentiality of electronic trade documents is paramount to fostering trust among stakeholders and facilitating smooth cross-border trade.

Electronic signatures, encryption techniques, and blockchain technology emerge as pivotal components in fortifying the security of eBOL systems. These mechanisms collectively serve to verify the identity of parties involved, protect the data from

unauthorized access or alteration, and create an immutable audit trail of transaction history.

Digital signatures are difficult to forge or tamper with, thereby mitigating the risk of fraudulent activities. Blockchain technology, characterized by its decentralized and distributed ledger, is increasingly being explored to bolster security in eBOL systems. Blockchain's transparency and immutability attributes provide a robust framework for preventing document alterations and fraudulent practices. The decentralized nature of blockchain ensures that no single entity can manipulate or compromise the integrity of the eBOL, enhancing trust among trading parties. Moreover, real-time data tracking and monitoring mechanisms have gained traction in the eBOL landscape as part of security-enhancing strategies.

### ***Environmental sustainability and carbon footprint reduction***

The adoption of Electronic Bills of Lading in international trade presents a pivotal opportunity to advance environmental sustainability goals and reduce the carbon footprint associated with paper-based shipping documentation. By replacing traditional paper-intensive processes with efficient and streamlined digital systems, eBOL has the potential to significantly curtail resource consumption (e.g. paper), energy usage, and consequently greenhouse gas emissions.

The implementation of eBOL eliminates the need for physical documents, thus decreasing paper consumption and the accompanying deforestation pressures. Furthermore, indirect emissions from logistics operations required for the physical movement of eBOLs and allied documentation is also eliminated.

A seminal study on reduction of greenhouse gas emissions by implementing cross-border paperless trade (Duval, Yann and Hardy, Simon; 2021), reveals the below mentioned trade documentation inputs that contribute to emissions:

- Paper
- Ink
- Electricity consumption by printers
- Excess hours of office environment maintenance using electricity
- Physical document delivery using conveyances that rely on fossil fuel
- Trade documentation storage facilities

This study concludes that most savings come from the reduction in office work needed to complete trade transactions. For the average trade transaction, 85 per cent of the

estimated emissions savings are due to reductions in office work hours. Working in an office environment is associated with emissions from air-conditioning, lighting, electricity required to operate office equipment, petrol for employee commutes, garbage disposal etc.

The next most important input is the elimination of paper (accounting for 10 per cent of the estimated emissions savings)

A recent study (Jiang, Li, and Shen, 2021) highlights the significant ecological impact associated with the production of pulp and paper. The issue of severe environmental consequences stemming from this industry has gained paramount importance. Among the foremost environmental concerns of our time is deforestation, with trees being the primary source of the raw materials for paper production, accounting for 93% of raw materials used. A substantial 42% of the global wood harvest is allocated to paper manufacturing.

The study further notes that as part of its operations, the pulp and paper sector emits noxious gases like nitrogen dioxide, sulfur dioxide, and carbon dioxide into the atmosphere. These emissions play a role in various forms of pollution, including acid rain, as well as the release of greenhouse gases such as carbon dioxide, which are recognized drivers of climate change, particularly global warming. Furthermore, the industry discharges considerable amounts of wastewater, contributing to the contamination of water bodies. This discharge can lead to a decrease in oxygen levels within aquatic environments and adversely impact aquatic life.

Duval et al; 2021, report that the physical transport of documents accounts for 4 per cent of the estimated emissions savings.

Paper documents no longer need to be physically moved between internal trade participants, e.g., for a signature, or to be collected from or submitted to relevant agencies. Preparation and submission of paper documents often involve environmentally damaging transport, including by motorbike courier services. Physical document movement necessitates use of packaging material such as envelopes. By contrast, digital data exchange requires electricity for routers, networks, and servers with a comparatively minuscule carbon footprint.

The authors results indicate that “even with conservative assumptions, the emissions savings from paperless trade implementation can be very significant. At the global level, they are equivalent to planting at least a billion trees, driven especially by efficiency gains from handling data digitally”

## **CHALLENGES OF ELECTRONIC BILLS OF LADING (eBOLs)**

### ***Legal validity and enforceability issues***

The legal standing and enforceability of eBOLs present significant obstacles that impact their widespread acceptance in global trade transactions.

