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ANALYSIS OF FEASIBILITY OF BLOCKCHAIN TECHNOLOGY FOR INTERNATIONAL TRADE RELATED TO SRI LANKAN CONSTRUCTION INDUSTRY

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ABSTRACT

Sri Lankan (SL) construction industry has been trading with overseas suppliers to fulfil the need for material and technology. This process faces many issues due to the poor digitalisation of the industry. The financial flow of international trade is dominated by financial institutions (i.e., banks) and the industry faces many issues e.g., delays, additional charges, complexity, lack of information sharing, and requiring legal assistance. Blockchain Technology (BCT) has emerged as a revolutionary digital technology in the past decade. Key features of BCT i.e., immutability, decentralisation, distributed ledgers, enhanced security, consensus, and speed have been identified to provide solutions for issues in the various industries including the supply chain. Hence this paper aims to investigate the feasibility of using BCT to solve existing issues in financial flow with special reference to the barriers to adopt it in the international trade of the Sri Lankan construction industry. As the data collection method, an expert opinion forum was carried out by involving both international trade experts and blockchain specialists in the Sri Lankan construction industry. Key findings present that BCT can solve issues such as transparency issues and poor information sharing between parties, excessive documentation and complexities, payment delays, and financial costs in the international trade of the SL construction industry. Further, findings revealed that the government's approval, legal requirements, lack of knowledge and technology, and reluctance to change the industry can act as barriers to adopt BCT in Sri Lanka.

Keywords: *Blockchain; Construction international trade; Expert interviews; Financial flow.*

1. INTRODUCTION

The involvement of a large number of stakeholders and the uniqueness of each output may describe the complexity and risk level of the construction industry (Belle, 2018). Being more complex construction has come a long way to a level to trade internationally with foreign stakeholders such as suppliers and contractors (Belle, 2018). Procuring materials and equipment for construction is one of the challenging areas because it governs the time for construction, cost, and quality factors of the construction output (Hewavitharana *et al.,* 2019). Exporting and importing commodities in and out of countries are common in construction because of the availability of limited resources and

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varied technology advancements in different regions (Schumacher, 2013). As a developing Asian country, Sri Lanka is showing interest in foreign supplies for fulfilling requirements of construction material and equipment. However, construction supply chains face many problems such as lack of coordination and trust between suppliers and customers in the supply chain, design problems, less transparency, misinformation, and poor quality of materials and equipment (Nanayakkara *et al.,* 2013).

In 2008, Satoshi Nakamoto invents blockchain as a public transaction ledger of the cryptocurrency (Abeyratne and Monfared, 2016). Due to the mainstream focus on bitcoin, blockchain was originally seen as a way to create new digital currencies that people can use anonymously in trade between untrusted participants beyond geographic boundaries (Wang *et al.,* 2017). Gradually, professionals have identified the significance of blockchain systems. Moreover, blockchain critically challenges conventional systems by improving in many areas such as transparency, accountability, security, trust, cost minimisation, and efficiency (Kshetri, 2018). Hence, this paper discusses the financial flow-related issues since they are considered more critical in the international trade of the SL construction industry and reviews the feasibility of adopting BCT as a solution to overcome such issues.

2. LITERATURE REVIEW

2.1 ISSUES IN THE FINANCIAL FLOW OF CURRENT PRACTICES OF INTERNATIONAL TRADE IN CONSTRUCTION SUPPLY CHAIN

In the Sri Lankan context, Wedikkara and Devapriya (2000) describe that price determination for projects, designing process, forecasting, and operation of the construction firm also depend on the supply side of the construction industry. Further, considering the environment of the Sri Lankan construction industry it depends more on foreign suppliers due to the scarcity of construction material and technology. According to the Board of Investment Sri Lanka (2013), the imported components used in major infrastructure in Sri Lanka vary from 45-63% of the total cost. Therefore, international trade is a vital component in the Sri Lankan construction industry.

Power (2005) identified that three types of supply chains in construction; i.e. (i) The primary supply chain: Supplies the material required for the final construction output, (ii) The support chain: Offers construction facilitating materials and equipment, and (iii) The human resource supply chain: Includes labour supply. The primary supply chain and support chain mentioned above can be identified very often in the history of the construction sector in Sri Lanka. Such flows are largely formalised, regulated, and managed by stakeholders in the construction supply chain such as clients, contractors, manufacturers, and subcontractors. Figure 1 illustrates that the generic supply chains are comprising of three flows; i.e. (i) Financial flow, (ii) Material flow and (iii) Information flow.

