Üçüncü Sektör Sosyal Ekonomi Dergisi
Third Sector Social Economic Review
60(1) 2025, 210-225
doi: 10.15659/3.sektor-sosyal-ekonomi.25.02.2512

Research Article

The Blockchain Technology Solution to the Pain Points of Letter of Credit

Akreditif Sorunlarına Blok Zinciri Teknolojisi Çözümü

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18.09.2024	**15.01.2025**

Abstract

Blockchain, decentralized and distributed ledger elements and smart contract, data security, transparency, speed, etc. advantages are revolutionary and will have a significant impact on improving and reshaping trade.

The purpose of this study is to investigate the elimination of disadvantages such as problematic points, transaction risks and costs of Letter of Credit, which is accepted as the most secure payment method in international trade, and in addition to this, general risk elements for the value flow of cross-border trade, with the gains of blockchain technology.

The study reveals the elements of the blockchain and the concepts developed with this technology. In the research, where the current structure, risk elements and inefficient aspects of the letter of credit process were determined, a process prototype developed with blockchain integration was created to improve the critical points of the process. The elements of supply chain, international financial transactions, and letter of credit payment method processes such as contract, letter of credit opening, documentation, shipment, transfer handled with blockchain technology, were compared between the traditional structure and the desired structure and interpreted with the inferences obtained from the studies in the literature. The workflow automation design in the letter of credit payment system and supply chain process, which is achieved by integrating the distributed ledger technology of the blockchain and the smart contracts created depending on it, concretizes the study. With this feature, the study provides guidance to those who develop models for this process or similar commercial processes and contributes to the literature.

Keywords: Blokchain, Smart Contracts, Letter of Credit, International Trade, Supply Chain

Jel Codes: F1, F2, F3, F4

Öz

Blok Zinciri, merkezi olmayan ve dağıtık defter unsurları ve akıllı sözleşme, veri güvenliği, şeffaflık, hız vb. avantajları bir devrim niteliğinde, ticaretin iyileştirilmesi ve yeniden şekillenmesinde önemli bir etkiye sahip olacaktır. Bu çalışmanın amacı, uluslararası ticarette en güvenli ödeme yöntemi olarak kabul edilen Akreditif'in sorunlu noktaları, işlem riskleri ve maliyetleri gibi dezavantajlarının ve buna ek olarak sınır ötesi ticaretin değer akışına yönelik genel risk unsurlarının, Blockchain teknolojisinin kazanımlarıyla ortadan kaldırılmasının araştırılmasıdır.

Önerilen Atıf /Suggested Citation
Ortakarpuz, M., 2025, The Blockchain Technology Solution to the Pain Points of Letter of Credit, *Üçüncü Sektör Sosyal Ekonomi Dergisi*, 60(1), 210-225.

Çalışma, blok zincirinin unsurlarını ve bu teknoloji ile gelişen kavramları ortaya koymaktadır. Akreditif sürecinin mevcut yapısı, risk unsurları ve verimsiz yönlerinin belirlendiği araştırmada, sürecin kritik noktalarının iyileştirilmesine yönelik blok zinciri entegrasyonu ile geliştirilmiş bir süreç protatipi oluşturulmuştur.

Blok zinciri teknolojisi ile ele alınan tedarik zinciri, uluslararası finansal işlemler ve sözleşme, akreditif açılışı, dokümantasyon, sevkiyat, transfer gibi akreditif ödeme yöntemi süreçlerinin unsurları, geleneksel yapı ile istenen yapı arasında karşılaştırılmış ve literatürdeki çalışmalardan elde edilen çıkarımlarla yorumlanmıştır. Blok zincirinin dağıtılmış defter teknolojisi ve ona bağlı oluşturulan akıllı sözleşmeler entegre edilerek elde edilen akreditifli ödeme sisteminde ve tedarik zinciri sürecinde iş akışı otomasyonu tasarımı çalışmayı somutlaştırmaktadır. Bu özelliği ile çalışma, bu sürece veya benzer ticari süreçlere model geliştirenlere yol gösterici nitelik kazanmaktadır, literatüre katkı sağlamaktadır.

Anahtar Kelimeler: Blok Zinciri, Akıllı Sözleşmeler, Akreditif, Uluslararası Ticaret, Tedarik Zinciri

Jel Kodları: F1, F2, F3, F4

1. Introduction

While the elements such as trust concerns, fraud, loss of time, bureaucracy, etc. that occur in the flow of international trade negatively affect the functioning of trade, applications are being developed with developing technologies to eliminate these elements. It is thought that the most important development that has emerged in recent years regarding the coordination of cross-border transactions and data flow between parties is blockchain technology. Although the use of blockchain technology is still in its infancy, it is already being talked about as a revolutionary factor in global trade. Its appeal seems irresistible as it can replace standard documentation methods, facilitate logistics, increase transparency, speed up transactions, and improve trade planning and follow-up. It is possible that this technology will have a positive impact on all trade segments, but it faces a number of challenges in terms of regulation, infrastructure, and adoption of standards. The first applications of blockchain technology in the field of international trade were in the financial sector on international money transfer, and this was soon followed by logistics activities such as customs clearance, insurance, and transportation.

Letter of Credit (L/C), which is considered the most reliable payment method in international trade, despite all the advantages it provides, contains some risks and disadvantages for the parties in practice. This payment method, which basically provides a bank guarantee, guarantees payment to the exporter, and ensures that the documents are obtained in a healthy and timely manner for the importer, is seen to have a complex and cumbersome structure in its application due to a number of procedures. For this reason, letters of credit are seen as a financial transaction that is preferred by large enterprises with strong institutional infrastructure, while small and medium-sized enterprises avoid both because of their weak potential to carry out procedural intensive transactions and because banks demand high transaction costs compared to small-scale transactions.

The first questions asked in this field are whether blockchain technology has the ability to transform the risky framework of the document-based credit process into a safer, faster and more convenient process, thus eliminating general letter of credit risks (Al-Amaren et al., 2020: 6052). Serving as a shared ledger (database), blockchain is seen as facilitating trade finance through its distributed network that keeps transparent records of critical transactions between trade stakeholders (Jessel and DiCaprio 2018: 37). Blockchain has the potential to increase transaction transparency and supply chain traceability (Kshetri, 2018: 84). Smart contracts hosted by its technology can be integrated into the blockchain environment to execute case-based contract terms or agreements, allowing the parties involved to carry out all processes under the security of a digital contract (Szabo, 1996; Zamani and Giaglis, 2018).

This study investigates the technological potential offered by blockchain and smart contracts in improving traditional business processes in international trade. In this direction, it is to seek ways to eliminate the problematic points of letters of credit, which are considered the most secure payment method in international trade, disadvantages such as transaction risks and costs, and general risk elements for the value flow of cross-border trade, with the benefits of blockchain technology, to draw inferences from studies conducted in this field and to offer ideas to trade actors.

The first part of the study presents the elements of the blockchain and the concepts developed with this technology. The second part provides literature on the use of blockchain technology in the context of letters of credit. The last part examines the traditional L/C process, the painful points of the process, and commercial risks, and presents a model process for closing the gaps in the process using blockchain technology.