#### *Legal Validity of eBOLs*

The legal efficacies of digital bills of lading are not fully tested under the law of contract. The eBOLs have not been regulated under the enforced International Sea Conventions, namely the Hague-Visby Rules and the Hamburg Rules (Plomaritou, E., & Jeropoulos, S., 2022). Rotterdam Rules 2009 however aims to bring legal modernisation, legal harmonisation and legal certainty in international carriage of goods by sea. The ecommerce practices have been recognised under the Rotterdam Rules but challenges in interpretation remain (C. J. C. Tseng, 2018, Dec).

A study (Schiltz, Q., 2019, Sep) concludes that MLETR (Model Law on Electronic Transferable Records) and the Rotterdam Rules support the digitalization of eBOL. However, both laws cannot be implemented without concern as there are still some barriers to overcome. First and foremost, MLETR is limited as a guideline to national legislatures. Secondly, the Rotterdam Rules have not yet been supported by enough countries to be ratified and adapted internationally.

Lind M., et al, 2021, note that an obstacle recognized by shipping firms is the absence of a comprehensive international legal framework. Almost every jurisdiction has its own set of rules. Local regulations, along with uncertain legal areas where laws supporting the use of digital records are not clearly established, present difficulties for implementation. Since maritime shipping occurs on a global scale, the advantages can only be fully realized when all involved parties can legally acknowledge eBOLs and other digital paperwork.

The legitimacy of eBOLs hinges on their adherence to prevailing legal structures and conventions. The United Nations Commission on International Trade Law (UNCITRAL) Model Law on Electronic Transferable Records and the UNCITRAL Model Law on Electronic Commerce furnish pivotal guidelines for establishing the legal authenticity of digital documents like bills of lading.

Furthermore, regulations such as the Electronic Signatures in Global and National Commerce Act (ESIGN) in the United States and the Electronic Identification and Trust Services (eIDAS) Regulation in the European Union set benchmarks for

electronic signatures and their acceptance. Adherence to these rules is pivotal in shaping the legal standing of eBOLs and their validation as dependable documents in international trade.

### ***Enforceability Obstacles***

Despite strides in legal frameworks, challenges to the enforceability of eBOLs linger. A prominent challenge revolves around cross-jurisdictional recognition. With international trade involving entities governed by distinct legal systems, the harmonization of laws and regulations across borders is indispensable. Without universally accepted norms, disputes arising from eBOL usage can escalate into intricate dilemmas and impede swift resolution.

Another hurdle pertains to the weight of evidence. Traditional paper-based bills of lading boast historical precedence as primary proof of goods' acceptance and condition. The transition to eBOLs necessitates the establishment of an equivalent evidentiary value, mandating robust technological solutions to guarantee data integrity, validation, and secure transmission. The assurance against unauthorized access, tampering, or loss of electronic records is pivotal for preserving the trust of all stakeholders involved in the transaction.

While the legal landscape for eBOLs evolves positively with the reinforcement of international agreements and national regulations, challenges linked to cross-border acknowledgment, evidentiary weight, and data protection persist and are being tackled.

### ***Standardization and interoperability concerns***

#### ***Standardization***

In the context of eBOL systems, standardization entails establishing consistent formats, data elements, and communication protocols that facilitate uniform information exchange among diverse stakeholders in global trade. The absence of standardized formats can lead to confusion, data inaccuracies, and impede seamless data flow. Instituting industry-wide norms is pivotal to guarantee smooth interactions between distinct eBOL systems and participants, including shippers, carriers, banks, and customs authorities.

#### ***Interoperability***

Interoperability signifies the capacity of diverse eBOL systems to communicate, comprehend, and process data seamlessly. Achieving interoperability is vital to ensure that eBOLs can be exchanged and accepted across distinct platforms and jurisdictions.

In the absence of proper interoperability, the potential gains from eBOL adoption could be undermined by fragmented systems and limited cross-system operability.

Numerous challenges obstruct interoperability within the eBOL landscape. These challenges comprise disparities in data formats, varying security protocols, and divergent legal and regulatory structures across nations. Addressing these hurdles necessitates harmonizing technical norms and cultivating collaboration among stakeholders.