Financial flow is the process of optimising the working capital of the party to get the expected outcome within successful boundaries (Phong, 2018). Traditionally, financial flow is heavily relied on centralised financial authorities to reduce financial risks (Chang *et al.*, 2019). Moreover, the author states that in terms of reducing potential risks among trading parties, certain types of payment methods such as; payment by delivery, telegraphic transfer, open account, and Letter of Credit (LC) are introduced and adopted in different contexts.

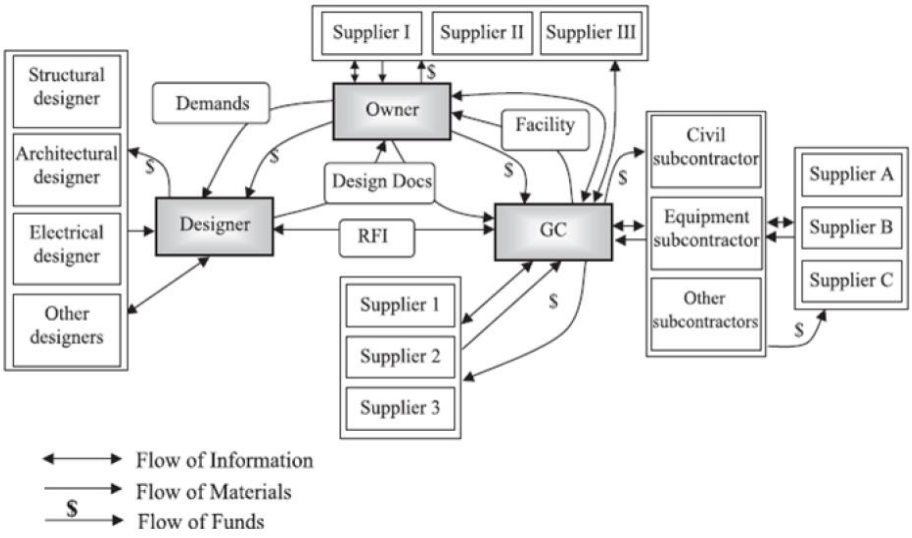

Figure 1: Model of global construction supply chain (Source: Phong, 2018)

Focusing on international trades in the construction supply chain, greater emphasis is given to LC (Rodrigo *et al.*, 2018) that involves two banks (customer's bank and supplier's) to ascertain the financial credibility (Mann, 2000). To understand issues in the traditional process required attention must be given to the sequence of financial activities in the LC process. Figure 2 illustrates the steps of international trade related to the LC process.

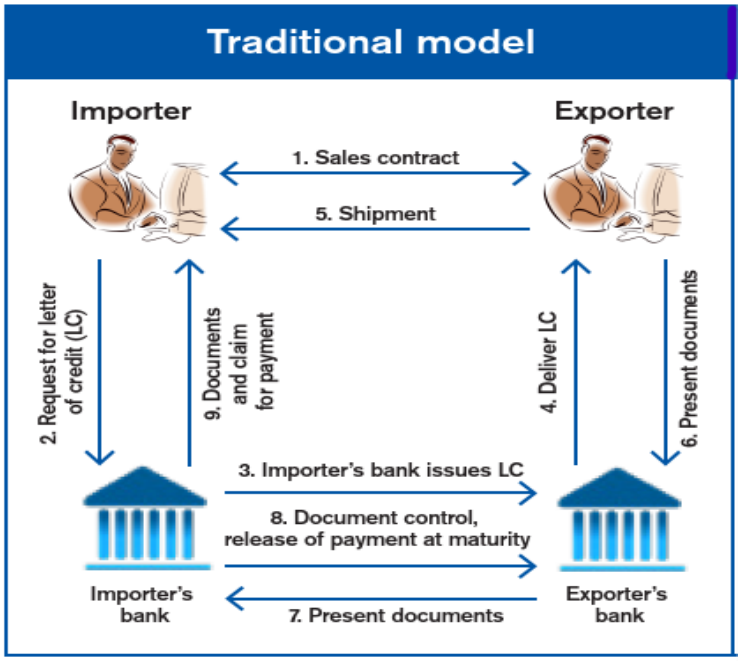

Figure 2: Traditional method of trading using LC (Source: Ganne, 2018)