2. Blockchain

Block chain is a concept that takes its name from its working logic and refers to a technological infrastructure developed with data blocks cryptographically chained to each other in the form of rings (Nakamoto, 2008: 2). It is the distributed ledger technology that is decentralized and impossible or difficult to tamper with, revolutionizing data security and transparency. Blockchain is a data block that allows encrypted transaction tracking and is a type of database that contains raw, unprocessed information. It is a peer-to-peer technology that allows information to be written to a ledger held simultaneously on different computers over a distributed network (Dannen, 2017).

Blockchain consists of a chain of sequentially encrypted blocks that are linked together (Singhal, Dhameja, & Panda, 2018). Each step in sending digital assets constitutes a block. This structure, which consists of a chain of interconnected sequentially encrypted blocks, can record information through digital signatures and cryptographic hashing (Hill, et al., 2018).

It is useful to understand the prominent features of blockchain.

2.1. Distributed Ledger

Blockchain refers to a different structure than a standard database with a central management or network where data is stored and managed. Since there is no such network in which data is stored in the blockchain, there is no central database or control center (Bambara & Allen, 2018: 6). Since this technology has a database that does not require a central network or server, a copy of the data is kept on all devices included in the network. In addition, when a new data or transaction is entered into the system, this data is verified and approved by all devices within the network, not by a central administrator.

2.2. Smart Contracts

Smart contracts are one of the most interesting aspects of blockchain technology, especially in the field of international trade. It is a programmable protocol that has the ability to automatically execute, verify, and update transaction status through coding. The concept of a smart contract was introduced by Szabo (1996) and is referred to as a set of digital promises, including terms and agreements made by the parties to the contract. A smart contract can be designed with pre-set coding conditions related to the business process. Usually, business process procedures executed through smart contracts are set to be triggered by a specific entity, event, or time (Zamani & Giaglis, 2018; Chang et al., 2019).

Smart contracts are not a type of blockchain in themselves, but a feature of the blockchain. They are software applications that execute themselves autonomously (based on if... then... logic) when certain conditions are met (Deloitte, 2018). Unlike a standard legal contract, they can take information as input, analyze it according to the contract rules, and ultimately perform any agreed action.

A smart contract can be designed to trigger a specific entity, event, time, etc. can be automatically executed by preset conditions triggered by , while the traditional contract does not initiate subsequent activities until the paper contract is received by mail. In this sense, while shipment delays often occur due to documentary delivery, the smart contract can update the process status in seconds or minutes and speed up the process without the worry of distance (Eberhardt and Tai, 2017). Moreover, in terms of data security, smart contracts are inherently secure, while traditional paper-type contracts are subject to interference and manipulation that cause disputes or arguments (Chang, et al. 2019: 1716-1717).

2.3. Encrypted Transaction Security

It is a concept for “cryptographically chained” data security in the blockchain and refers to the encryption of data so that only authorized parties can access the data. These blocks created during information transfer are encrypted and can never be changed or hacked. In order to delete or change the records in the blocks, all blocks in this registry, which has billions of copies, must be changed. It is almost impossible for such an intervention to occur. Thanks to this feature, blockchain is also a secure system for storing data.

2.4. Transparency

Blockchain technology consists of blocks and the records that make up these blocks, and these records are transparent. Anyone who wishes can examine all accumulated blocks. The information can only be processed by the buyer and seller specified on them.

2.5. Immutability

Since a copy of the records in the blockchain exists on all devices included in the network, any changes or deletions made by either party to their own records will have no validity. No participant can change or tamper with a transaction once it is recorded in the shared ledger. If there is an error in a transaction record, a new transaction must be added to reverse the error, making both transactions visible.

2.6. Consensus Mechanisms

Consensus mechanism is a process used to update and maintain the integrity of blockchain technology. It provides a distributed record that does not require trust between different parties, but allows them to be sure that the information they share and accept is accurate, and furthermore, they can reject any information that is not, if any. Technically, it is the procedure in which a node (network participant) is selected to add a new block to the chain (Valkenburgh, 2017; Allende & Colina, 2018). There are two important consensus mechanisms.

Proof of Work (PoW) Mechanism: It is the mechanism where users must solve the algorithm required to add blocks to the system. The user who solves the algorithm has the right to add the block to the chain. The factors to consider in the algorithm are processing power and the number of miners. Because the increase in processing power and the number of miners makes the algorithm theoretically safer. The main purpose of this system is to prevent each user from adding blocks.

Proof of Stake (PoS) Mechanism: Although proof of work is currently the most preferred block production and verification mechanism on blockchain platforms, alternative mechanisms have been produced due to high energy consumption, longer block production times and the need for special hardware. In the proof of ownership mechanism that emerges in this context, the block producing peer is given validity approval authority in direct proportion to the share he/she has in the relevant blockchain network. With the proof of ownership mechanism, it is aimed to accelerate block production and verification processes and reduce energy needs (Ünsal and Kocaoğlu, 2018: 56-57).

In summary, blockchain is a set of technologies that provide distributed, transparent, immutable and secure data structures. Transaction information on it is verified, recorded and shared by stakeholders in the network as immutable records. In other words, blockchain is a decentralized and ever-growing ledger where records of transactions are kept in cryptographically linked data structures called blocks.

Blockchain is used not only in the production of cryptocurrencies but also for operations such as storing, managing and storing in many different areas. Originally designed for cryptocurrencies, blockchain applications have spread across a variety of industries, including finance, supply chain, and healthcare.

2.7. Byzantine Fault Tolerance-BFT

In this proof approach, even a first-time participant can join the system, regardless of the share ratio or hardware elements he has. The aim here is to create a collective decision-making system by reducing the effect of faulty connections. In the Byzantine Fault Tolerance application, the devices within the network must be aware of each other. A new verifier device to be added to the system must also be approved by a central system. Due to this system conflicting with the distribution network structure of the Blockchain system, the Byzantine Fault Tolerance approach is generally preferred in special structures where the devices included in the network know each other (Usta and Doğantekin, 2017, p.125).

2.8. Blockchain System

The Blockchain system is a structure consisting of blocks where data is stored. The blocks in question are arranged by adding them to each other in a linear chain over time. The first block created in the chain ring in terms of time is called “genesis” (Usta and Doğantekin, 2017, pp.118-119). Each block created after the genesis block contains a summary of the previous block. In order to change a data in the blockchain system, it is necessary to change all the blocks before it. Blocks consist of a block header and data (Bambara and Allen, 2018, pp.17-18).

Block Header: A block header is used to identify a specific block in the entire blockchain and is hashed repeatedly to create proof of work in mining. Each of the blocks contains a unique header, and each such block is individually identified by the block header hash value (Pandey, 2019: 7-8; Liang, 2020: 123).

Hash Value: The root of the word “chain” in the blockchain definition is based on the use of the Hash value of the previous block in connecting the blocks. The Hash value is also a fingerprint that guarantees that the data in the block is unique. In case of any change or damage to the original data, the Hash value of the changed data will be incompatible with the original (Beck, 2018: 55; Pandey, 2019: 7-8; Liang, 2020: 123). Timestamp:

Proves that the data must be present at that time in order to be entered into the Hash. Each timestamp includes the previous timestamp in its hash, forming a chain, and each additional timestamp strengthens the previous ones (Nakamoto, 2008: 2; Pandey, 2019: 7-8; Liang, 2020: 123).