### ***Technical infrastructure requirements and accessibility concerns***

#### ***Technical Infrastructure Necessities***

Embracing eBOLs mandates a sturdy and standardized technical infrastructure to ensure secure, dependable, and interoperable transactions. Vital technical components encompass:

- a) **Digital Signatures and Encryption:** eBOL platforms must support sophisticated digital signatures and encryption methodologies to ensure the credibility and intactness of electronic documents. These technologies assure that data remains unaltered during transmission.
- b) **Blockchain Technology:** Blockchain can furnish a decentralized and immutable ledger, heightening trust and transparency in eBOL transactions. Its decentralized nature mitigates the risk of single-point failures and potential fraudulent activities, contributing to a more secure system.
- c) **Data Interoperability:** A proficient eBOL system should seamlessly share data between varied stakeholders, including shippers, carriers, and customs authorities. Norms like Electronic Data Interchange (EDI) and the utilization of APIs facilitate data exchange.
- d) **Cloud Infrastructure:** Cloud-based solutions provide scalability and accessibility. Leveraging cloud infrastructure ensures that eBOL services can accommodate varying workloads and remain accessible from diverse geographical locations.

#### ***Accessibility Challenges***

Although eBOLs offer substantial benefits, they present several accessibility challenges that must be surmounted for broad adoption.

- a) **Digital Divide:** Not all regions and businesses possess equal access to advanced technological resources, obstructing the universal embrace of eBOL.

Developing nations or smaller enterprises might lack the required infrastructure, including reliable internet connectivity and contemporary computing devices.

- b) **Interoperability Obstacles:** The coexistence of multiple eBOL platforms with distinct technical specifications can culminate in interoperability issues. Without standardized protocols, seamless communication across different systems becomes arduous.
- c) **Cybersecurity Apprehensions:** Since eBOL involves transmitting sensitive trade-related information through digital channels, ensuring cybersecurity is paramount. The risk of data breaches, hacking, and cyberattacks necessitates robust security measures.
- d) **Legal Acknowledgment:** The legal validity of eBOL is not uniformly recognized across all jurisdictions. Diverse regulations and legal frameworks regarding electronic signatures and document authenticity might hinder the cross-border acceptance of electronically generated documents.
- e) **Technological Obsolescence:** Swift technological advancements can render existing eBOL solutions obsolete over time. Regular updates and adaptability to emerging technologies are essential to sustain the efficiency and security of eBOL platforms.

In conclusion, the triumphant implementation of eBOLs in global trade necessitates a robust technical foundation incorporating digital signatures, blockchain, data interoperability, and cloud resources. However, challenges related to accessibility, interoperability, cybersecurity, legal recognition, and technological evolution must be effectively addressed to ensure the widespread adoption and seamless functioning of eBOL systems.

### ***Cyber security risks and data protection concerns***

The integration of eBOLs in global trade introduces significant cybersecurity risks and data protection concerns that require careful consideration and strategies for mitigation. The interconnected nature of eBOL systems exposes vulnerabilities that could be exploited by malicious entities. These risks involve unauthorized access, data breaches, identity theft, and denial-of-service attacks, which could disrupt trade and compromise sensitive data. Recent instances of cyber-attacks on digital trade platforms validate these concerns.

Data protection issues related to eBOLs primarily center around managing Personally Identifiable Information (PII) and trade-sensitive data. Stringent data protection measures are vital due to regulations like the EU's GDPR (General Data Protection

Regulation). eBOL platforms often involve exchanging PII, including names, addresses, and financial details of trade stakeholders. Mishandling such data could lead to legal consequences and undermine trust in digital trade.

Blockchain-based eBOL systems' data immutability, while a security advantage, may present challenges. Rectifying inaccurate sensitive data may be complex due to blockchain's design. Ensuring accurate data from the start is crucial.

### ***Resistance to change***

The reluctance to adopt new technology is a common phenomenon during technological transitions. Organizations and individuals often hesitate to depart from established practices, even when presented with more efficient alternatives. In the context of eBOL adoption, this resistance can be attributed to various factors.

