

Report On
*“Implementation of Blockchain Letter of Credit and its General
Impact on Logistics and Trade Supply Chain”*

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A report submitted to the “Brac Institute of Governance and Development” in partial
fulfillment of the requirements for the degree of
Masters in Procurement and Supply Management (MPSM)

Brac Institute of Governance and Development, BIGD
Brac University
August 2021

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Declaration

It is hereby declared that,

1. The report submitted for the completion of Masters in Procurement is Supply Management degree under BIGD, Brac University based on self-completion.
2. The report is based on the own analysis and findings based from the references from different sources which are fully cited and quoted with references mentioning the sources.
3. The report does not contain material of previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
4. The report does not contain material from which has been accepted, or submitted, for any degree or diploma at a university or other institution.
5. Information and known sources were duly mentioned and support is acknowledged.

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Subject: Approval for submission of Report for completion of course Supply Chain Management in Practice (PSM 665) under MPSM degree

Dear Sir,

This is my pleasure to submit the report regarding “Implementation of Blockchain Letter of Credit and its General Impact on Logistics and Trade Supply Chain” which I was appointed by your direction and supervision.

Despite challenges due to COVID-19 and difficult work schedule, I have attempted my best to finish the report with the essential data and recommended proposition in a significant compact and comprehensive manner as possible.

I truly and sincerely admire and recognize Brac University, BIGD and your kind support for the completion, formulation and submission of the report which is imperative for me to compete the degree in Masters in Procurement and Supply Management.

Finally, I sincerely hope and believe that the report will serve its requirement, purpose and criteria for the fulfilment of the course and degree as well.

Sincerely yours,

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Non-Disclosure Agreement

The submission of the report entitles an agreement between Brac University, Dhaka, Bangladesh and Abdullah Noor-A-Elahi (Student Id.: 17382008, MPSM Program, BIGD) which is hereby declared that the Report titled as “Implementation of Blockchain Letter of Credit and its General Impact on Logistics and Trade Supply Chain” has been prepared and submitted a part of mandatory completion requirement of Masters in Procurement and Supply Management (MPSM) degree for the course “Supply Chain Management and Practice” under Brac Institute Governance and Development (BIGD), Brac University as per due regulation for completion of course PSM-665 (Supply Chain Management in practice). This report and required applicable its contents, information and details are limited and only to be used only for the mentioned purpose and should be remain under confidentiality to avoid unauthorized disclosure from any parties.

Hereby, both parties are needed to be agreed as above.

Acknowledgement

I am sincerely grateful to different persons and institutions for supporting me directly and indirectly over completion of the report. Though, it was as challenging and an unprecedented time considering ongoing and prolonged worldwide spread of COVID-19 pandemic I truly acknowledge the grace of the Almighty for giving me strength and support amidst of the adversities including my hectic work schedule.

I gratefully recognize the contribution of BIGD, Brac University which have provided me provided their support over completion of the report. I also humbly recall the support of my report supervisor and honorable faculty member, Mr. Mir Mehbubur Rahman, MCIPS [Faculty, MPSM Program, BIGD, Brac University] and workplace supervisor Ms. Nusrath Jabin [Service Manager (Priority), Standard Chartered Bank, Gulshan Branch] for providing his valuable critical thinking, advice and guideline which helped me enriching my thinking capabilities over completing the report.

I am also appreciating the different researchers, academicians, scholars and writers whose writings, journals and ideas helped over formulating necessary ideas, key insights and references for information and critical secondary data was imperative over completion of the report.

I would also want to thank BIGD staffs, faculties, coordinators and admin personnel including Ms. Tanzina Mizan, Training Officer, BIGD and Dr. Md Shanawez Hossain, Assistant Professor and Director Executive Development Center (EDC), BIGD.

Finally, I thank to all of my office colleagues, friends, well-wishers and family members who directly or indirectly supported and inspired me over completing this report.

Abstract

Our world is now a Global Village with global trade, business and corporate networks, relationships, agreements. From the beginning of business and commercial Trade; trade and supply of goods around the world was affected by change in different process, policies, rules and regulations, protocols, agreements, relationships, embargo and sanctions which made the free trade limited and disruptive sometimes. Certain challenges were also faced considering the interaction of external environments and situations including the environment, politics, economy, socio economic issues and cause of unprecedented situations including pandemic or calamities. The use of technology has paved the way for the inclusion of the Blockchain in the Supply Chain of global and commercial cross border Trade which has made the process automated (removing the manual documentations) more effective, efficient and decentralized by adding operational efficiency, information and goods, money security, funds, payments availability (Supply finance) and saving logistics time and costs untangling the hurdles. The performance of contract and agreement can be encrypted and validated also by the step by step authenticated networking process. Moreover, inclusion and participation of 3rd party vendors, suppliers and platform distributors has also affected the trade and Letter of credit contract manifold. Nevertheless, there are limitations of any technological implementation, incorporation likewise blockchain in financial, scarcity, infrastructural and socio economic aspects.

Considering all odds like many countries the blockchain has recently been implemented in Bangladesh by SCB, HSBC in commercial consortium LC based Trade supply chain creating an important milestone and paradigm shift in the long history of commercial trade in Bangladesh.

This report has be furnished identifying the key features, design, process, aspects of blockchain archetype and overall diverse effect of incorporation of blockchain in the logistics and supply chain of commercial trade functionalities.

Key words: Blockchain, trade, costs, payments, supply chain, efficiency

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List of Acronyms

LC or, L/C	Letter of Credit
B/L	Bill of Lading
ETB	Existing to Bank
BC	Blockchain
DApps	Distributed apps
PoW	Proof of Work
PoS	Proof of Service
BFT	Byzantine Fault Tolerance
PBFT	Practical Byzantine Fault Tolerance
B2B	Business to Business
P2P	Peer to Peer/ Person to Person
IOT	Internet of Things
GPRS	General Packet Radio Service
ERP	Enterprise Resource Planning
RFID	Radio Frequency Identification
RTGS	Real-time Gross Settlement
DLT	Distributed Ledger Technology
EOQ	Economic Order Quantity
SWIFT	Society for Worldwide Interbank Financial Telecommunication
IBM Corporation	International Business Machines Corporation
EY	Ernst & Young
HSBC	Hong Kong and Shanghai Banking Corporation
SCB	Standard Chartered Bank
BNP Paribas	Banque Nationale de Paris Paribas
CTBC	Chinatrust Commercial Bank/ Chinatrust Banking Corporation
IMS	Inventory Management System
GDP	Gross Domestic Product
RMG	Ready-made garment
MNC	Multinational Corporation
TPS	Transactions per Second

Implementation of Blockchain LC in and its General Impact on Logistics and Trade Supply Chain

Chapter: 1 Letter of Credit (LC) and Trading

1.1 Definition:

A letter of credit, or "credit letter" or technically irrevocable "Documentary Credit" is a Negotiating facility issued through transferable letter from a bank guaranteeing that a buyer's (Importer who will be buying or, receiving goods and pay money) payment to a seller (Exporter who will be receiving money after selling goods) will be received on time and for the correct amount to holder (Beneficiary as receives the document from the issuing via the beneficiary) upon all the conditions duly met and contract is valued.

