Batch: A2 (BCT-1)	**Roll No.: 1911031**
Experiment No. 07	

Title: Case study of any Block chain application as per students choice

Objective: To perform a detailed study of any blockchain applications (SUPPLY CHAIN TRANSPARENCY: IBM AND MAERSK).

Expected Outcome of Experiment:

CO	Outcome
CO1	Build your own Blockchain businesses with acquired knowledge.
CO2	Learn Solidity language & Multiple Technology-based developments.
CO3	Apply the algorithm and techniques used in Blockchain.
CO4	Grasp the in-depth understanding of Blockchain, Smart Contracts & how it works.
CO5	Describe the methods of mining.

Books/ Journals/ Websites referred:

1. https://pdf.usaid.gov/pdf_docs/PA00TKX9.pdf
2. https://www.ibm.com/blogs/blockchain/2018/03/blockchain-for-intelligence-supply-chains/
3. https://www.intechopen.com/chapters/67390
4. https://www.researchgate.net/figure/Managing-supply-chain-process-using-blockchain-technology-A-proposed-model_fig13_341202879

Abstract:-

BLOCKCHAIN APPLICATIONS IN TRADE International trade requires several transactions (and corresponding movement of documents) between various actors that include exporters, importers, customs administrations, and other operators, such as banks, insurance companies, freight forwarders, shipping companies, and/or port operators. Developing countries, in the same way as developed countries, are processing higher levels of cross-border transactions (and thus documents) especially with the advent of e-commerce. The traditional systems are largely paper-based, which are administratively costly, prone to fraud, and inefficient with respect to time. It has been difficult to digitize the processes that facilitate trade (e.g., the paperwork required) especially because of the wide range of entities that need to be brought under a common platform. Blockchain, due to its distributed architecture and tamper-evident design, seemingly presents an opportunity to rethink the processes that facilitate trade. Businesses of all sizes, information technology (IT) companies, and government organizations are beginning to collaborate on blockchain projects that aim to address some of these issues in global supply chains. This section provides an overview of the major blockchain-based trade initiatives across the world. The application areas range from trade financing to integrated supply chains to traceability of products to other blockchain platforms that combine blockchain with other technologies, such as Internet of Things (IoT) systems. These projects are at varying implementation stages; the tables below classify the projects accordingly (see box). While most projects have occurred in more developed countries, developing countries such as the Colombia, the Common Market for Eastern and Southern Africa (COMESA), Costa Rica, Democratic Republic of the Congo (DRC), Indonesia, Malaysia, Peru, Rwanda, Seychelles, and Zambia, are also directly or indirectly considering, developing, or implementing blockchain projects. Table 1 (in the Appendix) highlights 10 projects in the Trade Finance category, all implemented in the past 2 years. Of these projects, none are implemented at scale and are operational. Few (3) have completed successful pilots and are actively in the process of scaling (including the we.trade platform, Infosys/Emirates NBD ICICI Bank collaboration, R3CEV). Most of the other projects have just completed pilots or are in the process of completing pilots. Table 2 (in the Appendix) examines 8 projects in the Supply Chain Digitization category, which have been implemented over the course of the past 2 years. Of these projects, none are implemented on scale. However, IBM/Maersk's TradeLens platform is rapidly scaling (as we will see in the case study section). Most of the other projects are in the pilot stages only. Table 3 (in the Appendix) highlights 10 projects in the Traceability category implemented in the past 2 years. Of these projects, none are implemented at scale. IBM's Food Trust initiative is scaling actively.

Implementation Stages

1. **Concept:** Theoretical concept has been proposed.
2. **Pilot Currently Running:** Various stakeholders have been brought together to execute a pilot to test the concept for a one-off transaction.
3. **Pilot Completed:** The pilot has been completed and the stakeholders have gathered evidence from the pilot for the one-off transaction.
4. **Actively Scaling:** Post the success of the pilot, stakeholders are being brought together to adopt the technology to replace the existing system in a phased manner.
5. **Implemented at Scale and Is Operational:** The technology has replaced the existing system for all transactions and is being used on a day-to-day basis.