As Figure 2 illustrates Seller (exporter) and Buyer (importer) agree to the contract first then the buyer request LC from his bank and the bank issues the LC including the specified amount to the seller's bank. Later, the seller receives the LC from his bank and it works as a guarantee for his commitment and the supplier can ship the product by

contacting the shipping service. Shipping service issues the document called Bill of Lading (BL) to the supplier confirming the supplier has deployed the shipment which presented as the proof to the seller's bank. Those documents are issued to the buyer's bank by the seller's bank and the buyer claims them from his bank by making the payment. The buyer can release the products delivered to his port by presenting the documents to port authorities (Faber and Butler, 1992). This process has been able to provide excellent risk reduction in trading over the decades (Chang *et al.,* 2019). Due to the benefits of LC, the Sri Lankan construction industry also relied on the LC procedure for international trading while there are other methods such as on-account wire transfer and telegraphic transfer methods being less used. However, dependence on third-party centralised financial authorities has created several issues eventually due to increased demand in production (Bai and Sarkis, 2020).

Table 1 provides the issues related to the financial flow of construction international trade that has been identified through literature study.

Table 1: Issues in the financial flow of Sri Lankan construction international trade

Issue	Reference	Explanation
Payment delays	[1], [2], [3], [4], [5]	LCs can be amended or rejected due to several reasons and the buyer has to await the payments longer.
Lengthy payment cycle	[4], [5], [6]	Payments should be circled through two banks to receive by the seller.
Time-consuming	[1], [2], [3], [4], [5]	Documentation practices are time-consuming because of the involvement of more parties.
Complexity and coordination problems	[1], [5], [6]	More parties incorporated in the process other than the seller and the buyer. Documentation practices are time-consuming.
Increased cost due to bank financial charges	[1], [5]	Third-party financial agents impose financial charges resulting in an additional cost to trade parties.
Require legal assistance	[5]	Current payment terms are based on complex documentation practices, and they will require legal assistance.

(Sources: [1] Perera *et al.,* 2020; [2] Vrijhoef and Koskela, 2000; [3] Lu *et al.,* 2021; [4] Wibowo and Sholeh, 2015; [5] Le *et al.,* 2018)

The issues above stated do require a modern solution and the intent of this research is to answer those issues using blockchain technology. Therefore, the next sub-topics are concerned about BCT, its benefits, and its usage.

2.2 BLOCKCHAIN

Blockchain is considered a potential disrupter of the status quo in the commercial sector innovating in transactions, revolutionising industries and driving economic change on a global scale (Perera *et al.,* 2020). Kinnaird *et al.* (2017) comprehensively describe the blockchain as a distributed ledger. But instead of being centrally oriented and managed

as today's most databases, it is decentralised and not under the control of any single person, group, or organisation.

Many of today's experts claim that BCT is a greater and important invention and it will become outstanding than the World Wide Web (WWW) (Kinnaird *et al.,* 2017). Cryptocurrency Ethereum's white paper states that the blockchain technology's range of potential applications is infinite from digital currency to blockchain empowered legal contracts with the most striving applications yet to be created (Buterin, 2015).

The elements of BCT architecture and important features of BCT are described hereon.

Distributed Ledger (DL)

Blockchain processes the transactions in a database similar to actual ledger entries but electronically assembled roughly into groups called "blocks" and ensures that already entered data can never be modified or deleted hence it is difficult to hack (Kinnaird *et al.,* 2017).

Nodes

A node can be represented by an active electronic device (e.g. a computer or smartphone) connected to the blockchain network using the internet (Binance Academy, 2020).

Asymmetric encryption/digital signature

Used in many IT systems, email, and the internet which allows people to encrypt the data without sharing confidential data. A pair of keys are introduced "private" and "public". Any person or machine can use the public key to encrypt the data and only the owner of the specific private key is authorised to decrypt the data (Kinnaird *et al.*, 2017).

Block

In a distributed ledger, each valid transaction is recorded in a "block" which is cryptographically linked into another (Bogart and Rice, 2015). Mining is the mechanism of transactions that are clustered into a block and added to the end of the current blockchain (Sarmah, 2018).