Nonce: This is the method used to prove that a computer has worked on a task. It is a changeable number value used to produce the desired block hash value. If a suitable block hash value is not formed, the nonce value is increased and an appropriate hash value is attempted (Drescher, 2017: 89-90; Pandey, 2019: 7-8; Liang, 2020: 123).

Merkle Root: Considering that there are many data blocks in the blockchain system, the summary information of a certain number of data blocks is combined and collected under a single package. This summary value is called the Merkle root (Drescher, 2017: 88). The purpose of the Merkle root structure is to aggregate large data sets and verify them securely and quickly (Pandey, 2019: 7-8; Liang, 2020: 123).

3. Literature Review

Chang et al. (2019), who aimed to investigate the applicability of blockchain technology in the international trade process from the perspective of L/C payment, designed a new engineering process by taking advantage of the benefits of distributed ledger and distributed workflow automation in blockchain and its smart contract technology. They adopted the extraction of system requirements from the perspectives of users and defining what the system should do functionally, and determining system processes. In this context, they compared the proposed process with traditional commercial processes, and discussed the relative advantages, compatibility, complexity, trialability and observability elements. Practical evidence in the industry and the difficulties encountered in similar blockchain applications were discussed.

Bhat et al. (2021) discussed in their study how blockchain technology can be used to create an effective model to optimize the process in trade finance. In this context, they examined the developed Accepire-BT platform. In addition to blockchain features such as immutability, decentralization, authentication and data structure, Accepire-BT investigated how the disadvantages of current trade finance processes can be eliminated with advantages such as efficiency, transparency, collaboration and auditability. The study proposes a solution that integrates blockchain technology with standard L/C.

Belu (2019) evaluated the advantages of blockchain technology in logistics and financial transactions in international trade, and also evaluated the L/C process in his study. He claimed that the costly structure of the process and long-term complex transactions would be eliminated with the advantages of the blockchain, and brought together the views of the World Trade Organization and other international trade organizations.

Ilovaysky (2021) discussed the status of distributed ledger technology in the Russian Federation in the regulation of the form of L/C settlement and the possibilities for normative improvement of Russian law. The study states that the blockchain strengthens the tracking of the movement of funds and goods in banking activities and transactions under the L/C, providing a secure relationship between the parties. He defined blockchain technology as an information system and processing technology that verifies ownership and other rights and responsibilities, collects and stores accurate data on this, and allows important actions electronically. He stated that with this feature, it is quite possible to integrate it into L/C processes, despite the lack of appropriate legal infrastructures.

Al-Amaren et al. (2020) stated that the L/C method, which is a paper-based, slow, inefficient and expensive system where it is necessary to share and verify documents between parties across borders, does not require such a complex and global paper chase, and transparent, end-to-end trade is possible with today's technology with a single system that is carried out quickly between the buyer, seller and relevant bank partners. In this context, he assumed that Blockchain is a miraculous solution for the bright future of L/C. The study investigated how the main points of the L/C process are improved when developed with the use of blockchain. The author claimed that blockchain will be beneficial to L/C processes for 5 main reasons.

1. Blockchain will help mitigate the risk of document fraud and reduce transaction costs.
2. Blockchain has the potential to make it more efficient, reliable and easier for all parties and to enhance the good reputation of letters of credit in international trade.
3. Blockchain eliminates the need for correspondent banks in letters of credit transactions.

4. Blockchain enables faster, more secure payments by automating payment methods and preventing disputes due to contractual ambiguities, which reduces payment delays by early discovery of discrepancies and reduces the cost and difficulty of making changes.
5. Blockchain technology makes bureaucratic steps faster and easier for parties to letters of credit by eliminating the need for physical presentation of documents. It can help complete all letters of credit transactions in just one day. It also ensures that all parties have visibility into the process and can check the documents presented by the seller.

Fukuzawa et. al (2024) discussed preparing a L/C-based contract within a blockchain network using smart contracts. In this context, they modeled a small-scale general contract scenario under perfect conditions using Ethereum smart contracts. They stated that blockchain research is needed in other application areas to explore the potential use of distributed ledger technology, that small-scale contracts are an area where trust and payment security can become problematic for all parties involved, and that blockchain technology can help overcome these challenges. In the model, it is stated that the exporter, who is the obligor, and the importer, who is the customer, define their obligations to each other with a small-scale contract. In detail, it is designed to connect their funds to a digital wallet and to define the system that proof of work progress in the form of digital image transmission should be provided.

Chang et al. (2020), in their study analyzing the applicability of blockchain innovation in trade finance through distributed ledger technology-based L/C initiatives, interpreted the issue as a paradigm shift in terms of logistics tracking and procedures. The study aims to provide evidence of a possible shift in trade finance paradigms using empirical evidence from multiple cases. In this context, different scenarios regarding blockchain implementation of trade-related procedures related to L/Cs and B/Ls were brought together. According to the inference made from the examined cases; blockchain has the potential to reshape business operations thanks to its immutability, transparency and interoperability, and is expected to reduce paper-based manipulation, increase trust among trade stakeholders and ensure the development of sustainable finance as well as sustainable business environments.

4. Integration of Blockchain Technology into Letters of Credit

Before the goal of integrating blockchain technology, it is necessary to examine the details of the traditional L/C in order to see the dimensions of the L/C payment method and understand the process.

4.1. Letter of Credit Features

Although the L/C is the most reliable and most commonly used payment method in international trade, it is a difficult application for the average person or a company that has not reached sufficient expertise in trade to know or execute due to its provisions and complex processes. In the L/C, which is accepted as a conditional payment commitment, importers provide assurance to exporters through their banks. Exporters benefit from this assurance by complying with the specified conditions and fulfilling the provisions.

In general, we can list the features of the L/C in the following 10 items;