The technology has replaced the existing system for all transactions and is being used on a day-to-day basis. Some private blockchain solutions such as BanQu's project with Anheuser-Busch InBev and Everledger's diamond trace projects are also in the "actively scaling" stage. Table 4 (in the Appendix) highlights 4 other projects which act either as a combination of the above application areas or serve as an independent application (e.g., trade insurance). Among these, again none are implemented at scale. Singapore/HongKong's GTCN platform (see case study on large scale roll out of implementation), and NTT DATA's projects with Tokio Marine and SkuChain are the most advanced projects in this category.

Related Theory: -

This case study examines the blockchain trade platform developed by technology company IBM and container shipping company Maersk and its application, including a recent pilot in Peru. An executive at IBM10 provided insights on the TradeLens platform. From a user standpoint, an official from SUNAT – Peru's Customs administration – provided their experience of implementing the TradeLens platform for two routes: Callao – Amsterdam, Netherlands and Callao – Algeciras, Spain.

CONTEXT

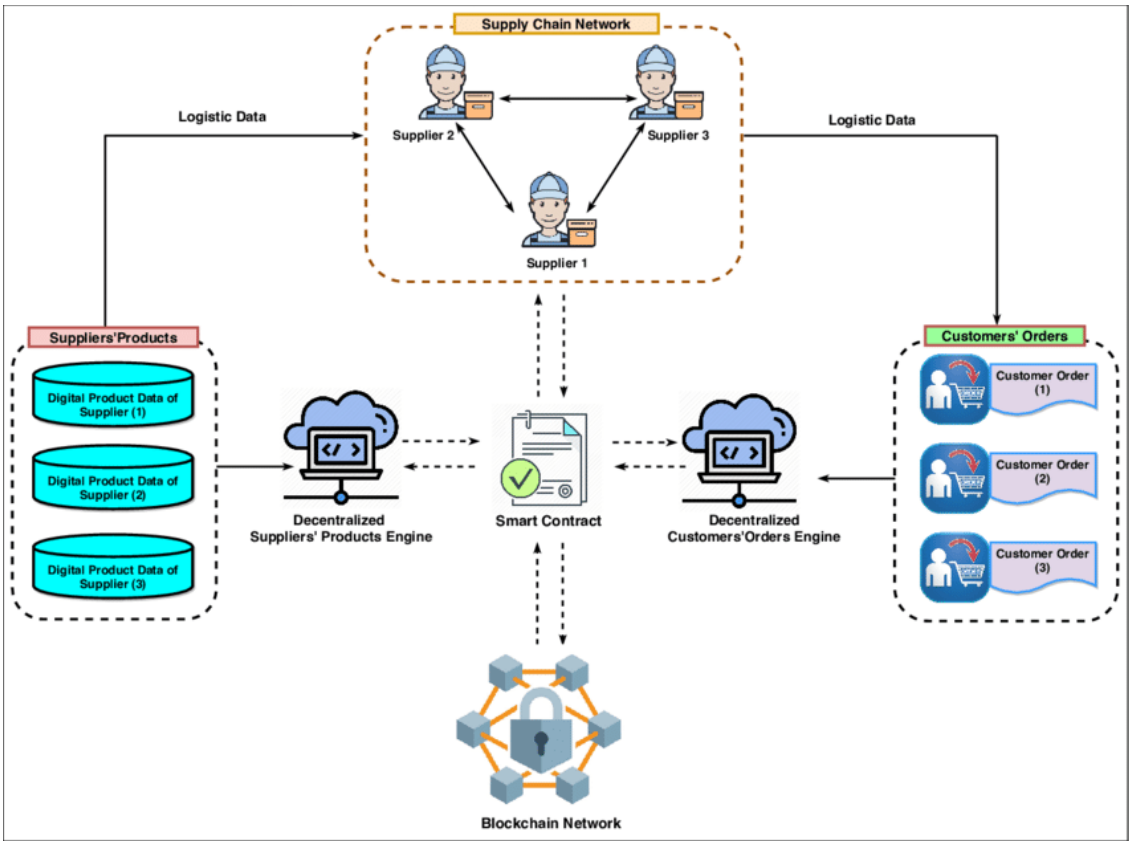
Traditionally, trade generates high volumes of paperwork. Supply chains and governments rely on the physical movement of such documents to provide security against illegal smuggling, counterfeit goods and in some cases, human-trafficking.