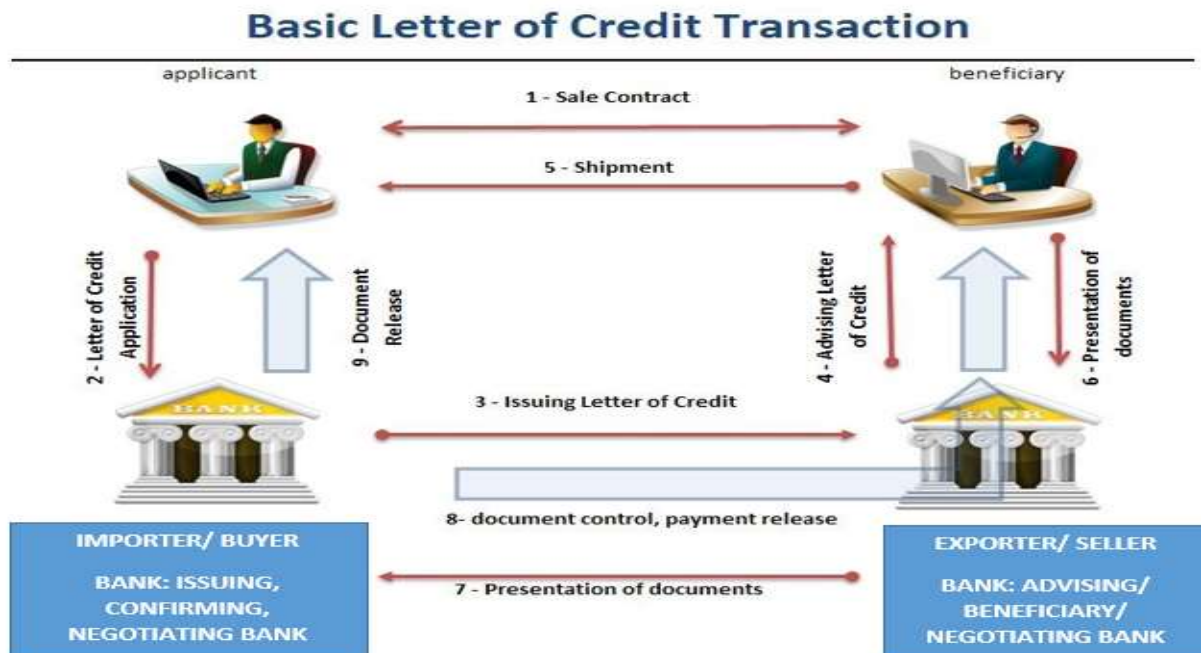


Figure 1.1 Letter of Credit Transaction Process

[Source: <https://www.letterofcredit.biz/index.php/2018/05/11/how-does-an-import-letter-of-credit-work-in-international-trade-transactions/>]

1.2 General Process:

- Importer/ Buyer and Exporter/ Seller makes contract for the Sales and Receipt of Goods
- Importer nominates the Issuing Bank and Exporter nominates Beneficiary/ Advising Bank/ Negotiating Bank (Bank normally located at the same country and Bank at which the Beneficiary already has an account or, established relationships)
- Importer applies and submits a letter of Application for receiving fund via LC proclamation at the Issuing Bank on the basis of which the Issuing Bank issues the LC against the advising Bank (Beneficiary Bank)

- The Advising bank notifies the seller that the Letter of Credit (LC) is available and provides the LC advice to the Beneficiary Banks and thus also functions as the Notifying Bank
- Beneficiary Bank upon the confirmation and receipt of LC advice arrange to make the Shipment proceedings to the Buyer or Importer
- The seller or Exporter arrange to make shipment to the buyer and the shipper provides/ submits the Shipment confirmation including the bill of lading to seller (mentioning the Order, Volume, Invoice, Contract and details like: exact shipment dates, destination, and contents) to its advising bank which in turn submitted it to the Buyer via the Issuing Bank.
- Meanwhile the buyer / exporter pays their bank in exchange for the B/L the issuing Bank informs the advising bank to release the payment/ pays the Advising Bank on behalf of the Importer or, buyer and releases the necessary shipment and ownership claim, insurance document including the B/L to Importer/ Buyer
- The B/L is considered as the warranty to claim the ownership of the document which the seller sent to their bank (advising bank) which the advising bank provided to issuing bank or, importers/ buyer's bank to ultimately deliver to buyer.
- The buyer or importer ultimately then provided the B/L and required documents to shipper to receive the documents

1.3 Conditions and Precautions:

The Importer's Issuing bank will only issue a letter of credit if the bank is confident that the buyer or, importer can pay and thus can issue LC to only to established or, ETB Existing to Bank buyers (which has corporate account with the bank) against freeze deposits/ funds/ Line of Credit or loan from the Bank. Sometimes, Exporter or, seller may prefer to receive guarantee from a bank in their home country or, to where they used to have relationship or account (with which they are more familiar) called as the Confirming Bank. This may be the same bank as the negotiating bank. Sometimes, issuing bank upon its specific role may act as confirming bank or, negotiating bank at the same time. The Advising Bank can also perform as negotiating Bank. Otherwise, Seller can also appoint a Confirming Bank (trustworthy bank to the seller to which it may have already existing relationship) to ensure the payment receipt on time on buyers behalf. The bank will only release funds to the seller after the seller proves that the shipment happened. Sometimes Intermediary Bank also act in between to facilitate the payment and LC proceedings.

Letters of credit makes it possible to reduce risk and facilitates the business. However it is imperative to fully understand, evaluate and review all requirements for the letter of credit before agreeing to any deal and understand all of the documents required.

- Understanding payment and LC terms and conditions and assess the risks (including credit risk, liquidity and time etc.) and possibilities
- Assessing the relationship with Banks, channel partners and parties (including channel partners, suppliers, transporters, buyer, seller, regulators involved including the better knowledge about the trade terms and country specific guidelines

1.4 Advantages:

- Variability: Due to the nature of international dealings, including factors such as distance, differing laws in each country, and difficulty in knowing each party personally, the use of letters of credit has become a very important aspect of international trade.
- Seller protection: If a buyer fails to pay a seller, the bank that issued a letter of credit must pay the seller as long as the seller meets all of the requirements in the letter. This provides security when the buyer and seller are in different countries and even allows the payment security even the contract disputes with the buyer
- Buyer protection: Letters of credit can also protect buyers. Since, in the LC process Buyer pays the Issuing Bank to provide a guarantee to pay for product or service if they fail to deliver using a standby security or, alternative option such as letter of credit. Applying for issue of LC via the issuing Bank buyer ensures security of its payment via paying to an established bank rather than send the money directly to an unknown seller. Additional buyer security may involve shipment inspection and secured payment and protection from default and credit risk, country risk etc.
- In many cases it is subject to uniform rules and practices across countries minimizing the variability and delays

1.5 Limitations:

- The process is manual (Operation, Transaction and payments, monitoring, verification etc.) and lengthy with involvement of different parties, manual step by step process
- Costly with incorporation of higher logistics and transportation costs
- Not covering the compensation of for losing value of goods due to theft of misappropriation or damage
- Though under UCP-600 Trade policy LC's are generally irrevocable; sometimes LC's can be revocable due to the poor formulation and changes in governing laws and regulations (Some clause can be hard to evaluate in terms of difference in conditions or situations) in some countries (i.e. Bangladesh). Considering that, blockchain LC can be difficult to adopt and formulate to some countries considering its operational flexibility and alignment which can be eradicated by incorporating strong control and Government/ regulators interference.
- Now a days there are higher differences in the market regulations, political issues, and policies which are sometimes difficult to address. LC being rigid system sometimes are not enough to all the adversities and differences altogether
- There can be some residual risks for both the applicants and beneficiaries in nonperformance of certain terms under certain situations which can also not be always recoverable, diversifiable.

Chapter: 2 Blockchain and Blockchain Infrastructure

The theoretical concept of blockchain is more than 10 years older which was firstly used for trading of the Bitcoins, which started about 10 years ago at 1991. At that time, it was first described by Stuart Haber and W Scott Stornetta (Source: <https://www.icaew.com>).

2.1 Definition: Blockchain is performed between the miners or the participants who are present within the network and have the right to authorize or authenticate and validate the blocks/ nodes or, transactions transmitted through the encrypted channel or network virtually (individually or collectively: based on the type of transaction being individual or collective in nature).

The Blockchain transaction is a decentralized process each of the transaction is logically connected, integrated, validated. The step by step by process is executed and logically proceeded upon completion of the payment, performance of contract or, execution of predetermined functions and upon the authentication form the verifying body. It is executed through a programmable code, contracts, conditions and executable command. The connected miners can visualize the process in real time to their system and also the data and information are recorded in the network nodes of the Blockchain. Transaction data are also checked by verifying parties i.e. banks and channel partners in the collaborative network chain of the Blockchain to ensure the authenticity.

2.2 Key Features: Decentralization of Blockchain (BC) Networks and Consensus (Coordinate control for security, availability information, payment, speed and financing), Immutability (Un-editable or non-modifiability of information) and Transparency are the key features of the Blockchain functionality.

2.3 Types: There are 3 different types of Blockchain based on the usability and administration of these 3 features namely: Public (Individual Management), Private/ permissioned (Entity Management) or Consortium/ Hybrid Blockchain (Group Entity/ Party Management). There are different stakeholder or, users who are usually termed as miners likely as buyer, seller, banks (Exporter/Importer/ intermediary/ confirming banks etc.), regulatory bodies, customs, insurer, logistics, carrier/ transportation, payment parties etc. Blockchain LC is more common within the Consortium based LC Transactions. The basic differences as below.