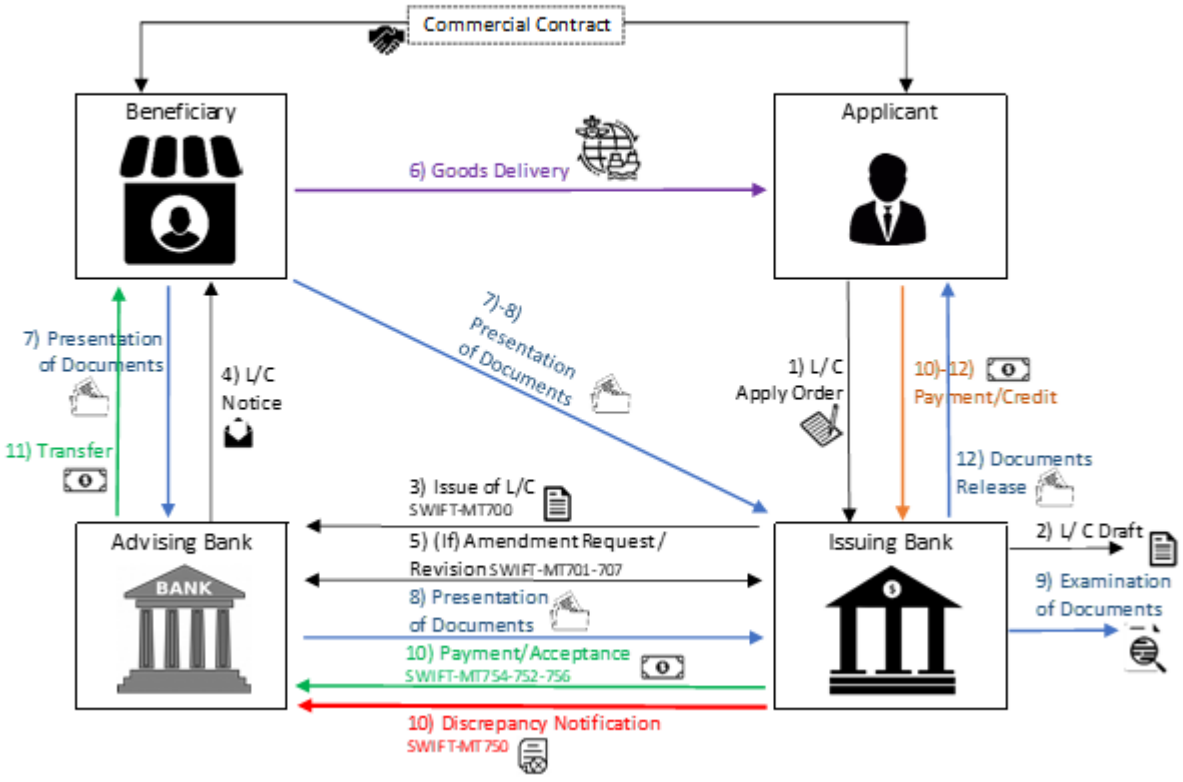
1. It is the most commonly used in practice because it is the most reliable payment method.
2. The expenses and costs of the L/C are higher than other payment methods due to the transaction processes and bank guarantee. While banks charge or make deductions for the transactions they have made, corrections or incorrect processes, repetition of transactions, they also request commission from the parties due to the assurance they provide.
3. Banks guarantee that the payment will be made to exporters with a text in which they present minimum conditions. Exporters act by seeing this assurance as a guarantee for their trade, and can use it as collateral in other financial transactions or obtain early financing opportunities.
4. Importers can obtain the documents and information they request in the L/C provisions in a healthy and timely manner, after they have been filtered by the bank, and thus they can carry out their import processes more efficiently.
5. Banks conduct transactions based on documents and are not interested in the physical condition and technical features of the goods.

6. A L/C is a different contract from the commercial/sales contracts on which it is based. Therefore, there may be differences between the provisions of a L/C and the provisions agreed upon between the parties.
7. Banks can open letters of credit with maturity, with a bill of exchange, with payment at sight (following the presentation of the document) or in advance (with payment before shipment).
8. Depending on the differences in application, there are confirmed, unconfirmed, transferable, revolving, back to back, and stand by types of letters of credit.
9. The procedure to be followed by banks and parties in L/C processes has been taken on a legal basis by ICC provisions and is updated from time to time according to changing conditions.
10. Today, banks use the messaging system provided by the SWIFT organization to carry out the communication of the L/C payment system (notification, transfer, etc.). By taking advantage of the SWIFT infrastructure and message formats, they use the text containing the parties and L/C provisions in a certain definition system.

4.2. Traditional Letter of Credit Process

The L/C transaction begins with the importer requesting that a L/C be opened in favor of the exporter and forwarded to the bank in the exporter's country. The exporter submits the necessary documents to his bank, in full, and within the credit validity period, indicating that the goods have been loaded in accordance with the conditions specified in the L/C and within the specified period. The bank reviews the documents submitted by the exporter, examines their compliance with the contract, and forwards them to the importer's bank. The importer's bank examines whether they comply with the terms of the L/C. When the importer's bank reaches the conclusion that the conditions are met, it transfers the amount of the goods to be exported to the exporter's bank (Kaya, 2019: 138). The L/C process can be summarized as in Figure-1;