Firstly, the comfort associated with traditional paper-based systems can create psychological resistance against transitioning to digital solutions. People may be apprehensive about learning new processes and adapting to unfamiliar technologies.

Furthermore, concerns about data security and privacy play a pivotal role in resistance to eBOL adoption. Organizations, especially in the realm of international trade, handle sensitive and confidential information. The fear of data breaches, cyberattacks, or unauthorized access to electronic documents can hinder the willingness to embrace eBOL solutions. In a study (Plomaritou, E., & Jeropoulos, S., 2022) respondents had a negative perception of eBOLs owing to concerns of cyber risk, the ability of eBOLs to function as a document of title, the transferability problems, the ambiguity of the legal status of e-bills of lading in jurisdictions, the high investment cost, the long hours of training etc.

## **ADOPTION FACTORS AND INITIATIVES**

### ***Government initiatives and regulations promoting eBOLs***

By providing a clear legal framework and regulatory support, some governments and international organizations are facilitating the transition from traditional paper-based processes to more efficient and secure electronic trade documentation systems.

Various countries and international organizations have recognized the advantages of eBOLs and have taken steps to encourage their use and provide legal validity to these digital documents. Some examples are provided below.

**UNCITRAL's Model Law on Electronic Transferable Records:** The United Nations Commission on International Trade Law (UNCITRAL) has been at the forefront of developing a legal framework to facilitate the use of eBOLs. Their Model Law on Electronic Transferable Records (MLETR), adopted in 2017, provides guidance on the legal recognition of electronic transferable records, which includes bills of lading. This model law serves as a template for countries to align their national laws, recognizing the legal validity of eBOLs on par with traditional paper-based bills of lading (UNCITRAL Model Law on Electronic Transferable Records, 2017)

**European Union's eIDAS Regulation:** In the European Union, the Regulation (EU) No 910/2014 on electronic identification and trust services for electronic transactions in the internal market (eIDAS) has been a significant step towards promoting eBOLs. It establishes a legal framework for electronic signatures, electronic seals, electronic time stamps, and electronic delivery services, thereby enabling the secure and legally valid use of eBOLs (The European Parliament And The Council Of The European Union, 2014)

**Singapore's Electronic Transactions Act:** Singapore has been a pioneer in promoting electronic commerce, including the use of eBOLs. The country's Electronic Transactions Act provides a robust legal foundation for electronic records and digital signatures, creating an environment conducive to the use of eBOLs and other digital trade documents. (Electronic Transactions (Amendment) Act, 2021)

**United States' Electronic Signatures in Global and National Commerce Act (ESIGN) and Uniform Electronic Transactions Act (UETA):** In the United States, the ESIGN Act and UETA have been instrumental in promoting the legal validity of electronic contracts and records, including eBOLs. These acts ensure that electronic documents, including bills of lading, are not denied legal effect, validity, or enforceability solely because they are in electronic form. (Electronic Signatures in Global and National Commerce Act, 2000)

**United Kingdom's Electronic Trade Documents Bill 2023** was granted Royal Assent on 20 July 2023. This enables documents such as a bill of exchange and bill of lading to be legally recognized in electronic as well as paper format.

### *Industry collaborations and standardization efforts*

Industry collaborations and standardization efforts are pivotal in propelling the adoption of eBOLs in international trade. They provide a foundation for interoperability, streamline processes, and offer a shared understanding of the complex legal and technical landscape. As the landscape of international trade continues to evolve, these collaborative endeavors will remain crucial in shaping the outlook of eBOL adoption.

Several international organizations and bodies are engaged in formulating eBOL standards. For instance, the Digital Standards Initiative (DSI) under the aegis of the International Chamber of Commerce (ICC), are actively involved in devising standard data definitions and message formats for eBOLs. This organization recently released a report on digital standards analysis and recommendations for eBOL, amongst other trade documents (International Chamber of Commerce, Digital Standards Initiative; 2023, March).