	Read permission	Write permission
Public	Open to everyone	Open to everyone
Permissioned	Subject to restrictions	Subject to restrictions
Hybrid	Open to everyone	Subject to restrictions

Source: IDATE DigiWorld, *blockchain*, October 2016

Table 2.1 Nature of different types of blockchain

[Source: Blockchain for supply chains and international trade. Retrieved from [https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641544/EPRS_STU\(2020\)641544_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641544/EPRS_STU(2020)641544_EN.pdf)]

2.4 Building Blockchain infrastructure: Blockchain are used in the Trade supply chain and Finance, Public/ Private Services, IT Administrations etc. cases mostly.

2.4.1 Determine Blockchain Type:

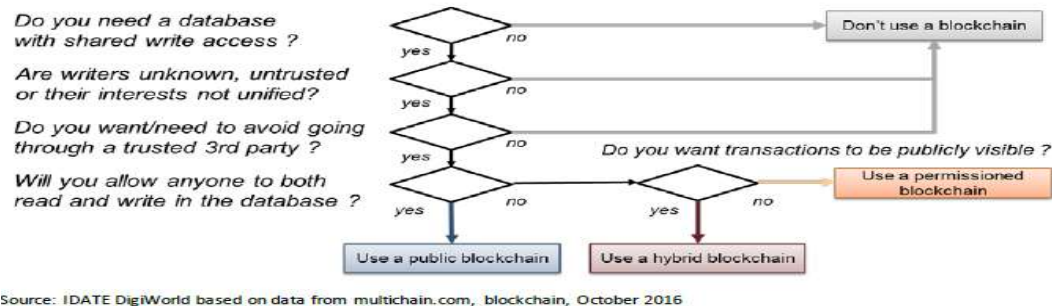


Figure 2.1 Blockchain process tree

Source: Blockchain for supply chains and international trade. Retrieved from [https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641544/EPRS_STU\(2020\)641544_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641544/EPRS_STU(2020)641544_EN.pdf)

2.4.2 Blockchain Design process: The design perspective and correspondingly future design principles for Blockchain-based and Blockchain-enabled supply chains are a hot research topic for the near future. This includes the development of specific distributed apps (DApps) for enabling the interactions and digital processes in future Blockchain-based supply chains. The research challenges include (among others):

- ✓ Identifying the Blockchain's starting point to the supply chain (Based on the applicable nature and type of blockchain)
- ✓ Researching and studying the regulatory, viability and infrastructural aspects sustainable Blockchain ecosystems for supply chains in international trade
- ✓ Clearly identifying and formulating the platform and program, algorithms for Blockchain-based supply chains in international trade along with network models
- ✓ Research and investigation on adaptation, viability to embed and integrate the Supply chain and blockchain network models to achieve optimal compatibility to ensure overall efficiency of Trade and Supply chain operation (Overall Supply Transaction)

2.4.3 Layers Model:

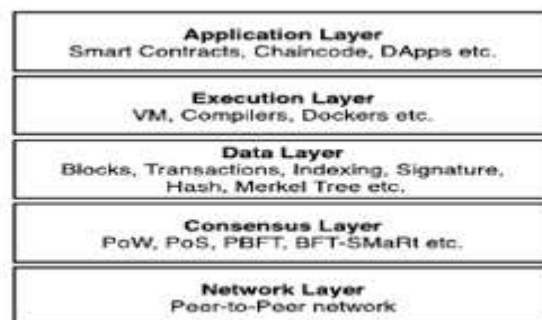
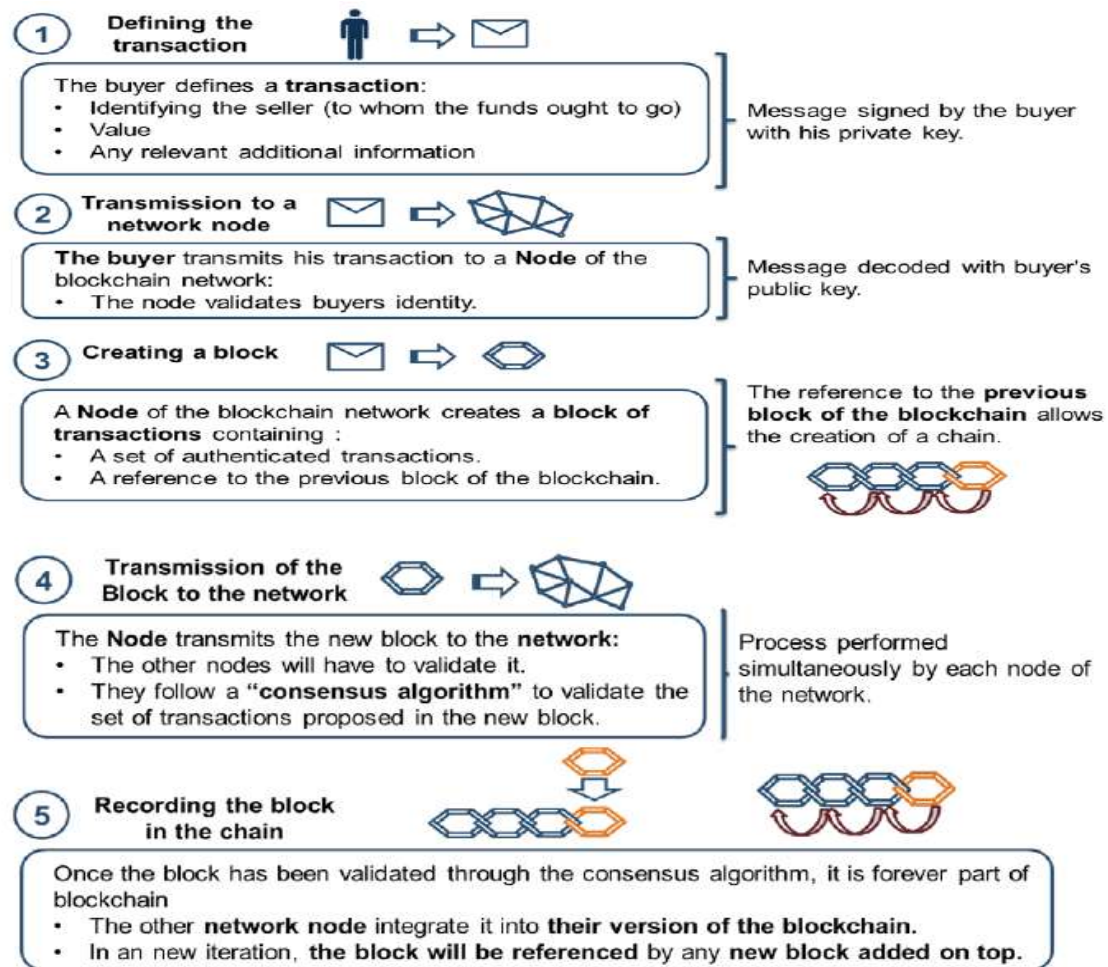


Figure 2.2 Designing blockchain model

Source: Application of Blockchain in International Trade: An Overview. The Romanian Economic Journal Collected from: <http://www.rejournal.eu/sites/rejournal.versatech.ro/files/articole/2019-04-01/3547/1belu.pdf>

2.4.4 Blockchain operation and process at a glance:



Source: IDATE.

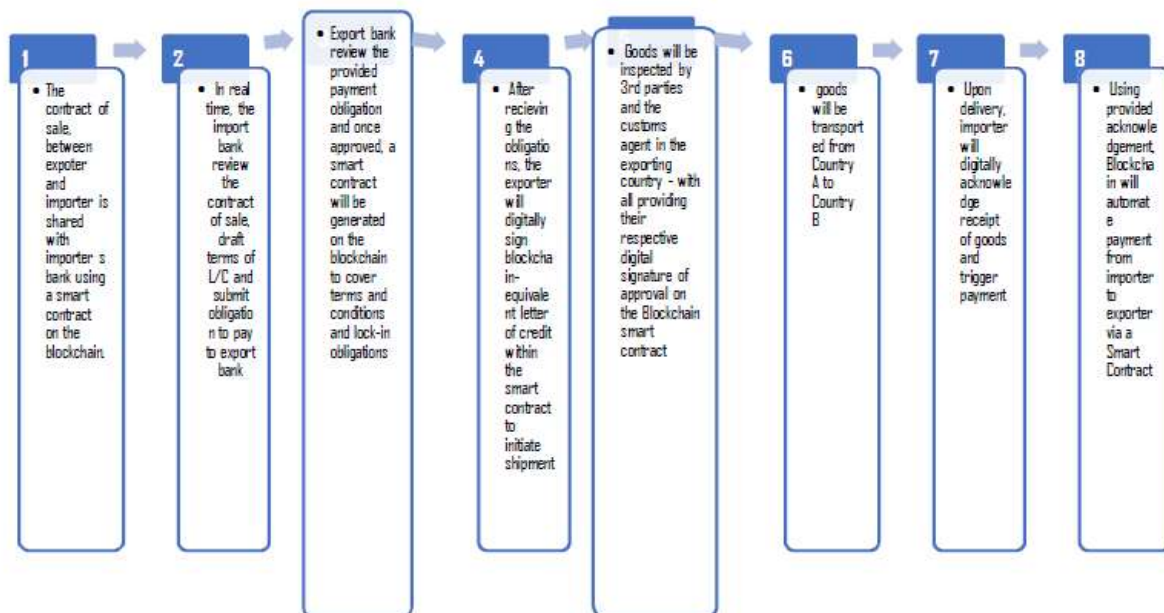
Figure 2.3 General Blockchain process

Source: Blockchain for supply chains and international trade. Retrieved from [https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641544/EPRS_STU\(2020\)641544_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641544/EPRS_STU(2020)641544_EN.pdf)