Consensus mechanisms

In the blockchain, consensus refers to a series of procedures related to approving and confirming a transaction or set of transactions by using consensus algorithms (Perera *et al.*, 2020). In Bitcoin blockchain, this achieved by generating a mathematical puzzle (referred to as "Proof of Work") and entering a transaction into the ledger can only be achieved by solving this mathematical puzzle (Crosby *et al.*, 2016).

Hashing

Hashing concept will allow BCT to remain un-hackable. Hashing can be described as a process of a string of characters and turns it into a usually shorter fixed-length value or key which serves as a representation of the original string which is widely used in cryptographic algorithms (Gervais *et al.*, 2016; Tavares, 2018).

2.3 BLOCKCHAIN FOR CONSTRUCTION SUPPLY CHAIN MANAGEMENT

The construction industry shows little adoption of the information technology revolution compared to financial and manufacturing industries which partake the greater outcomes through information technology (Agarwal *et al.,* 2018). Implementation of an ICT

solution in a project-based industry is challenging when compared to the process-based industry (Nanayakkara *et al.*, 2019). But, the uses of blockchain seem to provide solutions to dozens of issues related to various industries. Especially researchers show that blockchain has great potential to overcome supply chain issues (Ganne, 2018; Chang *et al.*, 2019). Following benefits can be ascertained by blockchain technology.

Quality assurance

Products can be purchased and tracked in the supply chain using blockchain technology and it reduces the risk. In this manner insuring costs and bank charges can be eliminated (Kinnaird *et al.*, 2017).

Security of transactions and time saving

Compared to the traditional LC method blockchain can provide more security and guarantee the funds (Ganne, 2018). Also, the P2P network is certainly fast compared to the traditional LC process and it is important to tally up the increased construction demand. Figure 3 illustrates the differences between LC and blockchain approaches.

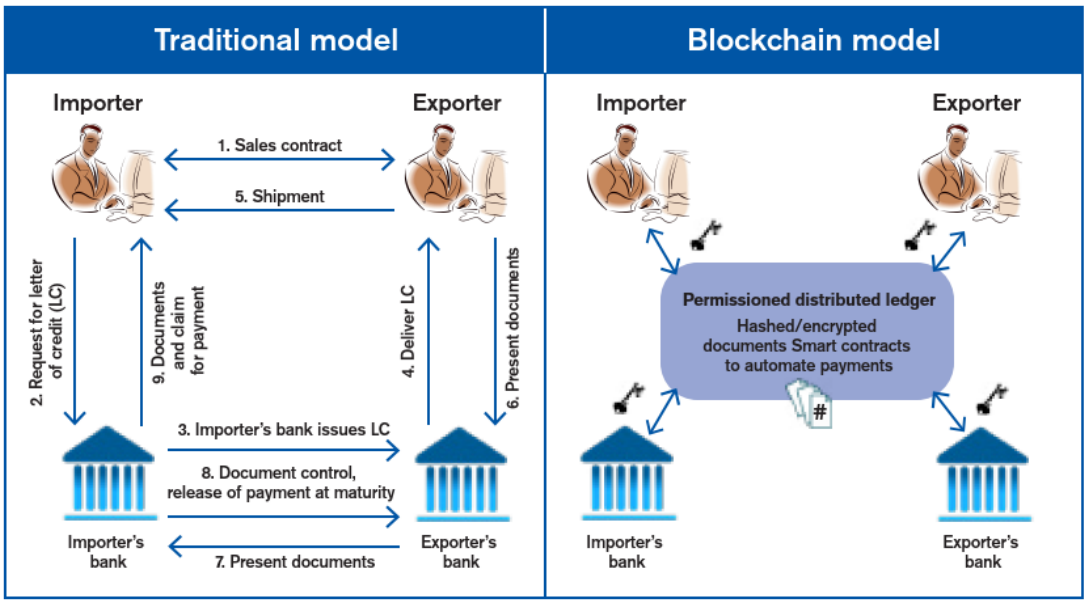

Figure 3: Differences between LC and blockchain approaches (Source: Ganne, 2018)

Better coordination and communication

The un-involvement of third parties makes the coordination and communication process much easier (Chang *et al.*, 2019). In this case, blockchain is a smart solution with a distributed database by creating time-stamped blocks via cryptography (Chang *et al.*, 2019) which means secured information with much less transmission time compared to all traditional methods.

Reliable information/records

The buyer can make sure of the product's quality and history of transactions (if any) by referring to the immutable distributed ledger (Ganne, 2018). It solves the trust and reliability issues that have had for years in business.