For the electronic exchange of Bills of Lading in containerized ocean shipping, the platform provider must be approved by the International Group of Protection & Indemnity (IGP&I). As of September 2022, there are seven approved platforms for the exchange of electronic Bills of Lading. For tracking and tracing cargo and vessel schedules, DCSA maintains a standard for the electronic Bill of Lading for container shipping (Digital Container Shipping Association, 2022, December). To achieve eBOL standardization, DCSA is collaborating with global trade stakeholders on several key areas. These include financial institutions (ICC, SWIFT, Banks, trade finance platforms), eBOL solution providers, regulatory bodies, customs authorities, customers, and standardization bodies (FIATA, BIMCO, UNECE, GS1). The goals include aligning DCSA eBOL standards with industry standards, promoting digital document transfer, ensuring interoperability between platforms, enhancing security standards for authentication, adopting MLETR (Model Law on Electronic Transferable Records) across jurisdictions, maintaining customs compliance, meeting customer needs, and achieving semantic and technical alignment across standardization bodies and fintech platforms.

Lind M., et al, 2021 recommend that financial institutions also need to collaborate. Currently, it's customary to require physical documents such as Bills of Lading for transactions involving Letters of Credit. Encouraging the necessary change in this practice could be driven by the Banking Standards Association and the International Chamber of Commerce (ICC).

The International Federation of Freight Forwarders Associations (FIATA) maintains a standard for the multi-modal electronic House Bill of Lading. BIMCO (The Baltic and International Maritime Council) now maintains a standard for the electronic Bill of Lading for wet and dry bulk shipping. Baltic and International Maritime Council (BIMCO) is the world's largest international shipping association, with over 2,000 members in more than 130 countries, representing over 60% of the world's tonnage. Its global membership includes shipowners, operators, managers, brokers and agents.

In today's age there is increasing instant collaboration within supply chain participants, and the utilization of cloud-based platforms for immediate data exchange. This has resulted in a pressing need for a more adaptable and compatible method of establishing uniform business semantics to facilitate seamless information sharing across supply chains. The creation of Reference Data Models (RDMs) by the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) sets the foundation for this necessary approach. A whitepaper published by United Nations (United Nations Centre for Trade Facilitation and Electronic Business, 2017) explains that the Reference Data Models provide “a consolidated list of standardized data and processes for use in a particular business domain, which are globally understandable and exchangeable between parties using common standard data exchange structures”.

### ***Trust, authenticity, and non-repudiation***

Central to the adoption of eBOL is the establishment of trust, authenticity, and non-repudiation in digital transactions.

#### ***Trust and Authenticity***

The successful implementation of eBOL hinges on building trust among the various stakeholders involved, including shippers, consignees, carriers, banks, and regulatory authorities. Establishing trust in eBOL involves addressing concerns regarding data integrity, tampering, and unauthorized access. One of the foundational technologies for achieving trust in eBOL is blockchain, a distributed and immutable ledger that ensures data authenticity and transparency. Blockchain's decentralized nature prevents a single point of failure, reducing the potential for fraudulent activities and unauthorized modifications to eBOL documents

#### ***Non-Repudiation***

Non-repudiation is a critical aspect of eBOL implementation, as it prevents parties from denying their involvement in a transaction. In the context of eBOL, non-repudiation ensures that once a party has digitally signed the electronic document, they

cannot later disavow their authorization. This is achieved using cryptographic techniques, such as digital signatures, which provide a verifiable link between the signer and the signed content. Digital signatures ensure the integrity of the eBOL, enabling parties to prove their involvement in the transaction if disputes arise.

Recent advancements in cryptographic algorithms and secure key management systems have strengthened the non-repudiation aspect of eBOL. By utilizing public and private key pairs, signatories can digitally sign documents, and these signatures can be independently verified without revealing the private key itself. This technology ensures that the authenticity and origin of eBOL documents can be irrefutably established.

### ***Technological advancements and infrastructure supporting eBOL adoption***

Advancement of technologies like blockchain, the establishment of interoperable platforms, enhanced identity verification mechanisms, and the integration of AI in eBOL processes collectively drive the adoption of eBOLs in international trade.

