



BLOCKCHAIN

T Ü R K İ Y E

KNOW YOUR SUPPLIER PLATFORM

*Blockchain Turkey Platform, Manufacturing,
Logistics and Transportation Working Group Report*

APRIL 2019



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Design and Graphic Works

TERMİNAL MEDYA LTD. ŞTİ.

Maslak Mah. Bilim Sokak No:5 SUN Plaza Kat:13 Sarıyer/İSTANBUL
0(212) 367 4988 ve 0(532)643 6959

Editor

ÖZLEM ÖZKAN

Graphic Works

GÜLİSTAN ŞENOL

Printing

RUMİ MATBAACILIK

Maltepe Mah. Fazılpaşa Cad. No:8 Topkapı/İSTANBUL
0(212) 612 7172



Manufacturing, Logistics and Transportation

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TÜRKİYE BİLİŞİM VAKFI

Turkish Informatics Foundation (TBV) was founded with the aim of transforming Turkey into an information society by contributing to the development of the required infrastructure and increasing the share of information technology in the country's economy by pursuing economic and social studies, undertaking scientific R&D, creating relevant projects and ensuring their application.



BLOCKCHAIN
TÜRKİYE

The Blockchain Turkey Platform was founded with the aim of creating a sustainable blockchain ecosystem in Turkey and alleviating the difficulties in the new modes of conducting business by creating a sharing platform, both led by the Turkish Informatics Foundation (TBV).

PREFACE



Faruk Eczacıbaşı

Turkish Informatics
Foundation (TBV)
Chairman of the Board

When we founded Turkish Informatics Foundation (TBV) in 1995, it had a simple mission: Leverage information and communications technologies to increase the country's productivity. Call it Industry 4.0 or the information society, the world has entered a period of acceleration, forcing us to change our thinking.

Blockchain is likely to be one of the most transformative products of this new line of thinking and further experience is needed for it to be properly understood and applied. As in every new technology, blockchain needs to evolve from the experimental stage, which involves conceptual thinking, to the pilot stage and on to the final product.

Blockchain's dependence on collaboration, which manifests itself in settings such as inter-industry consortia and other platforms, sets it apart from other technologies. Blockchain gives prominence to ecosystems, especially those that create value through collaboration instead of comprising individual companies with their own products.

Accordingly, as Turkish Informatics Foundation, we took action on 8 June 2011. We launched the Blockchain Turkey Platform (BCTR) to increase the prevalence of, awareness about and usage of blockchain in Turkey and to identify blockchain's strategic priorities. BCTR is a sharing platform which aims to alleviate the difficulties in the new ways of conducting business by creating a sustainable blockchain ecosystem.

I sincerely hope that, as the world migrates from the "build and sell" business model - to which we've grown accustomed since the invention of the steam machine - to the "co-create & presume" way of thinking, this platform and its work are beneficial for our country.

CONTRIBUTING INSTITUTIONS



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AKBANK



B K M
BANKALARARASI
KART MERKEZİ

 **KoçSistem**

Deloitte.

FORD  **OTOSAN**



SRP | **legal**
strateji regülasyon politika



T.C. TİCARET BAKANLIĞI


T Ü B İ T A K
B İ L G E M

INTRODUCTION



**Hayriye Karakuzu
Karadeniz**

Ford Otosan

Chief Digital Director (CDO)
& IT Director

The Blockchain Turkey Platform (BCTR) quickly attracted members after its foundation and swiftly set up working groups. We are now pleased to present you with the first output of BCTR's manufacturing, logistics and transportation working group, a group which we believe will be useful in areas outside of the common applications of blockchain technology.

The working group worked on understanding how blockchain, as a new technology on our agenda, can ensure simplification and trust in data sharing and business, what kind of products would be best to promote cooperation in the blockchain ecosystem, how to increase awareness and knowledge about blockchain and how to increase its use.

The representation of different sectors and fields in the working group allowed us to look at the matter from many different perspectives. We have identified the creation of a supplier exploration platform as our first to-do and the creation of Corporate IDs as its first step.

We believe that the supplier exploration platform will be beneficial for suppliers, buyers, the general public and the ecosystem; and as more and more members join our ecosystem, the platform will develop further and mature.

I would like to extend a thank you to each and every member company and group member of the manufacturing, logistics and transportation working group for their sincere support, which was motivated by their desire to make a change. I would also like to let you valuable readers of the working group's first output know that we are always open to your contributions. In working for this report, we have once again seen that knowledge multiplies when shared and growing our family would allow us to advance this much further.