Chapter: 3 Blockchain LC in Trade Supply chain

3.1 Process:

- Importer/ Buyer and Exporter/ Seller makes contract for the Sales and Receipt of Goods as per regular LC process initiation
- Importer nominates the Issuing Bank and Exporter nominates Beneficiary/ Advising Bank/ Negotiating Bank (Bank normally located at the same country and Bank at which the Beneficiary already has an account or, established relationships) as same as the General LC Process
- The importer creates an LC application for the importer bank or, Issuing Bank to review and stores it on the Blockchain.
- The importer or, issuing bank receives notification to review the LC and can approve or reject it based on the data provided. Once checked and approved, access is then provided to the exporter bank or, advising bank automatically for approval.
- The exporter's/ beneficiary's advising bank approves or rejects the LC. If approved, the exporter itself is able to view the LC requirements and is prompted to view through the application.



Source: Deloitte, *How Blockchain Can Reshape Trade Finance*, p. 2

Figure 3.1 Blockchain Letter of Credit process

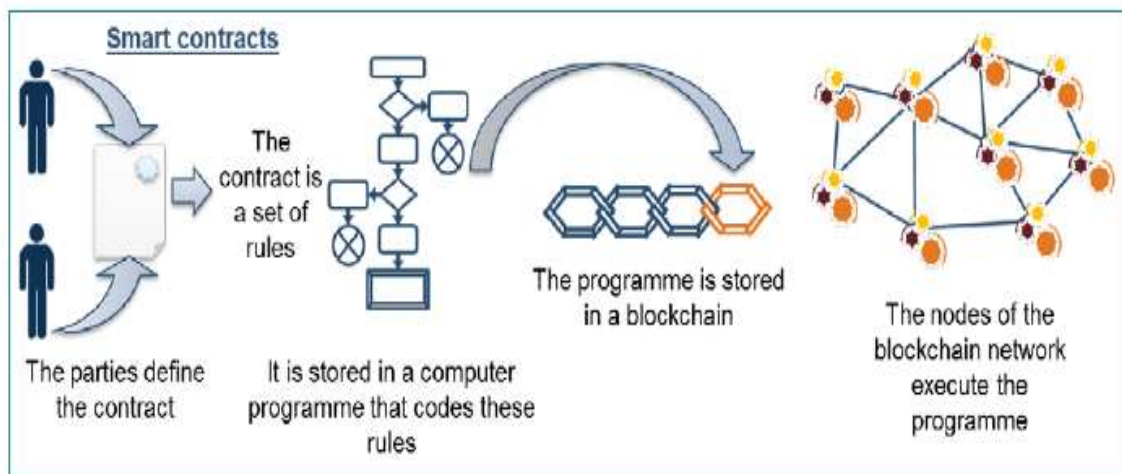
Source: The Romanian Economic Journal, Retrieved from <http://www.rejournal.eu/sites/rejournal.versatech.ro/files/articole/2019-04-01/3547/1belu.pdf>

- The exporter completes the shipment, adds invoice and export application data and attaches a photo image of any other required documents. Once reviewed and validated by the Issuing Bank and the buyer/ importer, these documents are stored on the Blockchain upon final check and approval by the beneficiary's Bank/ Advising Bank.

- When approved, the LC goes straight to completed status or is sent to the importer for settlement.
- If required due to a discrepancy, the importer can review the export documents and approve or reject them.

3.2 Key features:

3.2.1 Smart Contracts: They are technologically advanced than e-contracts (Refer to Appendix) and executable with consensus of all parties when certain agreement/s, set of commitments, protocol, preconditions are met as per program are fulfilled without the negotiation or, respond form the available intermediaries bringing speed, accuracy and lower cost of the whole process including the transaction and payment (Refer to Appendix Figure A.2).



Source: IDATE DigiWorld, blockchain, October 2016.

Figure 3.2 Smart Contract in Blockchain Letter of Credit process

Source: Blockchain for supply chains and international trade. Retrieved from [https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641544/EPRS_STU\(2020\)641544_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641544/EPRS_STU(2020)641544_EN.pdf)

These are defined and monitored by computer program and validated by attendees (with capacity). Such contact can be both P2P and B2B. L/C payments are done via the present conditions related to demand and order data, trade data, shipment informatics streamlining of the execution and transformation of trade information.

- ✓ Proof of Work: Nodes contacting unique record and data of work and functions recorded in the nodes of the Blockchain as codes encrypted but accessible to relevant authenticated parties
- ✓ Proof of Stake: In this process nodes are generated based on validated transactions within the network
- ✓ Proof of Capacity: In this process nodes are generated based on capacity/ authority within the network

Alternatives	Who can validate the transactions?	Choosing the node that validates a transaction	Advantages	Limitations
PoW (proof of work)	Anyone can become a network node	Randomly, Indexed on computing power	+ Security + Trust establishment over a trustless network	- High computing power costs - Data storage costs - Speed limitations
PoS (proof of stake)	Anyone can become a network node	Randomly, Indexed on economic stake	+ Less computing power costs + Trust establishment over a trustless network	- Favouring the richest nodes - Increased Complexity
Federation	Rules are defined on who can join the network (e.g. peer validation, defined identity and security deposit)	Voting of 2/3 of the nodes	+ Less computing power costs	- The underlying network cannot be truly trustless but rather requires some level of trust and security - No node anonymity - Does not necessarily solve the latency problem (time required for voting).

Table 3.1 Consensus Algorithm in Blockchain Letter of Credit process

Source: Blockchain for supply chains and international trade. Retrieved from [https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641544/EPRS_STU\(2020\)641544_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641544/EPRS_STU(2020)641544_EN.pdf)

- 3.2.2 Cyber Systems: IOT, GPRS, RFID, RTGS for logistics functionality of Trade and integration within the whole network system enriching the integration of company, enterprise systems, payments, logistics, payment and tracking etc. creating a holistic system.
- 3.2.4 Automated payment: In the Blockchain LC process via the execution of Smart contracts. The payment is channeled automatically from Issuing to Advising Bank (from upon authentication form concern parties when the certain conditions are met (i.e. presentation of shipment, exchange and insurance documents and shipment proceedings to concern importers Issuing bank).

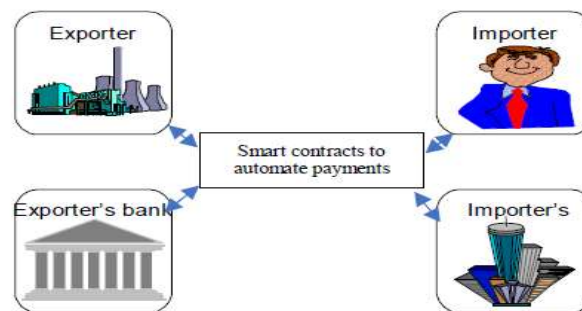


Figure 3.3 Transaction of Payment Blockchain Letter of Credit

Source: The Romanian Economic Journal, Retrieved from <http://www.rejournal.eu/sites/rejournal.versatech.ro/files/articole/2019-04-01/3547/1belu.pdf>

- 3.2.5 Use of Crypto currency: It can also be a future integration to blockchain function ability of LC based Trade due to current development towards integration of virtual currency in

different modes of virtual transaction worldwide due to its unified nature of acceptance and common value across border.