One of the foundational technologies enabling eBOL adoption is blockchain as it ensures data integrity and transparency by providing a single, immutable source of truth that all relevant stakeholders can access. Digital trade platforms with interoperable systems facilitate the seamless exchange of electronic documents, including eBOLs, among various parties in the supply chain. Advancements in identity verification technologies contribute to the secure implementation of eBOLs. Biometric authentication and digital signatures enhance the verification of parties involved in trade transactions, reducing the risk of fraudulent activities. The evolution of data analytics and artificial intelligence (AI) also holds potential in optimizing eBOL processes-

### ***Cost-effectiveness and return on investment considerations***

A critical aspect influencing the decision to implement eBOL is the cost-effectiveness and return on investment (ROI) considerations associated with this transition. Published research underscores the potential for direct cost savings, operational efficiency improvements, and various tangible and intangible benefits. Traditional paper-based bills of lading entail expenses related to physical documentation, printing, courier services, and document storage. In contrast, eBOLs eliminate these expenses

by digitizing document creation, transmission, and storage. Furthermore, eBOLs offer the potential to expedite customs clearance and reduce delays at ports, thus minimizing demurrage and detention charges.

### *Case studies, success stories, best practices and lessons learned*

As various stakeholders within the global trade ecosystem seek to embrace eBOLs, several case studies, success stories, best practices, and lessons learned have emerged from the field.

In a press release issued by DCSA on 15 Feb, 2023, the members committed to a 100% adoption of eBOLs based on DCSA standards by 2030, moving away from the issuance and use of physical paper bills of lading (Digital Container Shipping Association, 2023, February). The 9 members of DCSA, a neutral, non-profit group founded by major ocean carriers to digitize and standardize the container shipping industry committed to converting 50% of paper bills of lading to digital within the next 5 years, and 100% by 2030 to accelerate the digitalization of container trade. The press release said, “Switching away from the transfer of physical paper bills of lading could save \$6.5 billion in direct costs for stakeholders, enable \$30-40 billion in annual global trade growth, transform the customer experience, and improve sustainability.”

To quote a successful Indian case study (Kumar, 2023), Tata Steel has achieved a groundbreaking milestone by completing its first-ever eBOL transaction using CargoDocs, a digital trade platform provided by essDOCS. This achievement involved the export of steel coils from India's Dhamra Port to Turkey's Port of Karadeniz Ereğli. The entire process, including drafting, reviewing, signing, issuing, endorsing, and surrendering the eBOL, was carried out within 48 hours using the secure online platform. This is in stark contrast to the days or weeks typically required for traditional paper-based transactions. This accomplishment aligns with Tata Steel's ongoing efforts to optimize shipping and trade processes through digital means, leading to time and cost savings, enhanced transparency, and a reduced risk of fraudulent documents.

There has been a notable unsuccessful project as well (The Maritime Executive, 2022). A.P. Moller - Maersk and IBM have decided to end their TradeLens project, a blockchain-based global trade platform aimed at enhancing the efficiency and security

of the global supply chain. The platform that offered eBOLs, was launched in 2018 as a collaboration between IBM and GTD Solution (a Maersk division). It was aimed to facilitate real-time data sharing among trading partners. Despite attracting over 300 members including carriers, terminals, and customs authorities, TradeLens faced challenges in industry-wide adoption due to competition concerns and lack of trust. The developers believed blockchain suited the shipping industry's complexity, yet analysts highlight the need for natural adoption. Maersk plans to pursue other solutions for supply chain digitization, while the TradeLens platform will be shut down by Q1 2023. The industry still values blockchain applications, with the Global Shipping Business Network being a key competitor. Rotem Hershko, Maersk Head of Business Platforms explained “Unfortunately, while we successfully developed a viable platform, the need for full global industry collaboration has not been achieved. As a result, TradeLens has not reached the level of commercial viability necessary to continue work and meet the financial expectations as an independent business.”

## **FUTURE PROSPECTS AND OUTLOOK**

### ***Blockchain: eBOLs' Foundational Backbone***

The integration of advanced technologies, particularly blockchain, holds the potential to revolutionize the trajectory of eBOL and its influence on international trade.

A primary advantage of blockchain is heightened security and transparency, ensured by blockchain's cryptographic principles that render stored information tamper-proof and traceable. This minimizes risks of fraud and reduces the need for intermediaries to verify document authenticity.

Furthermore, blockchain's decentralized nature eliminates single points of failure found in centralized systems, enhancing the reliability and availability of eBOLs. A distributed network of nodes validates and maintains data integrity, bolstering the resilience of the eBOL process.