EXECUTIVE SUMMARY

Efficient supply chain management allows companies to provide better services while decreasing costs and improving customer satisfaction. The key to decreasing costs in the supply chain and providing better services lies in successful transportation, storage, inventory management and payments done in line with pre-determined conditions. Yet, succeeding in these areas can be more difficult than it may seem, with supply chain specialists and supply chain managers encountering many different difficulties across the supply chain. The volume and complexity of modern-day transactions can make supply chain management an intimidating task.

Buyers need to assiduously gather information on suppliers when choosing a supplier and work to get the necessary approvals in place after requesting many documents to sign on a supplier. In turn, suppliers have to reach potential clients, make a name for themselves in the sector and gain clients' trust. BCTR's manufacturing, logistics and transportation working group proposes a blockchain-based supplier exploration platform to solve these difficulties. Using this platform, buyers and suppliers will be able to find each other easily and quickly prepare and verify any required documents.

The platform will allow different stakeholders to form a consensus. After a consensus, the data's veracity will have to be accepted by everyone and the data will have to be concurrently filed and stored. The technology infrastructure must also allow any transactions relating to the data to have non-erasable records and be trackable on a transaction basis by different parties for data management purposes. Likewise, any changes must be transparent and stored as updates. Blockchain technology is the most suitable solution for these requirements. Global examples show that many blockchain-based applications are constructed with a similar Corporate ID-based logic.

The new system will involve many stakeholders. Public institutions, financial services companies, unions, chambers and associations, private companies, SMEs, banks, logistics firms, IT providers and investors will be the system's leading stakeholders. These stakeholders can take on one or more of the following roles in the system: information-provider, information-seeker, information-verifier or ecosystem-provider. Data accessibility will range from publicly available data to members-only data to data that can be only accessed with a special permission. The system's ability to store the data in layers will allow for the different levels of data accessibility and enable companies to operate at a confidentiality level of their own choosing.

The system will be monetised through members' fees and commissions for different transactions such as data storage, data verification and data inquiry. Thus, the system will be self-sufficient in covering its R&D, operations, maintenance, safety and marketing costs.

The supplier exploration platform will be beneficial for suppliers, buyers, the public and the ecosystem. The platform will simplify communications between suppliers and buyers, allow for a transition to paperless trade, accelerate the digitalisation of supply chains, increase efficacy by decreasing transaction times and benefit the whole ecosystem by preventing mistakes stemming from fraud or human error.

The next steps are to evaluate potential business collaborations, clarify mutual expectations with public institutions, define the proof-of-concept areas and reference models and assess the system's compliance with competition law and other regulations.

1. A DETAILED DEFINITION OF THE PROBLEM

1.1. Difficulties encountered in supply chain processes

Efficient supply chain management allows companies to provide better services while decreasing costs and improving customer satisfaction. The key to decreasing costs in the supply chain and providing better services lies in successful transportation, storage, inventory management and payments done in line with pre-determined conditions. Yet, succeeding in these areas can be more difficult than it may seem, with supply chain specialists and supply chain managers encountering many different difficulties across the supply chain. The volume and complexity of modern-day transactions can make supply chain management an intimidating task.

Supply chain processes become more complex as the number of stakeholders increases. As a result, problems encountered during the transfer of a product that is manufactured stage-by-stage in different locations can lead to prolonged delivery times and less efficient supply chain processes. These problems can be complications in customs procedures (especially in customs checks involving manual or paper-based processes), transportation delays and disruptions, issues in inter-party payments or duplicated product checks as a result of mistrust between parties.

The three main types of flow - material/product flow, information flow and monetary flow - in a supply chain are usually detached from one another. Information usually does not flow at the same time as materials do and it can even be months before there is any monetary flow. Moreover, in most supply chains, the flow of information is disrupted as the material changes hands. While the sender in an exchange only keeps track of its own actions, the receiving company only starts keeping records when it receives the product. Therefore, it is usually not possible to see the whole flow, *meaning a lack of end-to-end traceability*. Furthermore, even information flow within the same company can be hindered by discrepancies between the different databases of the company, *preventing the flow of consistent and correct information* about product movements. Companies try to manually fix these discrepancies at the end of the financial calendar, leading to an increase in workload. On the other hand, *security flaws in information systems* can leave companies susceptible to attacks from individuals looking to steal trade secrets and/or confidential client information.