Processing the documents and information for a container shipment is purported to cost more than twice the actual cost of transportation (IBM Blockchain 2017). A joint study conducted by IBM and Maersk found the following inefficiencies during their pilot projects (IBM 2018):

- A single shipment of avocados from Mombasa, Kenya to Rotterdam, Netherlands involves 30 actors/organizations, 100+ individuals and 200 information exchanges. Interactions between these actors involve time-consuming manual, paper-based processes. The information collected across organizational boundaries were inconsistent leading to blind spots throughout the supply chain. These blind spots include missing or incorrect paperwork across the supply chain with limited traceability. Peer-to-peer messaging was complex, cumbersome and costly. Risk assessments lacked sufficient detail and clearance processes were vulnerable to fraud.

- In another trade transaction over the same trade network11, conventional flow of documents accompanying a shipment of flowers from Kenya to the Netherlands takes several days for the documents sent from the farm in Kenya to reach the authorities at Dutch customs. It is a cumbersome process and, according to a Maersk executive, "the average border-related administrative costs of trade are 21 percent of the total cost, compared to 8 percent for transportation."

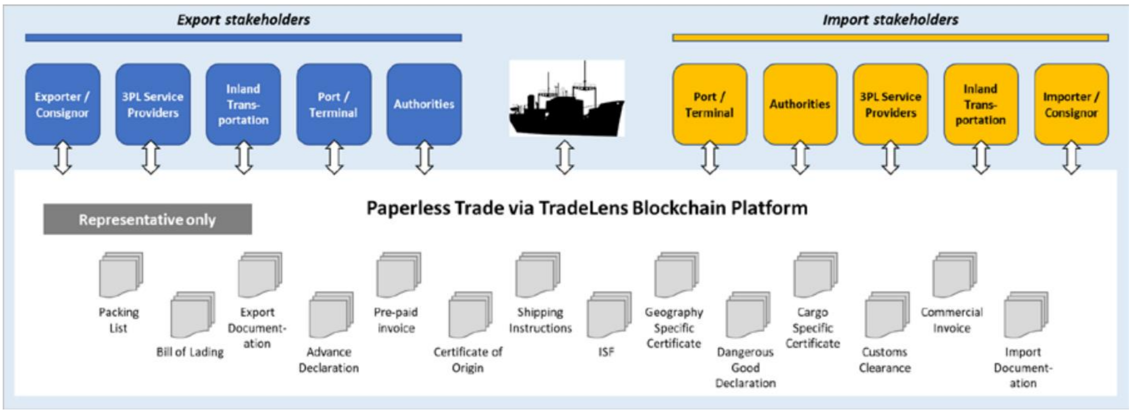
- The same stands true for other trade networks too. Shipments from Central Europe to the United States were often delayed by four weeks due to a lack of transparency and delayed information exchange. Some of the issues that caused this delay included missing customs documents that prevented gate-in at arrival terminal; containers arrived on different mode causing complications for