Figure-1: Traditional Letter of Credit process

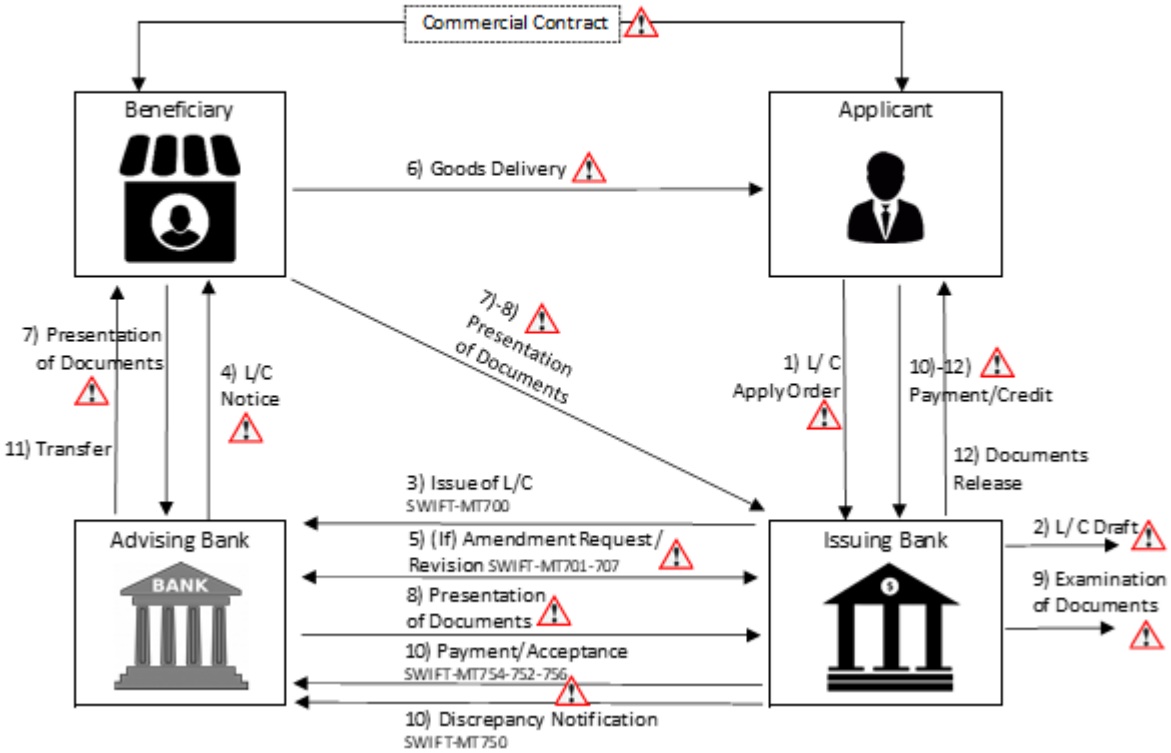


(1) The importer, referred to as the *Applicant* in the L/C, applies to a bank with instructions to provide payment security in favor of the exporter for the import to be made. (2) The importer's bank, referred to as the *Issuing Bank* in the L/C, which examines the instruction, accepts the application based on the customer's credibility and the terms of the L/C and creates a draft L/C by taking into account the details specified in the instruction. (3) The prepared draft is sent to the exporter's bank, referred to as the *Bank*, via the SWIFT message system. (4) The Correspondent Bank notifies the exporter, referred to as the *Beneficiary*, of the L/C. (5) If the Beneficiary wants to make a change in the L/C text that he has reviewed, he requests the Applicant to correct it from his bank. The Issuing bank sends a correction message. (6) The Beneficiary ships the goods before the last loading date specified in the L/C, the terms of which it accepts. (7) The Advising Bank delivers the documents prepared for export and meeting the conditions specified in the L/C to the Advising Bank for preliminary control and sending to the Issuing Bank. (8) The Advising Bank sends the documents to the Issuing Bank. (9) The Issuing Bank examines the documents received within the presentation period specified in the L/C in accordance with the terms of the L/C within the specified period. (10) If the examined document meets the terms of the L/C, the Issuing Bank makes a payment or negotiation notification in the L/C. Accordingly, when payment is seen, payment is made as soon as possible following the payment (sight) or bill of exchange acceptance notification, and in the case of a term L/C, payment is made on the specified term. On the other hand, if the examined document does not meet the terms of the L/C, it is stated that the money to be paid is reserved with a discrepancy notification. In this case, the Beneficiary sends a new document to resolve the discrepancy or requests the Applicant to indicate that it accepts the reserved document and instructs its bank to remove the reserve. (11) The transfer takes place after the presentation of the document meets the conditions of the L/C. In a confirmed L/C, the Advising Bank will make the payment to the exporter. In this case, the name of the bank will be the Confirming Bank. (12) As agreed in the L/C application, the importer can make the payment to its bank either at the beginning or at the time of receiving the document. And he obtains the document to perform customs procedures.

4.3. Risks of Letter of Credit

Although the L/C is the safest payment method in practice, it carries some risks for the parties in terms of its various aspects and operation. The risks mentioned for all parties can be explained as follows (Figure-2), both in general and through the operation specified in articles during the L/C process.

Figure-2: Risks of Letter of Credit



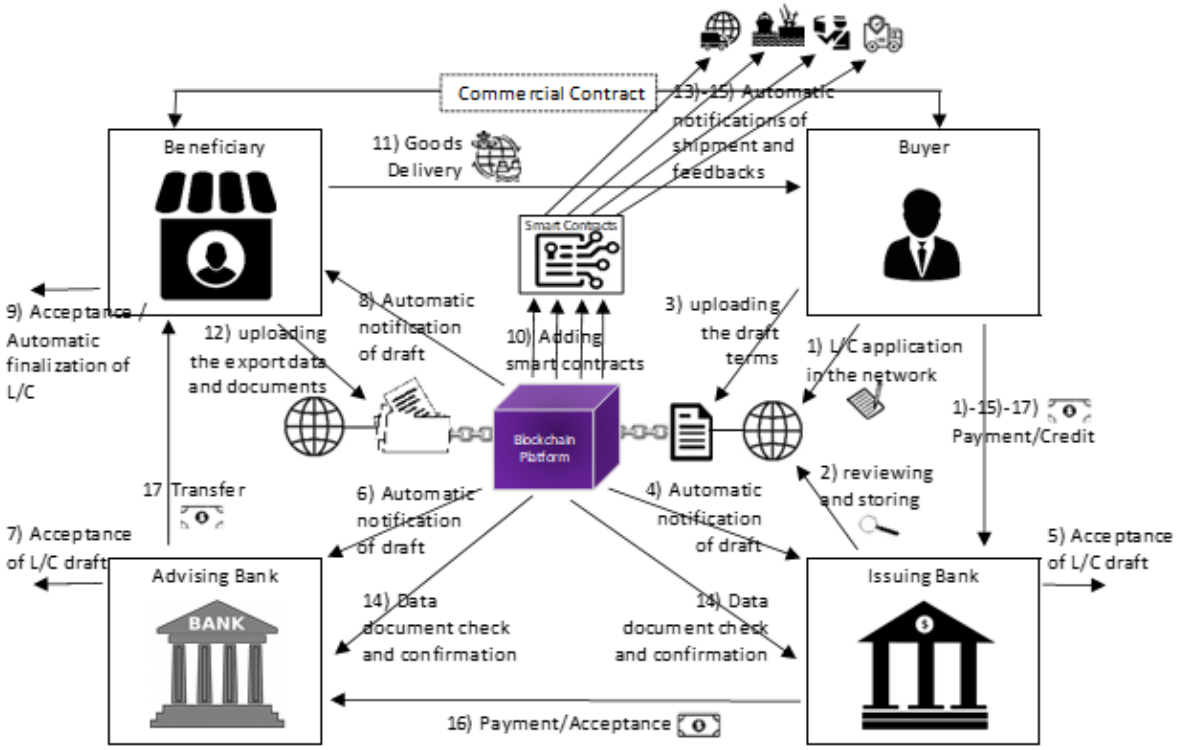
• In cross-border trade, if the seller and the buyer cannot transfer the details of the L/C payment method they have agreed on to the contract, proforma invoice or offer forms they have drawn up between them in detail and as desired, the L/C may be opened or applied in a way that will create a risk for any of the parties.

- (1) The parties' contract details may be transferred to the L/C instruction given by the Applicant to the Issuing Bank with different or incomplete information. In this case, the Issuing Bank may open a L/C with different, previously unagreed terms. Thus, it may incur risks or additional costs for later corrections due to a process contrary to the expected situation.
- (2) The Issuing Bank may add to the L/C some terms that are not fully compliant with the L/C instruction or are not specified in the instruction but are added by itself, or leave them incomplete. This situation may pose risks for both parties.
- (4) (5) The Beneficiary may receive the L/C notice opened in his favor late from the Advising Bank or directly from the Issuing Bank, may be inadequate in examining the terms of the L/C, may not receive sufficient support from his bank. He may not be able to request a correction, there may be communication problems with the importer for this, or the assumption of the costs related to the correction may create a problem. He may be late in requesting a correction, may be torn between missing the last loading date and waiting for the correction. He may load without seeing the corrected and suitable conditions, and therefore without fully receiving the L/C guarantee, assuming the risk.
- (6) The Beneficiary may present forged documents that apparently comply with the terms of the L/C, and the authorized bank may accept these documents. Thus, he may be able to receive his money even if he has not made a healthy export. On the other hand, the Beneficiary may act in accordance with the terms specified in the L/C, comply with the loading date and appropriate presentation. However, the physical conditions of the agreed products may not be in accordance with the quality and standards specified in the agreement, there may be incomplete loading, the goods may be damaged or lost during transportation or storage, and thus the buyer may not receive a healthy delivery.
- (7) (8) (9) The Beneficiary may not present in accordance with the conditions specified in the L/C, there may be inconsistencies between the documents and the L/C terms, they may present late, and the Issuing Bank may attribute some differences in the documents as inconsistencies in a manner that is not in accordance with the rules of the L/C. In such cases, it may place a reserve on the payment and the beneficiary may not receive the payment or may receive it late. Document corrections may take time to remove the reserve. The seller may request the buyer to instruct his bank to accept the reserved document, in which case, despite the L/C quarantee, the process is left to the buyer's initiative. On the other hand, the Issuing Bank may charge a fee per inconsistency and make a deduction from the payment.
- (10) The Issuing Bank or a Reimbursing Bank indicated in the L/C may not make immediate payment due to the condition of the “sight letter of credit” despite the appropriate presentation, and may delay the process or delay alternatives to the L/C such as acceptance or negotiation. In this case, the Beneficiary may receive the payment late.
- The L/C may be fake, the Issuing Bank may not be a reliable bank, it may be a bank with a deteriorated financial situation or in bankruptcy, its country may impose exchange restrictions, a force majeure situation may occur due to reasons such as war, internal turmoil, natural disasters. In such cases, if the guarantee is not received from the Confirming Bank, the Beneficiary may not receive the payment.
- (10) (12) The importer may be insolvent, may not make the payment to its bank for the amount of the L/C or may make it late. If the Issuing Bank does not receive the payment from its customer in advance or does not receive sufficient assurance, it may make the payment due to the guarantee it has given to the Beneficiary, assuming the risk, but may not receive the return.
- The Advising Bank or any bank may confirm the L/C, but if the Issuing Bank does not fulfill its duty and does not make the payment, it may have to pay the Beneficiary before receiving the money.
- The L/C process may take a long time, reserves and various procedures may delay payment. Parties may be affected by changes in exchange rates or high interest rates in the case of outsourcing, and their costs may increase.