3. METHODOLOGY

This research attempted to investigate the feasibility of BCT as a solution to address financial flow issues in SL construction international trade. Awareness of BCT within the Sri Lankan construction industry was found to be minimal at present because it is not yet adopted in the country resulting a qualitative approach is favourable rather than a quantitative approach. Therefore, to obtain data a qualitative approach was chosen by conducting an expert forum. Semi-structured interviews carried out in two phases involving the experts in the practices of construction international trade, and blockchain experts practising related to the construction industry.

3.1 PHASE I OF THE EXPERT FORUM

To get a better knowledge of the current practices, different perspectives from the different stakeholders in the study area were helpful. Therefore, three experts (E1, E2, E3) have been selected who work relating to international trading under Client, Consultant, and Contractor organisations. Semi-structured interviews were conducted to identify current practices and issues in the financial flow of international trade.

3.2 PHASE II OF THE EXPERT FORUM

Five experts (E4, E5, E6, E7, E8) including four experts involved in the construction sector who know BCT were selected for Phase II of the expert forum. An expert from the Information Technology (IT) industry is selected to collect precise technical knowledge. BCT's capacity to solve identified issues, challenges in implementation were discussed.

Hsieh and Shannon (2005) stated that the content analysis method is the most used to interpret qualitative text data through systematic coding and patterns. Content analysis has been selected as the most suitable analysis method for this research.

4. FINDINGS

4.1 FEASIBILITY OF BLOCKCHAIN TO OVERCOME FINANCIAL FLOW RELATED ISSUES

Issues identified from Phase I of the expert forum are summarised in Table 2.

Table 2: Summary of issues related to the financial flow of current practices

Issue	Expert		
	E1	**E2**	**E3**
Time-consuming/possible delays		x	x
Excessive documentation	x	x	x
Lengthier payment path	x	x	x
Complexity and coordination problems	x	x	
Financial charges	x	x	x
Require legal assistance	x		

Table 3 demonstrates the issues identified through the expert forum and the strength of BCT to overcome the issues in the financial flow of the construction supply chain according to the experts' opinions.

Table 3: Strength of BCT to overcome the issues in the financial flow

Issue	Strengths of BCT to overcome
Time-consuming/possible delays	Peer to Peer transactions (Reduce time)
	Possibility of transaction automation
Excessive documentation	BCT does not incorporate complex documentation
	Smart contracts (Reduce the possibility of human errors)
Lengthier payment path	Eliminate banks (Uses P2P transactions)
Complexity and coordination problems	BCT does not incorporate complex documentation
	Process and conditions are defined initially (Smart Contract)
Financial charges	Eliminate bank-related financial costs
	Only occur small transaction cost depending on the consensus mechanism
Require legal assistance	BCT does not incorporate complex documentation

Findings of the data collection are discussed hereon under each issue identified.

Time-consuming/possible delays, and complexity and coordination problems

All the experts stated that if BCT is used to make payments it will save time because the transaction will happen buyer to the supplier directly. Further, the speed of money transfer through BCT will be very high compared to wire transfer through banks. E5 expressed a brilliant idea "*Think of an example like we can attach a GPS tracker in the product shipment, and we can programme smart contract to make payments when the product arrives at the customers port, of course, it can be tracked by the GPS tracker and payment can be automated likewise*". This will help to reduce the time consumption of transactions and reduce delays. E7 stated, "*By eliminating the third-party financial institutions such as banks the supplier and importer can achieve a better and shorter path for money flow*".

Excessive documentation / Require legal assistance

Phase I of the expert forum raised an issue regarding complex documentation in the LC payment method. E4, E6, and E7 stated that lengthy documentation in conventional practice can be eliminated by using BCT backed system, because it runs on a smart contract that reacts based on logic. E8 further stated that by the use of smart contracts, human errors can be reduced because it is automated. Possible errors in conventional bank payments such as arithmetic errors can also be eliminated. This will be a solution to the issue "requirement of legal assistance on the documents" that emerged in Phase I of the expert forum.