- 3.2.6 Use of Hyperledger: Hyperledger Fabric is open sourced and more customized blockchain platform different from Bitcoin or, other initial blockchain platforms as it is used as a permissioned, decentralized and community/ consortium based blockchain mainly for deployments like trade where series of transactions take place via multiple channels.
- 3.2.7 Use of specific Platform and Blockchain platform and infrastructure to ensure the data management, privacy, partnership, integration and validation across the minors/ parties involved in the transaction i.e. Coroda infrastructure, TradeLens and Food Trust by IBM.
- 3.2.8 Use of Distributed Ledger Technology (DLT): It is a protocol that enables the secure functioning of a decentralized digital database. Distributed networks eliminate the need for a central authority to keep a check against manipulation.

4.1 Practice and Implementation:

Blockchain LC in the trade – On 6 July 2017, Japanese conglomerate Marubeni Corporation and Sompo Japan Nipponkoa were involved in a trade transaction between Australia and Japan using blockchain/distributed ledger technology (DLT) via the Hyperledger Fabric platform with the incorporation of Smart Contract, Consensus algorithms, Digitized Tracking and payment systems. Benefits aroused for shorter time of operation and documents process and cost and faster payment and transaction process. However, limitations included compatibility and availability and alignment of system infrastructure and platform between the participants and stakeholders for transaction and exchanges along with security protocols and also keeping record of older transaction. Now a days due to incorporation and advancement of SWIFT channel of payment processing it is almost certain that after the initiation the Blockchain as a regular system of LC is only a matter of time with the technological advancement.

4.2 Effect of Blockchain LC in Logistics and supply chain:

Blockchain LC can significantly affect the whole Export and Import contract, proceedings, administration, documentation, control, authentication and payment proceedings of the transferability goods.

Reports, data and information generated promptly, instantly bearing accurate information can be easily available to the concern parties for their information and actionable (Which can also be preprogramed and recorded) therefore allowing faster logistics operation. According to a United Nations study, digitizing and automating foreign trade paperwork in the Asia-Pacific region could reduce spending by 31 percent and increase exports by 256 billion which can have significant impact over the overall supply chain and logistics cost reduction increasing the value SC proposition to manifold.

Revolutionize and digitize the freight forwarding industry is also necessary as out of the US\$20trn of global trade each year, 90% of it is carried by the ocean shipping industry. On 5 March 2017 IBM and Maersk announced their collaboration in order to revolutionize the cross border shipment and ocean logistics and freight forwarding using blockchain. “IBM and Maersk intend to work with a network of logistics and supply chain stakeholder including the shippers, freight forwarders, ocean carriers, ports and customs authorities to integrate the each parties and channel partners in the integrated network of blockchain in an intention to digitize, the whole Trade transaction, documentation (about 1/5th of the logistics cost) and operation process reducing costs, lead time, payments, contract authentication, redundancy, misplacement, misappropriations and fraud saving the paperwork.

Logistics formalities including the inbound transport and warehousing, handling of goods, transferability and delivery to the importer or buyer all things are systematically programmed and

embedded in the each block of the blockchain network to ensure both the physical goods related issues including lead time reduction, enhancing the visibility and tracking the goods in transit, assessing the conditions of goods and tracing of origin (Example: Everledger as launched at 2015).

Supply Chain Aspects	Stakeholders in Operations	Documents required	Implementation Blockchain aspects	Effect in Supply Chain
Commercial	Importers, Exporters, Advisory Bank, Issuance Bank, Insurance companies	Sales contract and trade terms, purchase order, invoice	Transaction for decentralized marketplace via Smart Contract	Ensuring automation in decentralized marketplace reducing policy variability, rules regulations, auto monitoring, validation and performance. <u>Efficiency Enhancement and Cost Reduction, pricing adjustment</u>
Trade	Credit institutions, importers, exporters, Insurance companies	Letter of credit, bill of exchange, insurance	Improving the letter of credit transaction process (Digitizing documents) for making process efficient	Digitalizing the supply chain operation ensuring [Key features: <u>Decentralization, Immutability, Speed and Transparency</u>]
			Limiting the risks of open account and loopholes of Trade financing and operation Using blockchain for financing and cross-border payment (Ensuring security, prompt payment)	<u>Simplifying the SC Trade Operation transactions and Reducing the Risks</u> Financial institutions to process costumers' cross-border payments resulting <u>Payment security/safety, promptness</u>
Logistics	Exporters, importers, transport companies, port authorities, Credit institutions, insurance companies, brokers	Credit institutions, insurance companies, brokers, Order and shipping documents	Digitalizing supply chain (Goods and location Tracking, scrutinizing in real time, monitoring), resulting prompt decision making (being on same shoes), reducing the entry barrier, ensuring global participation and increasing competition between vendors	Supply Chain integration with connected parties and channel partners, raising participation and thus competition of suppliers/ vendors and thus impacts pricing <u>Reducing Lead Time, shortening the distribution by reducing Channel partners and contract digitization</u>
			Automation and Integration using Technology making the process adaptable in different circumstances (Reducing Direct involvement of parties and reducing the operational loss and Times)	Digitalization and Modernization of LC and Trade Process for raising <u>Buyer-supplier relationship to new level, transparency and thus ensuring viability and sustainability of Supply Chain. This may affect the contract, negotiation and pricing of goods as well.</u>

Table 4.1 General Effect of application of Blockchain LC in Logistics and Supply Chain

Automation of the trade process via adopting the blockchain LC can reduce the usage and numbers of Supply chain channel partners and intermediaries in contract, inventory and vendor management, logistics, distribution, transportation including the overall controlling and monitoring of the massive supply chain and logistics function in the Trade.

Moreover it is also used in tracking and measuring inventories, and transportation goods (in real time to avoid fraud, misplacement using the e-certification of origin, EOQ order/ and cyber systems like IoT sensors, RFID and GPRS etc. with the blockchain network; Example, IBM using Food Trust for supply chain visibility connecting growers, processors, distributors, and retailers as implemented at 2018), quality and quantity assurance, receipt and delivery confirmation and service including digitization and instant review of documentation (Including the bill of exchange/ lading, insurance, shipment documents, invoices) processing decentralization of operation and payment execution (using RTGS) and invoicing without the direct engagement of the multiple relevant stakeholders, removing multiple intermediaries and reducing the task redundancy (issuing and advisor bank, confirming bank, exporter, importer, regulators, specific incoterms etc.) saving time and money whilst ensuring security, operation streamlining (reducing redundancy and operational loopholes/ backlog, lapse, cost of logistics, transportation, operation, labor, inventory) and increase precision by raising simplification and transparency. Such reduction of costs can have impact on the pricing of goods as well along the goods handling, docking, loading and clearing. Examples included, ZIM, Wave, Sparx Logistics (Digitization of Logistics docs like bill of lading). Moreover, the blockchain can also ensure the authenticity, non-modification (of data and information, records without the consent of other parties) or, ethical originality of source, safer movement or transportation etc. also including increasing efficiency over communication.

The adoption of Blockchain can ensure overall trust between the buyer and suppliers and thus can ensures lowering the entry barrier of Channel partners or, suppliers in the Sourcing process and ensures the global participation within the ecosystem of Trade and Supply Chain across the globe. These including the facilitation over maritime insurance can assist in potential enhancement of buyer-supplier relationship towards collaboration (please refer to Appendix at Figure A.1) can play a key part in enhancing the contract, negotiation overall productivity of Trade and Supply Chain. Examples include, Maersk, EY, Guardtime, Microsoft (Insurwave: Marine Insurance platform connect all stakeholders in the insurance value chains) as of 2017.

4.3 Role of Banks and Financial Institutions in blockchain based trade:

In May 2016, HSBC successfully launched Singapore's first Blockchain LC. They issued a Blockchain LC in favor of Eng Bank for the purpose of importing soybeans from Argentina to Malaysia for the Food and Agriculture Conglomerate named Cargill. The transaction process took only 24 hours to complete. Though the use of Blockchain is very recent in context of functionality of Trade in Bangladesh it has been introduced in Bangladesh at 2018 as “Voultron” and the founding members were eight banks - Bangkok Bank, BNP Paribas, CTBC Holding, HSBC Inc., NatWest, SEB, and Standard Chartered. During August 2020, Standard Chartered Bank has successfully executed Bangladesh’s first Blockchain transaction by issuing a Letter of Credit (LC)

for Viyellatex Ltd over the Contour Blockchain network which is a milestone at RMG sector trade in Bangladesh. Standard Chartered Bank acted as the issuing bank for the applicant, as well as the advising bank for the beneficiary of the LC, said a press release. The entire transaction was paperless and completed digitally through Contour's network. Contour provides a distributed trade network enabling an enhanced degree of collaboration across the main elements of trade with all participants leveraging the network to create and renew trade data in real-time. As one of the founding members of Contour, Standard Chartered benefitted from Contour's network which simplifies the LC process, delivering shorter settlement times, instant discrepancy resolution and simplified sanctions screening also.