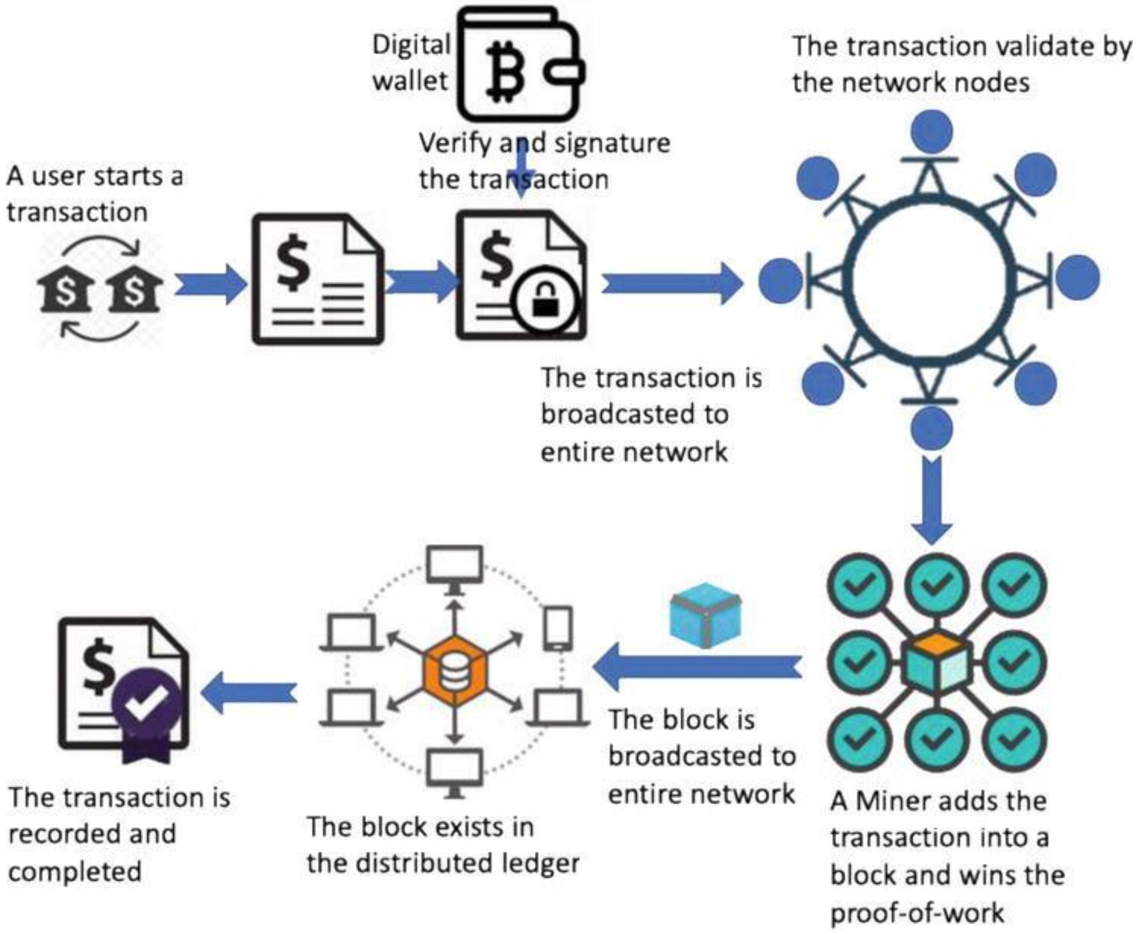


CONCEPT

IBM and Maersk aim to address these issues through a distributed permissioned platform called TradeLens (formerly Global Trade Digitization - GTD). The platform facilitates the exchange of event data and handling of document workflow within the supply chain ecosystem.

Using the platform, all the stakeholders can access documents in real time – though this feature is not unique to a blockchain-based system. Stakeholders digitally sign documents that they certify. These cryptographic signatures provide real-time authentication for the documents. These documents are entered into the blockchain (some directly by the stakeholders acting as nodes on the blockchain network; some indirectly via the stakeholders – see implementation section below). The combination of cryptographic authentication and the characteristic that a blockchain transaction cannot be modified seeks to resolve distrust among its various actors. Since it is a distributed database, there is no need for different jurisdictions to agree on a centralized authority that controls the ledger. USING THE TRADELENS (GTD) PLATFORM Figure 2 characterizes how a TradeLens platform operates with different stakeholders and the type of documents that usually form part of TradeLens Paperless Blockchain Network (Tan et al.).