Efficiency gains are also significant. Smart contracts, self-executing code within the blockchain, can automate various eBOL steps, from issuance to ownership transfer, based on predefined conditions. This automation slashes time and resources for trade transactions, expediting port clearance and lessening administrative burdens.

Blockchain ensures a single source of truth, granting all trade transaction parties access to the same real-time information. This streamlines communication, reduces disputes, and accelerates dispute resolution through an immutable transaction history.

Based on a theoretical model and stakeholder analysis, a study (Loklindt, C., Moeller, M. P., & Kinra, A., 2018) advises a set of eight design principles for the successful implementation of blockchain based e-document exchange. These are (1) Immutability,(2) Decentralization, (3) Security, (4) Privacy, (5) Compatibility, (6) Scalability, (7) Inclusiveness and (8) Territoriality.

However, challenges like technical hurdles, blockchain platform interoperability, and standardization demand attention. Regulatory frameworks must evolve to recognize blockchain-based eBOL legality.

Despite challenges, ongoing research, collaboration, and regulatory evolution could pave the way for widespread adoption of blockchain-based eBOL systems.

### ***Future Trends, Innovations, and Research Directions in eBOL***

- a) **Blockchain and Smart Contracts:** Integrating blockchain and smart contracts into eBOL systems can enhance security and automate processes.
- b) **Increasing Collaboration to facilitate Interoperability and Standardization:** Achieving cross-platform compatibility and standardizing data formats is crucial for seamless eBOL exchange.
- c) **AI and Machine Learning:** Implementing AI in eBOL systems improves risk assessment and decision-making.
- d) **Increased adoption of eBOLs within Regulatory and Legal Frameworks:** Adapting regulations to recognize eBOL's legal validity across geographical jurisdictions is vital for broad adoption.

In conclusion, the future of eBOL hinges on technological advancement, standardization, AI, and regulatory adaptation. Through collaboration, eBOL can reshape global trade toward efficiency, security, and resilience.

### ***Recommendations for policymakers, practitioners, and researchers***

Policymakers, practitioners, and researchers all have vital roles to play in shaping the evolution and adoption of eBOLs..

#### ***Policymakers:***

- a) **Ensure Legal Consistency:** Align eBOL legal frameworks globally to boost cross-border acceptance and legal assurance.
- b) **Strengthen Digital Infrastructure:** Encourage investment in secure digital infrastructure for effective eBOL transmission, especially aiding developing nations in bridging the digital gap.

- c) **Prioritize Cybersecurity:** Collaborate with cybersecurity experts to establish robust measures guarding eBOL systems against threats.

*Practitioners:*

- a) **Foster Expertise:** Provide comprehensive training to all trade participants to grasp eBOL intricacies and procedural shifts.
- b) **Design User-Friendly Platforms:** Collaboratively create intuitive eBOL platforms, ensuring seamless integration with existing systems.
- c) **Thorough Testing:** Rigorously test and validate eBOL systems before full-scale adoption to address operational and technical issues.

*Researchers:*

- a) **Assess Impacts:** Conduct extensive studies to evaluate economic, environmental, and operational effects of eBOL, comparing with paper-based systems.
- b) **Enhance Blockchain Integration:** Research potential integration of blockchain advancements to bolster security, transparency, and traceability in global trade.
- c) **Enhance User Experience:** Investigate user feedback to refine user-centered interfaces and system designs for smoother eBOL adoption.

## **CONCLUSION**

In the journey toward realizing the potential of eBOLs in transforming global trade, a delicate balance must be struck between innovation and addressing persistent challenges. While eBOLs promise substantial benefits, their legal validity, technical infrastructure, interoperability, accessibility, cybersecurity, and resistance to change present complex obstacles. These challenges demand interdisciplinary efforts from policymakers, practitioners, and researchers. By aligning legal frameworks across jurisdictions, fostering technological advancements, and prioritizing security, the potential of eBOLs to revolutionize international trade can be fully harnessed. As the landscape evolves, embracing eBOLs represents a step toward an efficient, secure, and sustainable future for the interconnected world of trade.

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