4.4. Letter of Credit Process with Block Chain

The L/C and supply process, representing the position of the stakeholders, designed with the integration of blockchain technology, is given in Figure-3, and the details of the process are itemized.

Figure-3: Blockchain Integration into the Letter of Credit Process



- (1) The Importer (Applicant) first creates the L/C application on the network where the blockchain infrastructure is located.
- (2) Then, the Importer's Bank (Issuing Bank) reviews it and the financial performance of its customer and stores it on the blockchain.
- (3) According to the format created on the system, the Applicant prepares the draft L/C and uploads it to the blockchain for the participation of the Issuing Bank.

  The L/C is organized in a distributed atechnology network consisting of the importer, exporter, banks and other units acting as participating nodes.
- (4) The Issuing Bank receives notification automatically for control and adds, rejects or proposes changes to the participation information based on the data provided by the Applicant.
- (5) The Issuing Bank reviews L/C request and accepts.
- (6) Following the acceptance of the Issuing Bank, access to the Exporter's Bank (Advising Bank) is automatically provided.

  Before the L/C is sent to the Exporter (Beneficiary), it can be revised and approved by other relevant banks, including the Advising Bank that is the addresseed at L/C.
- (7) The Advising Bank can accept or reject the L/C based on the data shared by the Issuing Bank.
- (8) If the Advising Bank approves the credit, the Beneficiary automatically receives the notice.
- (9) The Beneficiary checks the terms and conditions of the L/C, requests correction (if any), and if the terms are approved, the L/C becomes final as a contract between the Issuing bank and the Exporter.

  Any changes or updates to the L/C can be arranged as a 'multi-signature mechanism' that provides approval and viewing permissions of the buyer, seller and participating banks, depending on the nature of the changes required.

- (10) Smart contracts containing process details that other stakeholders in the supply chain participate in are added to the blockchain. Smart Contracts can be designed specifically for the service and transaction processes of external stakeholders such as forwarders, shipowners, port or warehouse operators, customs, and insurers.
- (11) The Beneficiary carries out the loading in accordance with the terms of the L/C.
- (12) The Beneficiary uploads the data and necessary documents related to the export and specified at L/C to the blockchain platform.
- (13) External stakeholders included in the chain with smart contracts receive automatic notifications, are informed about the loading and relevant export information with the documents added to the blockchain.
- (14) The documents are reviewed by the Advising Bank and the Issuing Bank, accepted or rejected, and if there are any inconsistencies, they are presented to the Applicant for review.
- (15) The external stakeholders receiving notifications through smart contracts provide feedback or approval regarding transactions such as bill of lading confirmation, arrival at the port or warehouse, unloading, declaration opening etc.

  Also the Applicant receives information that the documents have been approved, confirmed by the external stakeholders in the smart contract, and initiates the import transactions.
- (16) The Issuing bank makes the payment in accordance with the conditions specified in the L/C, on sight, on maturity or with the acceptance of the bill of exchange.
- (17) The payment that reaches the Advising bank through transfer is wired to the Beneficiary's account.

  According to the agreement with the bank, the importer can make the payment to his bank at the beginning of the L/C process, at the document approval, notification or after the payment is made to the exporter.

5. Discussion

The scope of traditional L/C trade and the scope of L/C trade designed with smart contracts integrated with blockchain are compared in terms of commecial contract, L/C draft, changes and updates, shipment, documents and payment at Table-1.

Table-1: Comparison Between Traditional Process vs Desired Process with Blockchain

Issues	Traditional L/C Trade Scope	Desired L/C Trade Scope with Blockchain
Commercial Agreement	The L/C is independent of the sales contract on which it is based. Therefore, any incompatibility between the commercial agreement and L/C, or subsequent commercial disputes may result.	Contract terms are recorded in smart contracts and blocks and changes are kept on the chain visible. There is no problem of tampering and manipulation in this system (Roberto, 2018; Chang et al., 2019).
L/C Draft	The draft of L/C created by the Issuing Bank and oppening process may not satisfy the parties due to unforeseen conditions. In practice, sellers may encounter surprises.	Once the initial record on the blockchain is made by the importer, the parties add their additional information and approvals. There are no unforeseen or surprising conditions (Lata & Rashi 2017; Al-Amaren et al., 2020).
Correction and Update	Changes to the terms of the L/C are made under the responsibility of the Issuing Bank and under the instructions of the importer. Information updates are based on manual labor such as e-mail, messages, telegrams, etc. Information transmission and approval cause additional costs.	The multi-signature mechanism in the blockchain requires that changes be finalized with the approval of all parties (Al-Amaren et al., 2020). Contract notifications are tracked simultaneously. Information transmission and approval do not incur any costs (Chang et al., 2019).

Shipment	L/C do not concern themselves with goods or their physical conditions. Transactions are made based on documents and payment is guaranteed if the documents are deemed correct. A malicious exporter can manipulate the process and cause damage to the importer.	With conditional smart contracts added to the blockchain, logistics stakeholders are included in the process and confirmations are received that the goods have been delivered and that they comply with quality and standards. The bank's transaction can be designed based on the fulfillment of contractual obligations (Zamani & Giaglis, 2018; Chang et al., 2019; Deloitte, 2018; Larson, 2018).
Documents	The Issuing Bank must see and review the physical-paper documents submitted by the exporter in accordance with the presentation requirements. The bank reserves the payment and makes a deduction from the total amount in cases where the documents are inconsistent or late. The exporter may not receive the payment or receive it late.	Blockchain technology operates on digital documents and data. Uploading documents to the system, submitting them to banks and checking them can be done on the same day without wasting time (Chang et al., 2019; Al-Amaren et al., 2020; Lata & Rashi 2017). Changes regarding inconsistencies in documents and data can be made without interruption and do not constitute a reason for placing a reserve on payment.
Payment	There may be reasons for delaying payment due to document control or reserve removal processes of the Issuing Bank or Confirming Bank.	Since document-data control is done online, banks have no excuses to delay the process. In addition, conditional smart contracts make the payment process transparent and provide assurance to the parties (Koji, 2018; Chang et al., 2019).