Export stakeholders
Import stakeholders
Exporter / Consignor
3PL Service Providers
Inland Trans-portation
Port / Terminal
Authorities
Port / Terminal
Authorities
3PL Service Providers
Inland Trans-portation
Importer / Consignor
Representative only
Paperless Trade via TradeLens Blockchain Platform
Packing List
Bill of Lading
Export Document-ation
Advance Declaration
Pre-paid invoice
Certificate of Origin
Shipping Instructions
ISF
Geography Specific Certificate
Dangerous Good Declaration
Cargo Specific Certificate
Customs Clearance
Commercial Invoice
Import Document-ation


Digital wallet
The transaction validate by the network nodes
Verify and signature the transaction
A user starts a transaction
The transaction is broadcasted to entire network
The transaction is recorded and completed
The block exists in the distributed ledger
The block is broadcasted to entire network
A Miner adds the transaction into a block and wins the proof-of-work

Related Theory (contd...): -

DATA PRIVACY

The TradeLens platform addresses data privacy with the use of a feature called "channels" in Hyperledger Fabric. When a user (e.g., exporter) initiates a shipment, the user also lists all the interested parties that need to access the data. Thus, for such a shipment, only the interested parties listed can access the specifics of the shipment. This essentially creates sub-networks for each transaction within the permissioned blockchain network for that trade network. For example, in a trade transaction involving a shipment of flowers from Mombasa to Rotterdam, only the relevant stakeholders will have access to information for that particular transaction. Other traders and logistics providers in the Mombasa-Rotterdam trade network who are registered on the TradeLens platform will not be able to access the information for that particular trade.

DATA PROTECTION

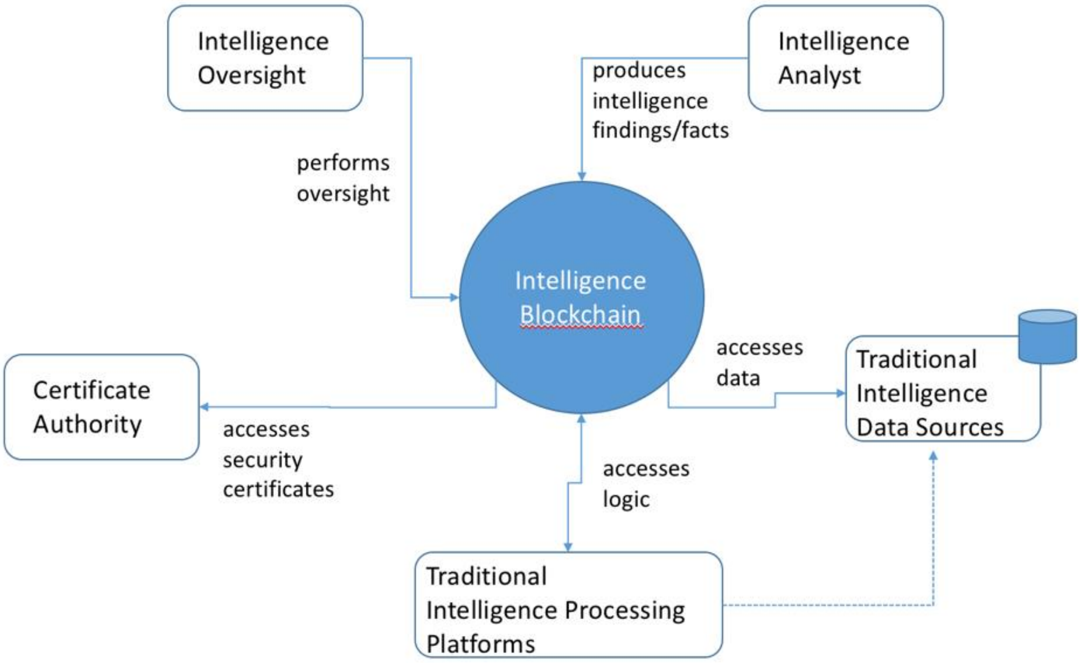
The type of data determines the level of data protection within the platform. Users that upload the data onto the platform own the data. As the vast majority of the data uploaded is data that participants already share globally, the data is not subject to personal data protection regulations such as the European Union's General Data Protection Regulation (GDPR). However, commercial data, including proprietary information and invoices, may not necessarily be public and requires a layer of protection. TradeLens does not accept such data as-is on the blockchain but rather stores and shares that data separately. Instead, these sensitive documents are hashed and only the hash values of such documents are available publicly over the blockchain. These hash values can be used to trace but not retrieve the sensitive information. Similar arrangement has been followed in the case of implementation in Peru with SUNAT. The users that upload the data own the data. The information exchanged is, however, public. SUNAT does not include personal data or confidential commercial information in the TradeLens platform. IBM and Maersk also hope, in the long term, to use the "channels" feature to keep certain classes of information within a country (data localization), as many countries continue to restrict cross-border exchange of and access to data.