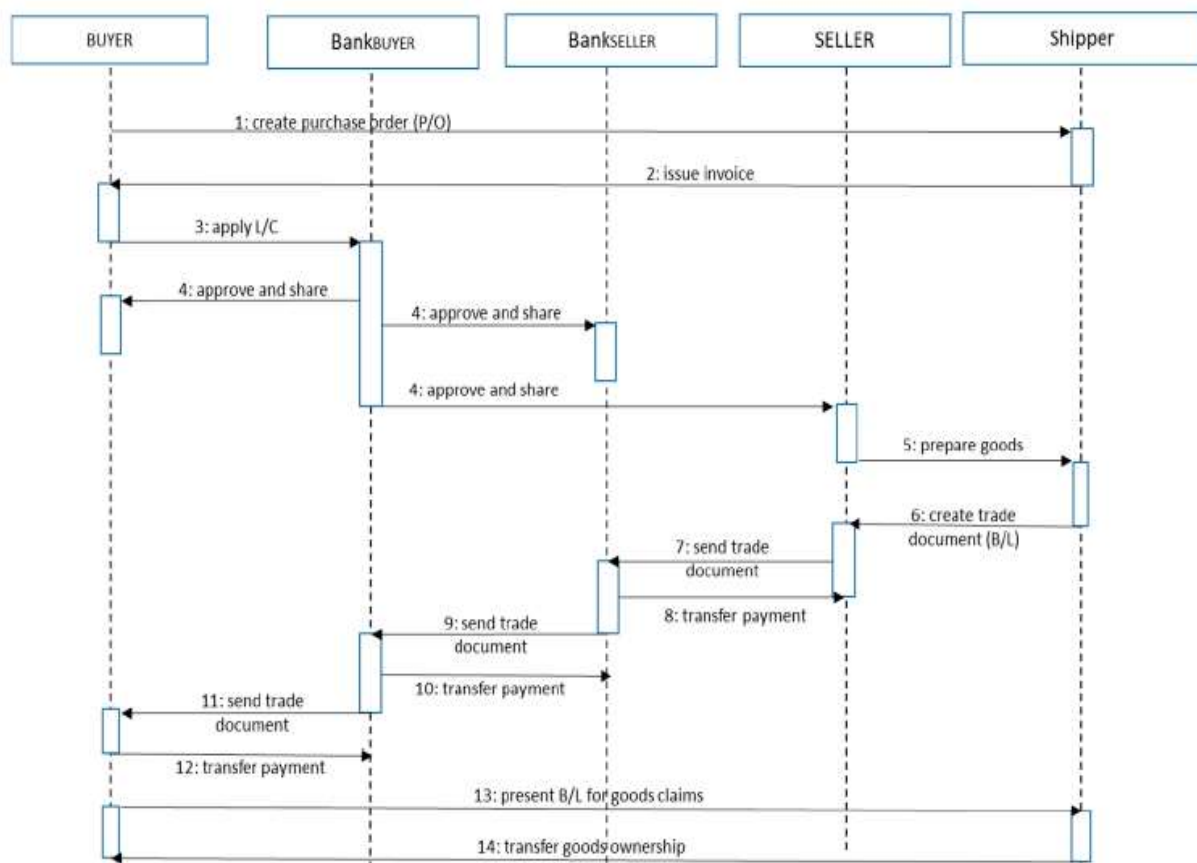


Figure 4.1 Transaction process in Blockchain Letter of Credit

A Potential Paradigm Shift on Using Letter of Credit. Retrieved from https://res.mdpi.com/d_attachment/sustainability/sustainability-12-00188/article_deploy/sustainability-12-00188.pdf

In most of the cases LC's are irrevocable and needed to be governed by internationally proclaimed trade practice named UCP 600 and countries regulations. The R3 Corda technology (Open source and reliable Blockchain platform which ensures data security for B2B platforms exchanges, documentation, distinct organization and validation) are used by the Banks and 3rd Party Service provided and the LC Blockchain process flow across the nodes in Corda blockchain are as mentioned above.

This R3 Corda platform is most suitable for the LC operations and specialized for the financial industries which currently constitutes of 300 Banks consortium across the globe containing different algorithms and much secured validation process including only the participants within the authority in the Blockchain. It also uses distinct algorithm for validating the transaction and thus much secured.

R3 Corda key features	
Permissioned network structure	
Consensus achieved on an individual level	
Various consensus algorithms supported	
Flexibility based on a module-based architecture	
High adaptability due to leveraging common technological standards	
High transaction/network performance (parallel processing of transaction inputs)	
R3 Corda key facts	
Privacy	Permissioned network structure, based on a need-to-know principle
	Data is only shared with those parties which are required to see it (if there is a legal permission).
Consensus	Point-to-point consensus handling
	Different notary instances can be used having different consensus algorithms
Performances	1000 transactions per second can be checked / processed
	Pre-buffering of transaction considered as a future development
Interoperability	High architectural modularity based on common technological standards.

Source: IDATE based on P. Sandner, R3 Corda: Implementierung eines Prototyps für Schuldscheindarlehen und Vergleich verschiedener DLT-Frameworks, 2018. <https://medium.com/@philipsandner/r3-corda-implementierung-eines-prototyps-f%C3%BCr-schuldscheindarlehen-und-vergleich-verschiedener-26d4f3d58089>

Table 4.2 Coroda Platform of blockchain [Source: Mentioned above]

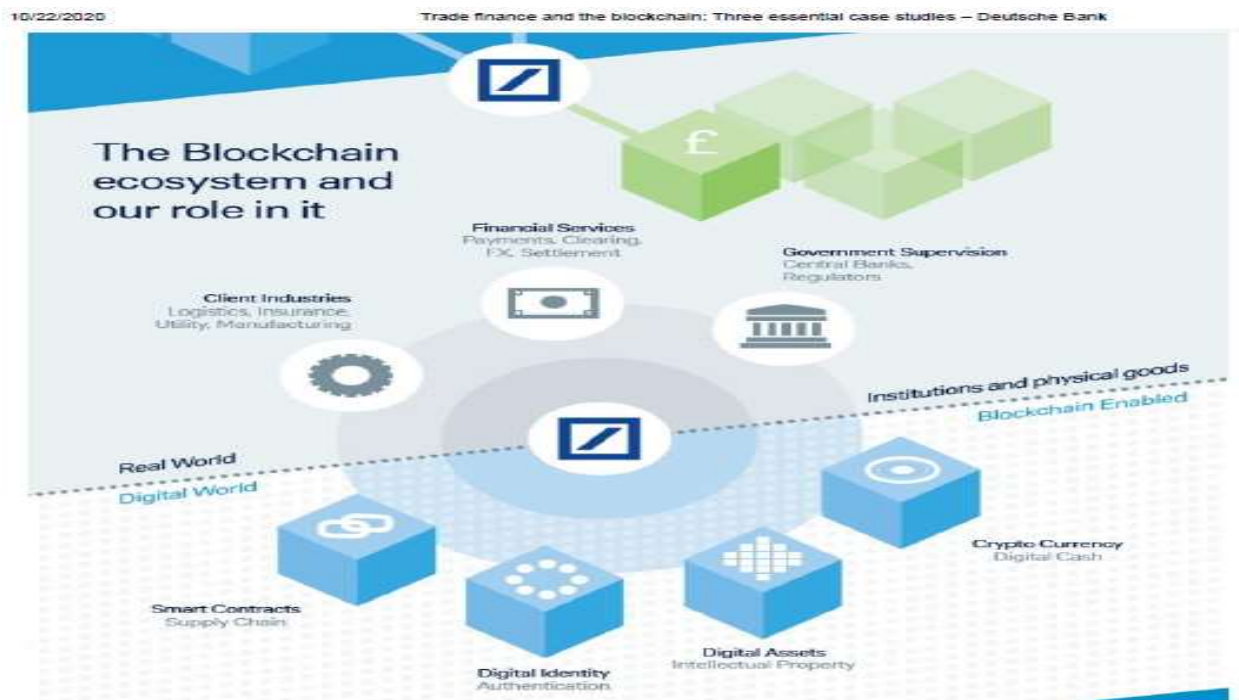


Figure 4.2 Involvement of Different stakeholders in blockchain ecosystem

[Source: Trade finance and the blockchain – three essential case studies. Retrieved from <https://flow.db.com/trade-finance/trade-finance-and-the-blockchain-three-essential-case-studies>]

Blockchain ecosystem consists of virtual and real world. The system is present in the virtual world where as the key players are present in the real world. To attain the proper integration between the two dynamics all the participants or, beneficiaries are needed to adopt the common blockchain platform/ infrastructure where the financial service companies are acted as “facilitator” and “advisor” and plays as a role of intermediaries between the initiator, beneficiaries and relevant parties. They interact and operate with the both worlds to provide a gateway and liaison.