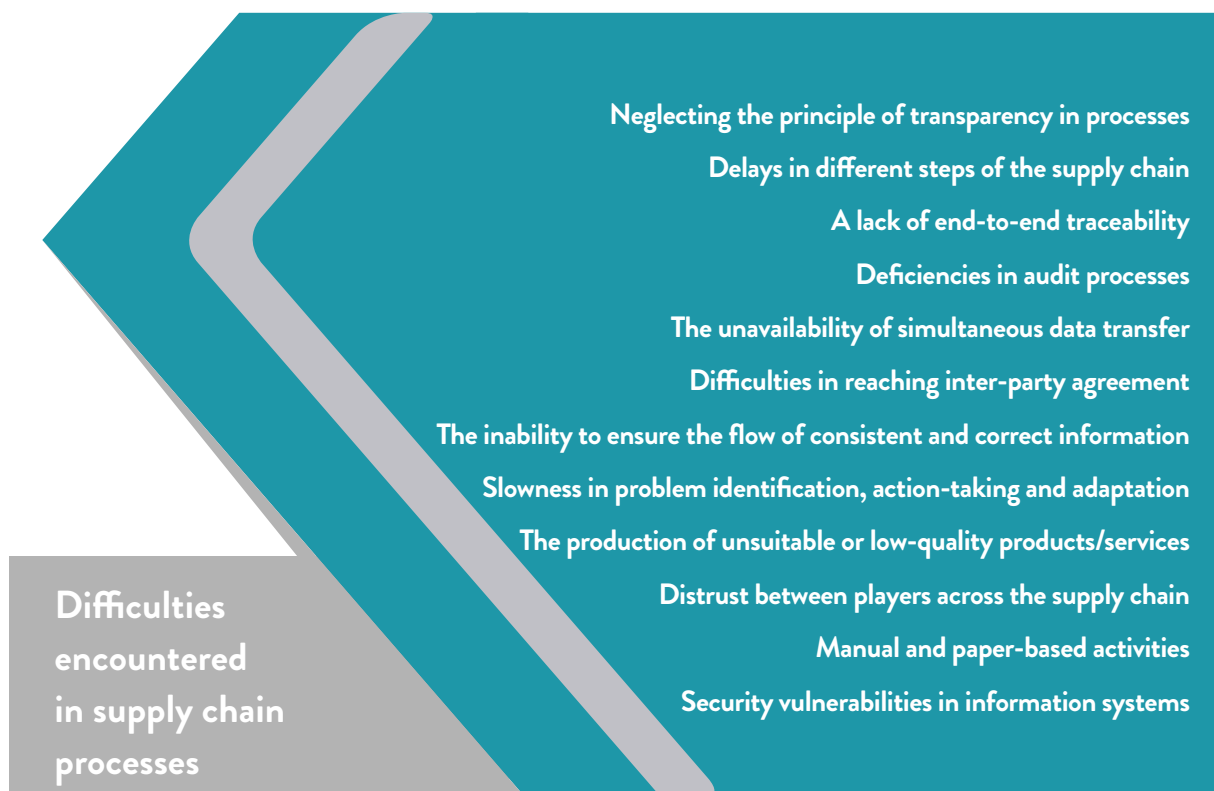
The inability to see what processes a product or an item have been through while in the possession of another party means that the *principle of transparency in processes isn't observed*. Furthermore, fraudulent behaviour, seen more frequently in industries such as drug manufacturing, agriculture and husbandry at various intervals, is testament to the *deficiencies in the audit processes of a supply chain*. Teams' slowness in taking action and

adapting can also stop a supply chain from reaching operational excellence. When a process becomes more complex due to a wide product range and *a lack of simultaneous data transfer*, supply chain teams risk losing their flexibility. Putting the system back to work after adjusting for any unforeseen changes can take longer than expected if the *involved parties have trouble coming to an agreement*. Without automated systems with commands such as “in case of problem x, put solution y into place” in place, ensuring flexibility in light of unforeseen changes is not possible.

The aforementioned problems are increasingly making supplier-customer relations more complex. The inability to quickly find a relevant supplier, gauge a supplier’s level of experience or the lengthy checks in the supplier evaluation process can make the process of finding suppliers difficult and cause delays.

Delays in the supply chain do not only happen in the supplier search phase. Products’ long waiting times at customs due to customs checks and inspections and at suppliers’ warehouses due to warehouse traffic are the most frequent and problematic causes of delays. Furthermore, unsuitable or low-quality products and services supplied by a supplier lacking in experience or lacking the necessary production / service infrastructure can result in a negative experience for the customer and even end up hindering the customer’s own reputation.