DATA VALIDATION

The platform does not prevent entry of incorrect information into the platform as there is no data validation mechanism at the nodes. Thus, if someone enters incorrect information at the initiation of a chain, the blockchain will "faithfully" enter it into the system and, thus, it does not prevent the issue of "garbage in, garbage out.12" However, blockchain allows for an "audit trail" and, therefore, one can track the origin of incorrect data entry once a fault is detected (while tracking errors is possible via other solutions too, the tamper-evident nature of the blockchain ledger makes the audit more trustworthy). This can prevent willful data corruption and enable post-fact assessment and targeted correction. In addition, if a government participates in the blockchain network (in the future) then they can be part of the consensus mechanism. The validation of transactions is done automatically according

DIFFERENCE WITH OTHER CENTRALIZED TECHNOLOGIES

How is the TradeLens platform different from a centralized ledger or database accessible to stakeholders via different permission rules? For one, a centralized database represents a single point of failure. The database is both vulnerable to attacks and poses a storage risk if redundancies are not in place. In addition, if entries are changed in the database (either by the attacker or by the system administrator), it is difficult to track changes made. With a blockchain platform, the database is distributed among its nodes (members), so attacking all the nodes at the same time is far more difficult than attacking a single node. Additionally, each block of transaction includes a hash of the previous block of transactions, thus forming a chain. If one entry is changed, the corresponding hashes after the changed transaction will differ from the original and, therefore, one can track where the change has been made instantaneously. Thus, a blockchain-enabled platform, such as TradeLens, is more secure than a centralized database operated by a system administrator.



IMPLEMENTATION STAGES

Stage	IBM/Maersk Actions
1st	Analyze the trade network or corridor in detail, including the context of host countries.
2nd	Identify organizations at both ends of the trade network to engage. Broadly, there are three categories of organizations: importers and exporters; government authorities at both ends that are part of the regulatory framework; and the organizations that are part of the logistics chains (e.g., ports, logistics providers, ocean carriers).
3rd	Communicate with organizations to receive buy-in to set forth an agreement between all parties
4th	Work within host countries ecosystems to agree on various information to capture and retrieve, as well as the governance mechanisms. This includes identifying and adopting the shared documents, approval processes, privacy and controls, and data retrieval procedures
5th	Send a team to the host countries to implement the solution. The fifth stage, on average, takes about 1.5 months before some quick wins based on the implementation can be observed. The steps include (as in the case of implementation in Peru) **i.** Implementation of technological architecture **ii.** Integration with existing platform and set up exchange of information **iii.** Integrated testing **iv.** Launch
6th	Transfer the platform to the stakeholders (with assistance only as required)

IMPLEMENTATION COSTS

Costs consist of implementation and maintenance costs. Implementation costs, mainly incurred by the network stakeholders in the fourth and fifth stages mentioned above, involves the cost of integrating the TradeLens with existing systems using APIs. Such integration requires participation of IT implementers within three to four organizations in a given country for a few weeks. On average, such implementation costs run between US $10,000 to $100,000. As far as ongoing costs are concerned, network clients pay to make use of TradeLens on a per transaction (container) basis. Network members (such as governments) receive access to the platform's data without needing to pay because they contribute significant amounts of data to the platform.