General evaluations of the L/C process designed with blockchain technology and comparisons of various factors according to the inferences made from the studies in the literature are given in Table-2.

Table-2: Comparison between Traditional L/C Process and Blockchain Based L/C Process

Factors	**Traditional L/C Process**	**Blockchain based L/C process**
Security	Low	High
Process Tracking	Low	High
Transparency	Low	High
Fraud and Manipulation	High	Low
Disintermediation	Low	High
Documentation	Paper-physical	Digital
Information Transmission	Manuel	Automatic-Online
Incorporation of IoT	Low	High
Customer and User Experience	Ordinary	Relative Advantage
Time	Long, Relatively Indefinite	Short, Clear
Cost	High	Low
Efficiency	Low	High

6. Conclusion

The integration of blockchain technology into international trade processes has been on the agenda of many sectors in recent years. In this context, individual applications are being developed, primarily for financial transactions, then for supply chain processes. Although it is anticipated that the advantages of technology will bring to trade and eliminate many problems, the development of applications is progressing slowly due to the concerns and hesitations of the parties due to the potential paradigm shift. On the other hand, the current rules of international organizations such as traditional banking systems, the International Chamber of Commerce, and the conventional legal regulations of the party states delay the implementation of this decentralized technology. It is thought that the complexity and compliance problems of blockchain technology will be eliminated in the near future.

L/C, which is a popular application in the financing of international trade and is considered the most secure form of payment, contains many painful points. When considered together with a number of supply chain problems, the problems complicate the operation of trade and cause loss of time, money, and trust. The painful points in question were investigated in the study, and a L/C process was designed that focuses on eliminating the problems with the integration of blockchain technology. It is envisaged to include supply chain stakeholders by adding smart contracts to the process. Thus, conditional processes are included and the L/C transaction process is interpreted as a whole with supply chain processes. The focus is on making trade risk-free, secure, low-cost and fast.

The L/C process design developed with blockchain provides a user experience that paves the way for customized banking services compared to existing procedures, conditional transaction capability with smart contracts that eliminate commercial uncertainties, document and information transmission speed, multiple approved secure processes where only all parties are involved in changes or updates to L/C terms, low transaction costs and traceability.

This study offers a unique perspective in terms of its scope. The contribution of blockchain technology to many areas has been specifically addressed, specifically in the case of letter of credit processes and supply chains. This study, which does not only focus on theoretical evaluations, has designed the integration of blockchain technology elements into the functioning of trade and processes. The opportunity to compare the processes to be achieved with the integration of blockchain technology with traditional processes has been seized. These designs, developed by utilizing experiences and cases regarding the problems of the process experienced in practice, provide an important compilation of information for blockchain software developers and entrepreneurs in the sector. In summary, the evaluations made in the study and the process design developed primarily contribute to the literature and guide technology integration developers and trade decision-making institutions.

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Araştırma Makalesi

The Blockchain Technology Solution to the Pain Points of Letter of Credit

Akreditif Sorunlarına Blok Zinciri Teknolojisi Çözümü

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Genişletilmiş Özet

Uluslararası ticaretin akışında meydana gelen güven kaygıları, sahtecilik, zaman kaybı, bürokrasi vb. gibi unsurları ticaretin işleyişine olumsuz yönde etki ederken, gelişen teknolojiler ile bu unsurları bertaraf edecek uygulamalar geliştirilmektedir. Taraflar arasındaki sınır ötesi işlemlerin ve veri akışının koordinasyonuna yönelik son yıllarda ortaya çıkan en önemli gelişmenin blok zinciri teknolojisi olduğu düşünülmektedir. Blok zinciri teknolojisinin kullanımı henüz emekleme aşamasında olmasına rağmen şimdiden küresel ticarette devrim yaratan bir etken olacağı konuşulmaya başlamıştır. Standart belgeleme yöntemlerinin yerini alabileceği, lojistiği kolaylaştırabileceği, şeffaflığı artırabileceği, işlemleri hızlandırabileceği, ticaretin planlanmasını ve takibini iyileştirebileceği nedeniyle cazibesi karşı konulamaz görülmektedir. Bu teknolojinin tüm ticaret kesimleri üzerinde olumlu bir etkisi olacağı mümkündür, ancak düzenleme, altyapı ve standartların benimsenmesi açısından bir takım zorluklarla karşı karşıyadır. Blok Zinciri teknolojisinin uluslararası ticaret alanında ilk uygulamaları finans sektöründe uluslararası para transferi üzerine olmuş, bunu kısa zamanda, gümrükleme, sigortalama ve taşıma gibi lojistik faaliyetler takip etmiştir.

Uluslararası ticarette en güvenilir ödeme şekli olarak kabul edilen akreditif (Letter of Credit - L/C), sağladığı tüm avantajlara rağmen, taraflar için uygulamada bazı riskler ve dezavantajlı unsurlar içermektedir. Temelinde bir banka güvencesi sunan, ihracatçıya ödemeyi garanti eden, ithalatçıya da belgelerin sağlıklı bir şekilde, zamanında temin edilebilmesini sağlayan bu ödeme şeklinin uygulamasında bir takım prosedürler nedeniyle karmaşık ve hantal bir yapıda görülmektedir. Bu nedenle akreditif, kurumsal altyapısı kuvvetli büyük işletmelerin daha çok tercih ettiği, küçük ve orta ölçekli işletmelerin ise hem prosedür yoğun işlemleri yürütme potansiyelinin zayıf olması, hem de bankaların düşük çaplı işlemlere oranlandığında yüksek işlem maliyetleri talep etmeleri nedeniyle uzak durduğu bir finansal işlem olarak görülmektedir.

Blok zinciri teknolojisinin, dokümantasyona dayalı kredi süreci olan akreditifin riskli çerçevesini daha güvenli, daha hızlı ve daha kullanışlı bir sürece dönüştürme yeteneğine sahip olup olmadığı, böylece genel akreditif risklerini ortadan kaldırabilmesinin mümkün olup olmadığı bu alanda sorulan ilk sorulardır (Al-Amaren vd., 2020: 6052). Paylaşılan bir defter (veritabanı) olarak hizmet veren blok zinciri, ticaret paydaşları arasındaki kritik işlemlerin şeffaf kayıtlarını tutan dağıtılmış ağı aracılığıyla ticaret finansmanını kolaylaştırabilir (Jessel and DiCaprio 2018: 37) olarak görülmektedir. Blok zinciri, işlem şeffaflığını ve tedarik zinciri izlenebilirliğini artırabilir potansiyele sahiptir (Kshetri, 2018: 84). Teknolojisinin barındırdığı akıllı sözleşmeler, vaka tabanlı sözleşme şartlarını veya anlaşmaları yürütmek için blok zinciri ortamına entegre edilerek, dahil olan tarafların tüm süreçleri dijital bir sözleşme güvencesi altında yürütebilmesine imkan tanır (Szabo, 1996; Zamani and Giaglis, 2018).