Financial charges

All the experts claimed that by using blockchain finance costs can be reduced. E4 said "*Current LC payment procedure incurs many associated costs such as postage, courier services, bank-to-bank reimbursement charges, and LC amendment charges. Using a blockchain-based system can discard all these additional costs*". E4, E7, and E8 discussed the gas fees for transactions of cryptocurrency. E8 elaborated the matter by stating "*Due to the rewarding phase, there would be a small transaction cost because we know there are people inside the network who verify the transactions and make a block into the blockchain, and they are compensated by the blockchain. But considering the*

current financial cost that we have to incur it will be a huge saving for both supplier and the importer parties".

Guarantee of funds

Assurance of the funds is the most important factor from the supplier's perspective. In conventional practise, banks are assuring the funds. E5 and E7 claimed that the same assurance can be generated through a network backed by blockchain. E7 elaborated the subject "*By using blockchain we can allocate the required amount of money in our wallet and give authority to the supplier to check whether we have an adequate amount of money to do business or not. Like in the bank, the guarantee of money is achievable*".

E6 stated "*if we implement blockchain transactions we have to think about the currency that we are going to use because Bitcoin is becoming more like an asset rather than a currency and its volatility is higher. Therefore, it can result in huge profits or losses for both parties. Then we have to use other stable coins like USDT, CUSD to make payments*".

Grounds to adopt BCT in Sri Lanka

E5 stated, "*Adopting blockchain-based payment system in the construction supply chain is possible compared to the other aspects that blockchain can do*". Experts stated that due to the prevailing condition of the construction sector the use of BCT to assure the material quality and history of plants is almost impossible. There is a technological gap to be filled before the adoption of BCT.

4.2 BARRIERS FOR IMPLEMENTING BCT

E5 explained that according to the focus of the research to apply BCT to international trading the central bank's acceptance will be vital because money will be sent overseas, and the central bank will surely want to monitor the transactions. Originally, blockchain's P2P transaction method will restrict the observation to such authorities. Therefore, the Central bank will have to develop a platform to do the cryptocurrency international trade where they can monitor the process. E5 further explained "*It is not just material cost that we have to pay. Sri Lanka has been collecting taxes and duties for importing products. Therefore, we have to consider the taxes, duties and levies, and other related costs when we import materials equipment from foreign suppliers. Therefore, the government should be able to develop a platform backed by BCT to collect duties and taxes".*

The anonymity of the blockchain user can pursue criminals to make deals without leaving proof and that is the reason why bitcoin is involved in illegal black-market deals globally. E4 stated that the implementation of blockchain will need relating laws to prevent such activities.

E4, E7, and E8 claim that there will be a technology barrier to adopt blockchain in the construction sector. E4 elaborated "*There is a report by McKinsey where they have identified that the construction industry is second least digitalised industry, and we are only better than agriculture. Being the second least digitalised industry, of course, it would be difficult to get it implemented*".

All experts agreed that knowledge of new technologies is minimum with construction practitioners. E4 stated that even the practitioners use smartphones and new technologies in their social life they are quite reluctant to use technology even in developed countries

such as Australia. E8 stated that industry practitioners' trust in the blockchain system will be a considerable factor to implement blockchain. E6 added "*Almost every organisation keeps their funds in banks, and it is a difficult task to change their attitude into something that neglects the use of banks. I'm not saying that is impossible, but it will take a big effort*". Moreover, it will affect the decision of each parties' willingness to do business on a BCT-based platform.

Identified barriers are listed below:

- Approval of the Central Bank of Sri Lanka is required.
- A BCT based platform is required to impose taxes and to monitor transactions.
- Enacting new legal protocols to prevent misconduct is needed.
- Technological incapacity of industry practitioners.
- Trust about BCT will be a challenge due to the lack of awareness.
- Industry practitioners' natural reluctance to change.

5. CONCLUSIONS

This paper provides evidence that the current practices in the financial flow of international trading in the Sri Lankan construction industry comprised of many difficulties. The study proved that the application of blockchain technology to address such issues will be an effective solution hence the features of blockchain such as distributed ledger technology, consensus mechanism, peer-to-peer trading, and asymmetric encryption can provide the needing for an efficient supply chain. Unfortunately, the Sri Lankan construction industry is lacking behind in the adoption of new technologies. Expert forum interprets that the Central Banks' approval, a new taxation procedure, legal empowerment and lack of technology awareness will challenge the adoption of BCT in Sri Lanka. Therefore, the adoption of blockchain to the international trade process will require the government's enormous support. Most importantly the industry practitioners should be regularly updated on new technologies and their effort will eventually persuade the government to facilitate blockchain.

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