Chapter 5: Performance evaluation of Blockchain in Trade and Supply Chain

5.1 Areas to measure the blockchain performance:

Such business areas included are:

Matrix	Criteria	Features
Audibility	To Eliminate Mistakes	Documentation, Transaction, calculation and payments processing
Compliance	To mitigate and diversify Risks	Comply Smart contract, LC terms, policies and regulations
Data management	Improve the Forecasting	EOQ, Demand forecasting
Data security and Authentication via Identity Management	Encrypting the critical data	Protecting key information and payments secrecy using the codes and authentication system via automated identification (using verification)
Ownership	Possession and Liability of goods	Proper transfer of ownership according to applicable incoterms and contract conditions
Payments and Reconciliation	Transactions and authentication (Banks and Channel Partners/ miners)	Accuracy, security and promptness of payments (Using RTGS)
Process automation	Digitization of Documents and Process	Digitalize the trade documents, contracts and process flow
Standardization	Alignment	Retaining trade data and apply the business models using the platform features to attain the best compatibility between the business and technology
Track and trace	Transportation, Logistics, Inventory and warehousing	Using integrated techs as mentioned (Barcode, RFID) determining EOQ and replenishment requirement using IMS
Data Sharing and Transparency	Reliability and data protection	Data alignment for accurate decision making across the participants and Decentralized data management system and authentication to protect the transaction and payments security
Resilience	Handling load and pressure	Handling bulk transaction and higher memory, simultaneous and scalable transactions
Trust	Relying and assuring	Due to higher transparency and using the same system or, platform or taking service from same service provider acting as mediator
Relationship building	Emblems of Trust and loyalty	Commitment and Trust for using same infrastructure in same ecosystem
New product and service and pricing	Opening marked beyond border and increasing the competition	Ensuring service quality tracking the product origin, handling etc. and increasing competition ensuring better quality and pricing
New partnership	Enhancing relationship	Reducing the entry barrier of new players and building relationship towards higher cohesive relations (according to relationship spectrum between buyers and sellers)

Table 5.1 Areas to measure the blockchain performance

5.2 Subjective Analysis:

5.2.1 Differences between General vs. Blockchain LC based Trade Supply Chain:

General LC Process	Blockchain LC
Manual Process and Documentation	Automated Process and Documentation (Shared Ledger). Not required manual matching.
Decentralized Process with Separate Cross Party Involvement	Centralized Process with Virtual Authentication
Higher propensity towards Risk and Time	More Quicker
Transaction is Risk Sensitive	Transaction is Less Risk Sensitive and Digitally encrypted
Logistics and Transportation process is Lengthy and Time Consuming	Logistics and Transportation process is less Lengthy and Time Consuming
Higher Manual Documentation and Ownership change process	Lesser Process towards documentation and Change of Ownership
Payment Process is Manual and involves multiple confirmation	Transaction process is step by step and not bypass able. Payment process and Digital and based on Logical automated approval process (Upon Meeting up certain condition)
Tracing Process is manual and not spontaneous	Real time Tracking of Goods using technological integration with the Blockchain process
Prominantly Manual or, General Contracts are used	Smart Contracts are used

Table 5.2 Differences between General vs. Blockchain LC based Trade Supply Chain

5.2.2 Blockchain value proposition of Trade:

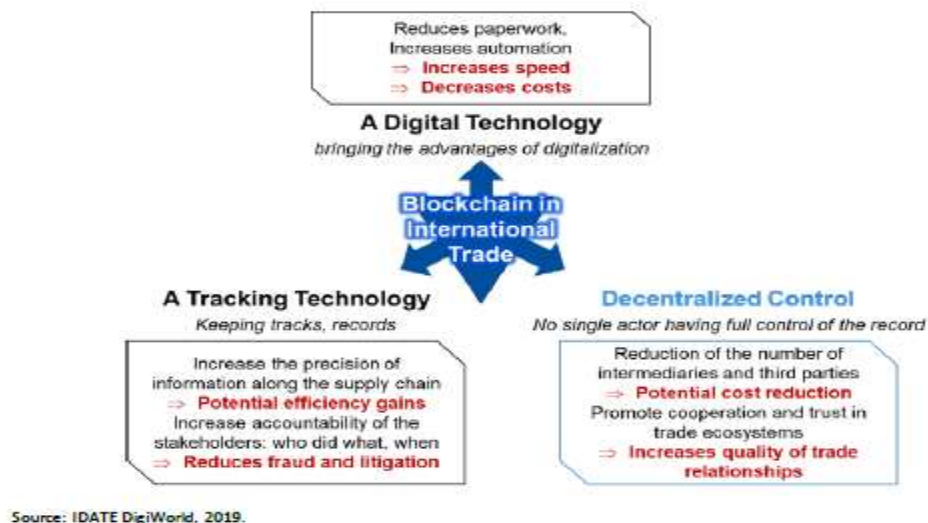


Figure 5.1: Blockchain value proposition for international trade

Source: Blockchain for supply chains and international trade. Retrieved from [https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641544/EPRS_STU\(2020\)641544_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641544/EPRS_STU(2020)641544_EN.pdf)

5.3 Qualitative Analysis:

5.3.1 Advantages of Blockchain to LC based Trade Supply Chain:

- In 2018, 80% of the world's trade by volume is carried by sea (source: WTO), which is considered the most cost-effective and efficient means of transportation. During the process, several actors were found to be engaged in sourcing, transportation, logistics, making the process complicated to coordinate resources and necessary documentation. Adopting the BC process helps in reduction of operational loss (streamlining the process and time (Considering simultaneous processing of different stages altogether; reducing the time laps) of processing including significant reduction of Lead time in Supply chain.
 - Thus reducing Logistics costs (using blockchain enabled technologies, software)
 - Increasing operational efficiency
- Adopting BC process using the 3rd party vendors can assist in diversifying the logistics costs by manifold using multiple options of transportation according to means and necessity based on the product type, nature and requirement as well
- Reduction of the costs and time of issue payment formalities, eliminating double financing, simplifying and automating and at the same time auditable payment management, trade financing and process and associated costs by decentralizing operations. Since, in Today's highly tech savvy world till now 80% of the foreign trade is yet financing through advance payment method. BC technology also helps to digitize the documents, whole payment proceedings and visualize/monitor in real time reducing traditional paper based approach. As per a report from UN, digitizing the Trade documentation can reduce its overall costs (sourcing, logistics, operation, transaction, payments) by 31% and can boost trade by 257 bln. USD at the same time (*Source: Blockchain LC: A new dimension to trade; Daily Bonik Barta*).
- Securing the finance in the time of the cyber-attacks is a major challenge now a days which is addresses to many extent by adoption of BC technology especially encrypted shared ledger or, database making it transparent an secured at the same time
- Adopting inbuilt infrastructure: In the Blockchain facility the firms/ exporters, importers, banks involved, logistics, insurance companies can develop their protocol, formalities and proceedings and incorporate into the program and infrastructure of the Blockchain making it easier to visualize and administer across different platform and institution without direct presence or, interference of the relevant parties.
- Blockchain enables exporters, importers and their respective banks to share information on a private distributed ledger thus information are well preserved but transparent at the same time to the relevant parties
- Transaction are more secured, through encrypted digital documentation (using codes) transparent (both Goods and payment) considering relevant Data are protected being encrypted and private to the parties involved and well authenticated (ensuring data integrity and security)

- Simpler, leaner, on the go, spontaneous, faster, paperless yet documented and less back and forth and lesser parties and redundancy.
- It reduces the risk of documentary fraud and reduces the cost of transaction reconciliation between and within banks
- Using Blockchain technology can help streamline the manual processing of import/export documentation, improve security by reducing errors, make companies' working capital more predictable and increase convenience for all parties through mobile interaction.
- The real time tracking of the shipment and product delivery traceability associated with Blockchain could potentially provide assurance and authenticity of products delivery and delivery control in the supply chain eliminating the risks of counterfeiting and fraudulency of goods and hampering customer wellbeing and companies reputation
- The encrypted and unmodifiable to provide a secure transfer of value and deliver a solution to the trade finance problem of endorsement
- Automatic conditions, situations and sanctions and protocol adherence of protocols/ regulations and notification where applied
- Increase the efficiency of the whole Trade and LC process incorporating software technology in the information, logistics, payment re-engineering reducing vulnerabilities and loopholes
- IT solution providers and platform designers can advertise and assist in the process and making the process more convenient to adopt and spread across different regions