The most common difficulties that supply chain specialists and managers come across in supply chain management can be summarized as follows:



The first step in simplifying a process is identifying the most common and highest impact problems. Yet, it is not possible to solve all the problems associated with a process at once. Therefore, it is critical to identify the problems to be prioritized.

1.2. Identifying the Problems to Focus on

Prospective clients need to gather detailed information on different suppliers when choosing a supplier. Likewise, before signing on a chosen supplier, different approvals need to be obtained and numerous different documents need to be requested from the supplier. These processes can be lengthened if the supplier does not have the required documents ready or cannot instantly check / guarantee that the documents in question are up-to-date. Mistakes made in preparing the documents, such as a signature by an unauthorized employee, can be difficult to fix and can make any updates to the supplier information almost impossible to track.

The processes by which a supplier reaches potential clients and establishes its reputation can also be improved. Suppliers usually try to establish their trustworthiness through the references on their own websites. Yet a mere list of past clients is not the same as getting feedback about the supplier from these past clients and can be an inadequate way to establish trust.

Therefore, it would not be incorrect to say that problems of traceability, transparency, reconciliation and simultaneous data flow arise frequently in supplier-buyer relationships. It is necessary and practical to create solutions allowing processes to run smoothly by enabling prospective clients and suppliers to find one another easily and quickly prepare and verify any required documents after deciding to do business together processes.

We propose a blockchain-based supplier exploration platform as a solution to the aforementioned problems after discussions in meetings held by the BCTR manufacturing, logistics and transportation working group and attended by many different firms from different sectors.

2. THE PROPOSED SOLUTION

The supplier exploration platform will enable firms to quickly and easily find and get to know potential business partners. With this solution, information and documents will be transferred quickly on a digital platform and each firm will be responsible to ensure that their information is accurate and up to date. The relevant stakeholders will be notified when there is a change in a company's information. A company looking for suppliers in a new field will be able to look up the firm in question on the system and verify their information.

Companies will be able to obtain a performance score from their referees and upload certified information / documents to the system after getting these documents / pieces of information verified by the relevant organizations.

2.1. Stakeholders and user types

The system will have many stakeholders. The following is a non-exhaustive list of potential stakeholders:

- » The Blockchain Turkey Platform
- » Public Institutions
 - Republic of Turkey Ministry of Trade
 - Republic of Turkey Ministry of Industry and Technology
 - Tax offices
 - Commercial counsellors
- » Financial service providers
 - The credit bureau (KKB)
- » Unions, chambers and charities
 - Exporters' associations
 - Professional associations
 - Chambers of commerce
 - Purchasers' association
- » Municipalities
- » Members of the Blockchain Turkey Platform
- » Private companies and SMEs
- » Banks
- » Logistics firms
- » Information Technologies providers
- » Investors
- » Sponsors

These stakeholders can benefit from the new platform by taking on one or more of the different roles on the platform:

These roles are the following:

- » **Information-provider:** Registers own firm on to the system, adds/corrects/ deletes information on the firm
- » **Information-seeker:** Can access information / provide scores and references on a firm within its authority
- » **Information-verifier:** Checks and guarantees the veracity of any new / edited information within its authority
- » **Ecosystem provider:** Builds and manages the platform by satisfying the technological requirements and any other requirements related to the ecosystem



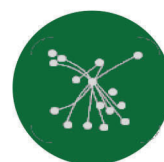
**Information-
provider**



**Information-
seeker**



**Information-
verifier**



**Ecosystem
provider**

2.2. Data content

Any type of objectively verifiable information that contributes to the knowledge on a legal entity can be stored on the system. The following is a list of examples:

- » The company's legal name
- » The company's brand name
- » Contact information for the company: Phone number, e-mail address, address
- » The tax office with which the company is registered
- » Company tax number
- » The company's Central Civil Registration System (MERSIS) number
- » The city in which the company is registered to the chamber of commerce
- » Chamber of commerce registration number
- » Chamber of commerce record of registration
- » Chamber of commerce registration document renewal date
- » Company type (Limited, Corporation, Private)
- » Date of incorporation
- » An authorized signatory list
- » The company's ownership structure
- » The company's sector

- » The company's lines of business
- » Commercial activity certificate (signed electronically)
- » Company information published on the Turkish Trade Registry Gazette (signed electronically)

Companies can upload information / documents on the company beyond those listed above; these uploads do not already have to be listed on the system.