TECHNICAL CHALLENGES

IBM and Maersk have implemented this solution on a pilot basis in multiple jurisdictions. Implementation has faced certain challenges. On the technical front, the solution can help developing countries leapfrog their existing trade platforms. However, there is a certain minimum IT capability required to operate such a system. A first requirement is to have the capacity to run a node in the permissible blockchain. The capabilities required for running such a node are relatively standard IT skills. The organizations must have some basic pre-existing IT infrastructure (e.g., a dedicated pool of IT staff, a functioning IT system both at the front and the back-end that is capable of executing consensus algorithms), to ensure that capacity building exercise is not too steep.

CAPABILITY CHALLENGES

During implementation, IBM and Maersk realized that not every member in the ecosystem has the technical capability to run a node in the permissible blockchain (operated on the Hyperledger Fabric). Additionally, individual stakeholders in the ecosystem are used to their own systems to enter and retrieve information. Thus, the consortium only places certain members of the ecosystem on the nodes of the blockchain. Currently, these include IBM, Maersk and usually other ocean carriers (totaling between 10 and 15 members). The importers, exporters, government agencies, access the platform through an API where they can enter and retrieve information from the blockchain but only via the nodes operated by the blockchain members. The longer-term goal is to include stakeholders who are more core to the platform, such as the customs organizations, as members of the blockchain operating the node so that these core stakeholders can be a part of the consensus process that determines rights to the blockchain network.

IMPACT

According to IBM, TradeLens platform has already demonstrated impact (the impact emanates primarily due to digitization of trade processes – however, this digitization across the supply chain was made possible due to accessibility and security features of a blockchain platform), albeit on a pilot scale:

- TradeLens has reduced the transit time of a shipment of packaging materials to a production line in the United States by 40 percent.
- TradeLens helped reduce steps taken to answer basic operational questions, such as "where is my container," from 10 steps and five people to one step and one person.
- As part of the European Union Core research program, Dutch Customs used the additional data in TradeLens to improve their targeting processes. They used the data to avoid unnecessary inspections that they would have otherwise performed - a benefit to legitimate trade.

RECEPTION AND OUTLOOK

The IBM and Maersk platform was operating in private beta from 2016. The platform moved to limited availability in mid-2018 with plans to move to general availability by the end of 2018 (when it would charge participants for using its platform). As of August 2018, 94 organizations have signed up to participate. These include, but are not limited to: 15 | BLOCKCHAIN FOR TRADE: SELECT CASE STUDIES AND LESSONS LEARNED USAID.GOV

- Port Operators: PSA Singapore, International Container Terminal Services Inc, Patrick Terminals, Modern Terminals (Hong Kong), Port of Halifax, Port of Rotterdam, Port of Bilbao, PortConnect, and PortBase.
- Terminal Operators APM Terminals' Network and Holt Logistics (Port of Philadelphia).13
- Global Container Carriers: Maersk Line, Hamburg Süd, and Pacific International Lines (PIL).
- Customs Authorities: the Netherlands, Saudi Arabia, Singapore, Australia, and Peru.
- Customs Brokers: Ransa and Güler & Dinamik.
- Beneficial cargo owners (BCOs): Torre Blanca / Camposol and Umit Bisiklet.
- Freight Forwarders, Transportation and Logistics Companies: Agility, CEVA Logistics, DAMCO, Kotahi, PLH Trucking Company, Ancotrans, and WorldWide Alliance