5.3.2 Limitations of Blockchain in LC Process:

- If the blockchain platform can't ensure the decentralized permissioned blockchain then centralized blockchain needed to be adopted. Blockchain cannot guarantee transfer of possessions. Therefore, supervision and engagement may be required from an independent regulatory body or, centralized entities like government agencies or, banks as facilitator.
- Due to collective and integrative nature of the Blockchain process the whole process can be dysfunctional if any party do not want to join in the infrastructure
- Decentralization of blockchain over larger scale may require higher computational power and memory which is not always easier to formulate, maintain and adopt
- The process can be vulnerable and can be prone to cyber threat if a party have lesser security measure or control
- Adopting process can be costly considering the use of technology and infrastructure across multiple geographies but in most cases the cost is one time or, initial and in many cases such support are usually provided by the already built and adopted infrastructure of reputed 3rd party companies across the world
- Small Importers of Smaller value/ volume of LC may not be willing to integrate to comparative newer Blockchain based LC process

- It is also very difficult to maintain common platform and compatibility of Blockchain LC across countries and borders due to difference of Blockchain type, nature, trade volume, product type, cross border agreement, regulations, and policies.
- Since, most of the Import in Bangladesh occurs through Non-liner and private shipping lines. Considering the nature of transport it is also difficult to integrate them within the Blockchain system.
- There are some technological limitations of Blockchain including the Speed Measured in TPS or Transaction per Second), Latency (Measure the rate of validation of Currency Transaction) and volume/ size of Blockchain which all significantly impacts the Blockchain.
- Sometimes the security of Blockchain data cannot be confirmed before it enters to the systems or, exists
- May need to switch the blockchain platform providers and start the network design and initiation phase over again. Moreover, Integrating the previous data of suppliers or exporters with different blockchain platform may be difficult and
- May raise unemployment due to process adaptation, usage of technology etc.
- Moreover, Blockchain contract can have challenge over implementation considering the laws and jurisdiction and applicability etc.
- Difficulty of standardization of trade information and security for blockchain/DLT at an international level along with the alignment and storage of transaction exchange information is challenging

5.4 Quantitative Analysis:

Generally the performance of blockchain LC can be measured based on the Quantitative and economic aspects like:

- ✓ Operational Efficiency i.e. Lead time, Transaction Speed or, Throughput (Based on number per unit time, currency and volume), computation and input, data, information processing capacity (based on capacity, memory usage, volume of goods and transactions without errors), utilization of resources, adaptability and modification considering change in infrastructure, transactions over different platform. For example, performance and adaptability of blockchain may vary across different platforms for even for same types of transactions (refer to Section 2.3). Permissioned private blockchains such as Hyperledger (refer to section 3.2.6 and 4.1) have better performance compared to public blockchains.
- ✓ Scalability/adaptability and customizability are also key features of the performance evaluation of blockchain which is measured by computing throughput by modifying and changing chain codes, ordering numerous single and parallel simultaneous operations etc. inducing endorsers (progressive codes/ instruction for simultaneous transaction which also saves time).
- ✓ Network strength and power, capacity to generate new block and integrate to new minors (addition of participants), bulk validation and authentication capacity etc.

5.5 Economic and Financial Measures:

Cost minimization (reducing costs of operation, Logistics, documentation and processing, shrinking human labor and working capital) and risk diversification. These costs have to be weighed against the financial benefits (return, profits) and environmental benefits of i.e. competition when assessing the economic impact. In this process the operation can be leaner, less complex, flexible, error free and less redundant.

Chapter 6: Recommendations and Conclusions

Blockchain has a wider impact over Trade and commerce as it can revolutionize the whole process from traditional to a modern one. It can build pillar of success for the cost effective, efficient and sustainable logistics, supply chain operations. However, blockchain platform is not easier to adopt and requires constant monitoring and reengineering to dig up the best output and may have some adversities considering some socioeconomic issues.

Banks and Financial intermediaries can play a key role over institutionalizing the whole operation where participants or, miners in the blockchain can integrate the blockchain platform to their organizations ERP and SCM, Logistics, IMS to attain the best output.

Nevertheless, it is always imperative to perform a thorough assessment on the blockchain type, platform, codes, design, performance, network, compatibility and security features based on the nature and types of transaction, letter of credit, contracts/ conditions etc. to attain the best output and best operational efficiency with less involvement of human capital. Many of world's renowned banks and companies have adopted the blockchain to boost and speedup the trade and increase its horizon and attain its advantages.

Over the last decade Bangladesh has seen sustained and continued economic growth in recent years with sharp rise in the Trade, with trade consisting of at least 35% to 40% of its GDP with 84% accounted for RMG Trading (Data provided in Appendix: Foreign Trade values at Table A.1 and Foreign Trade indicators at Table A.2). With more development works are undergoing and good business propensity due to economic stability and strategic geographical location; it is commanding that, our Government and Private sector put more focus over digitizing the trade, LC proceedings especially over marine freight and logistics to which it relies heavily upon for (about 80% of its overall trade).

Reputed MNC's, tech giants and reputed banks across world (with higher capital, worldwide operations and diversified technological infrastructures) played a huge role over advocacy, facilitating and spreading this digital trade and LC process all over the world. It is a great news that blockchain has seen its implementation and progression (with live and inspiring examples) in recent times in Bangladesh which is very promising indeed. Therefore, we expect blockchain to play a key part pioneering the sustained growth of Economy empowering the Trade, LC and supply chain operation in Bangladesh over the years what we can term as a "paradigm shift" on the LC based Trade, Supply chain and its sustainability.

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Appendix

Table A.1: Foreign Trade Values of Bangladesh

Foreign Trade Values	2015	2016	2017	2018	2019
Imports of Goods (million USD)	39,460	41,490	52,836	60,495	59,094
Exports of Goods (million USD)	32,379	34,956	35,851	39,252	39,337

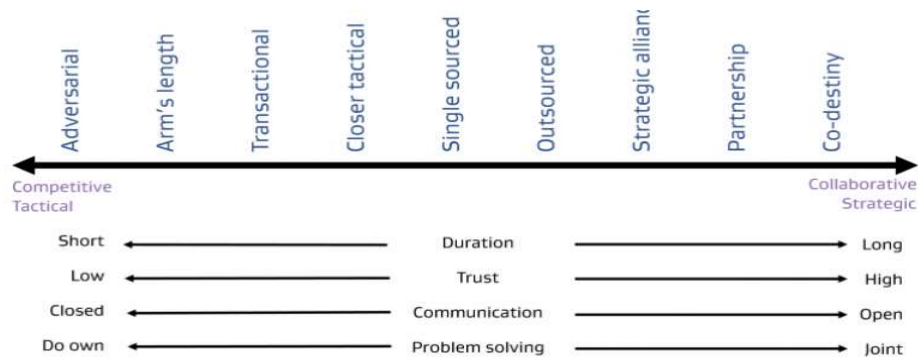
Source: World Trade Organization (WTO); Latest available data [Collected from: nordeatrade.com/en/explore-new-market/bangladesh/trade-profile; accessed from: <https://www.nordeatrade.com/en/explore-new-market/bangladesh/trade-profile>]

Table A.2: Foreign Trade Indicators of Bangladesh

Foreign Trade Indicators	2015	2016	2017	2018	2019
Foreign Trade (in % of GDP)	42.1	38.0	35.3	38.2	36.8
Trade Balance (million USD)	-6,120	-6,244	-12,966	-16,913	-15,611

Source: World Trade Organization (WTO); Latest available data [Collected from: nordeatrade.com/en/explore-new-market/bangladesh/trade-profile; accessed from: <https://www.nordeatrade.com/en/explore-new-market/bangladesh/trade-profile>]

Figure A.1: The Relationship Spectrum



Source: New Zealand Government Procurement [Collected from: <https://www.procurement.govt.nz/procurement/guide-to-procurement/plan-your-procurement/positioning-yourself-in-the-market/>]

Figure A.2: Smart Contracts (Technologically Advanced Programmable contracts)



Source: The Romanian Economic Journal, Retrieved from <http://www.rejournal.eu/sites/rejournal.versatech.ro/files/articole/2019-04-01/3547/1belu.pdf>

Notes