Bu çalışmanın temel amacı, uluslararası ticarette geleneksel iş süreçlerini iyileştirilmesinde blok zinciri ve beraberinde akıllı sözleşmelerin sunduğu teknoloji potansiyelini araştırmaktadır. Bu doğrultuda, uluslararası ticarette en güvenli ödeme şekli olarak kabul edilen akreditifin sorunlu noktalarının, işlem riskleri ve maliyeti gibi dezavantajlı yönlerinin ve buna ilaveten sınır ötesi ticaretin değer akışına yönelik genel risk unsurlarının, blok zinciri teknolojisinin kazanımlarıyla giderilmesinin yollarını aramak, bu alanda yapılmış çalışmalardan çıkarım yapmak ve ticaretin aktörlerine fikirler sunmaktır.

Çalışma, blok zincirinin unsurlarını ve bu teknoloji ile gelişen kavramları ortaya koymaktadır. Akreditif sürecinin mevcut yapısı, risk unsurları ve verimsiz yönlerinin belirlendiği araştırmada, sürecin kritik noktalarının iyileştirilmesine yönelik blok zinciri entegrasyonu ile geliştirilmiş bir süreç protatipi sunmaktadır. Blok zincirinin dağıtılmış defter teknolojisi ve ona bağlı oluşturulan akıllı sözleşmeler entegre edilerek elde edilen akreditifli ödeme sisteminde ve tedarik zinciri sürecinde iş akışı otomasyonu tasarımı çalışmayı somutlaştırmaktadır. Blok zinciri teknolojisi ile ele alınan tedarik zinciri ve uluslararası finansal işlemlerin, ticari sözleşme, akreditif açılışı ve işleyişi, dokümantasyon, sevkiyat, para transferi gibi süreç unsurları, geleneksel yapı ile arzulanan yapı arasında karşılaştırılarak, literatürdeki çalışmalardan elde edilen çıkarımlarla yorumlanmaktadır.

Geleneksel süreç ile ortaya konan tasarımın sunduğu yapı karşılaştırılmaktadır. Buna göre;

Tablo-1: Geleneksel Süreç ile Blok Zinciri ile Arzu Edilen Süreç Karşılaştırması

Sorunlar	Geleneksel Akreditifli Ticaret Kapsamı	Blok Zinciri ile Arzu Edilen Akreditifli Ticaret Kapsamı
Ticari Sözleşme	Akreditif dayandırıldığı satış sözleşmesinden bağımsızdır. Bu nedenle ticari anlaşma ile akreditif arasındaki uygunsuzluk veya sonradan gerçekleştirilen ticari anlaşmazlıklara neden olabilir.	Sözleşme şartları, akıllı sözleşmelere ve bloklara kaydedilir ve değişiklikler görülebilir durumda zincirde tutulur. Bu sistemde kontrolsüz müdahale ve kurcalama sorunu yoktur (Roberto, 2018; Chang et al., 2019).
L/C Taslağı	Akreditifi ihraç eden Amir Bankanın uhdesinde oluşturulan akreditif taslağı ve açılış süreci tarafları memnun etmeyebilir. Uygulamada satıcılar sürprizlerle karşılaşabilmektedirler.	Blok zincirine ilk kayıt ithalatçı tarafından yapıldıktan sonra taraflar ilave bilgilerini ve onaylarını eklerler. Öngörülemeyen veya şaşırtıcı koşullar yoktur (Lata & Rashi 2017; Al-Amaren et al., 2020).
Düzeltme ve Güncelleme	Akreditif şartlarında değişiklik Amir Bankanın uhdesinde ve ithalatçının talimatıyla gerçekleştir. Bilgi güncellemeleri e-posta, mesajlar, telgraf vb. gibi manuel iş gücüne dayanır. Bilgi iletimi ve onaylanması ilave masrafa sebep olmaktadır.	Blok zincirinde çoklu imza mekanizması değişikliklerin tüm tarafların onayı ile kesinleşmesini öngörür (Al-Amaren et al., 2020). Sözleşme bildirimleri eş zamanlı olarak takip edilir. Bilgi iletimi ve onayı herhangi bir maliyet doğurmaz (Chang et al., 2019).
Sevkiyat	Akreditif mallarla, fiziki şartlarıyla ilgilenmez. Belgeler üzerinden işlem yapar ve belgelerin doğruluğuna kanaat getirirse ödeme garanti edilir. Kötü niyetli bir ihracatçı süreci manüpile edebilir ve böylece ithalatçıyı mağdur edebilir.	Blok zincirine eklenen şarta bağlı akıllı sözleşmelerle lojistik paydaşları sürece dahil edilerek malların teslim edildiği, kalite ve standartlara uygunluğu teyitleri alınır. Bankanın işlem yapması sözleşmedeki yükümlülüklerin yerine getirilmesine bağlı olarak tasarlanabilir (Zamani & Giaglis, 2018; Chang et al., 2019; Deloitte, 2018; Larson, 2018).
Belgeler	Amir Banka ihracatçı tarafından ibraz şartlarına uygun olarak sunulan fiziki-kağıt belgeleri görmek ve incelemek zorundadır. Banka belgelerin tutarsız olması, geç ibraz edilmesi gibi senaryolarda ödemeyi rezerv eder, toplam tutardan kesinti yapar. Bu durumda ihracatçı ödemeyi alamayabilir veya geç alır.	Blok zinciri teknolojisi dijital belgeler ve veriler üzerinde işlem yapar. Belgelerin sisteme yüklenmesi, bankalara sunulması ve kontrolü, zaman kaybedilmeden aynı gün içinde bile gerçekleştirilebilir (Chang et al., 2019; Al-Amaren et al., 2020; Lata & Rashi 2017). Belge ve verilerde değişiklik kesinti söz konusu olmadan gerçekleşebilirken, ödemeye rezerv konması için bir sebep teşkil etmez.
Ödeme	Amir Banka veya Teyit Bankasının belge kontrolü ya da rezerv kaldırma süreçleri nedeniyle ödemeyi geciktirme nedenleri olabilir.	Belge-veri kontrolü online gerçekleştiği için bankaların süreci geciktirme bahaneleri bulunmaz. Ayrıca şarta bağlı akıllı sözleşmeler ödeme sürecini şeffaf hale getirir ve taraflara güvence sağlar (Koji, 2018; Chang et al., 2019).

Bu çalışmada tasarlanan iş akışı blok zinciri ve akıllı sözleşme tabanlı bir sürecin kavramsal tasarımına katkıda bulunmaktadır. Yapılan nitel değerlendirmeler ve geliştirilen süreç tasarımı ticari süreçlere model geliştirenlere yol gösterici niteliktedir. İş süreci operasyonlarının daha iyi performansına ulaşmak için, paydaşların ve beraberinde sistem tasarımcılarının araştırma ve uygulama çalışmalarına daha fazla çaba sarf etmesi ve koordinasyon için olmaları önerilmektedir.