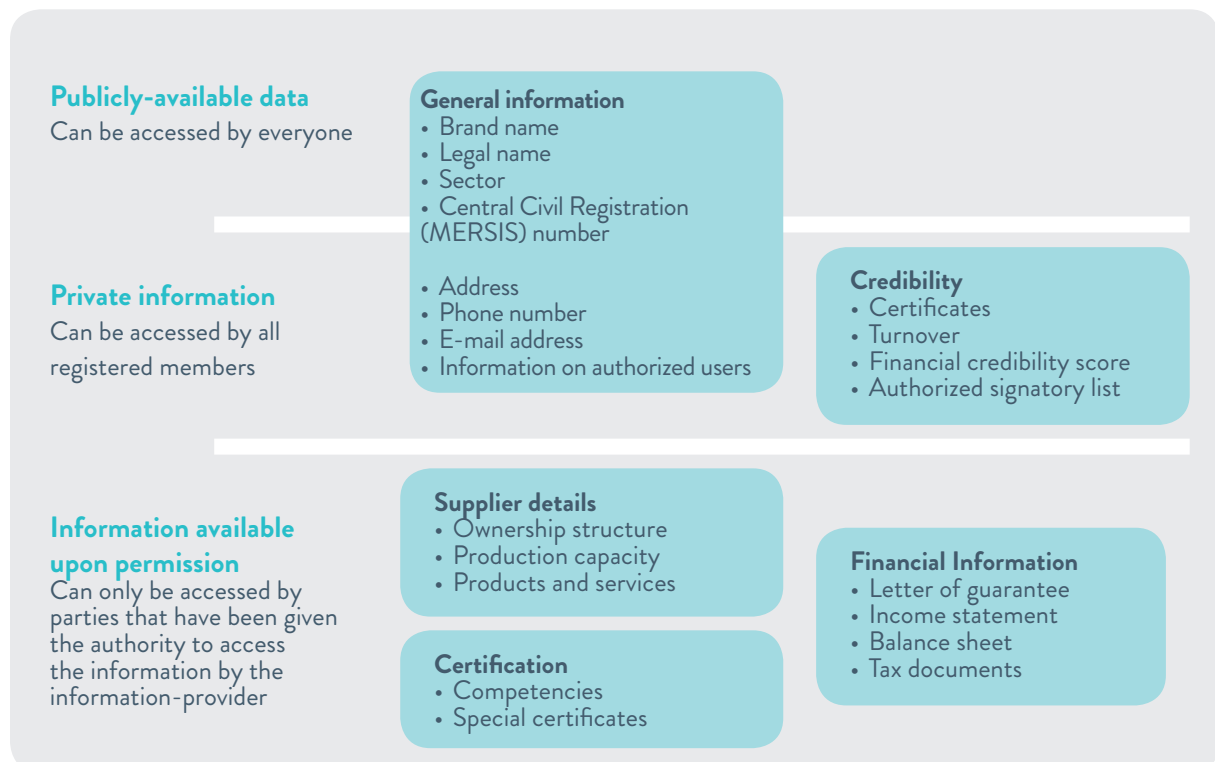
Companies operating internationally can upload information / documents that are required in their country of operation.

2.3. Data layers and data access

To ensure data security, data will be stored on the system at three different levels of accessibility:

- » **Publicly-available information:** Can be accessed by anyone with access to the internet. Even persons / parties who are not registered on the system can access this information by performing a search query
- » **Private information:** Can only be accessed by those who have registered on to the system
- » **Information available upon permission:** Can be accessed by information-seekers upon permission granted by the information-providers

Every company will be able to operate at a confidentiality level of their own choosing through the layered data storage capabilities provided by the system.



2.4. System operations

The system will work in the following way:

- » Companies create a node to represent themselves on the supplier exploration platform
- » Authorities representing the company register on to the system
- » Registered companies upload the documents required for registration and subsequently upload other information and documents to build their business profile
- » Registered companies ask companies that they have previously worked with to verify the information / documents and /or provide references / reviews
- » Companies that the registered company has worked with verify the information / documents and/or provide references / reviews
- » Members search for registered companies using keywords, reach the companies and access company information (both publicly-available or members-only information)
- » When needed, information-seekers request access to information that is only available upon permission; receive access and access the information
- » Companies receiving the information access requests answer the requests
- » When a consensus is required, authorities perform checks and vote to reject or approve a transaction

2.5. The system's revenue model and costs

The system will be able to generate revenue from a few different sources. The following suggestions are examples of potential revenue sources:

- » Membership fees collected from companies who want to register on to the system
- » Commissions charged for transactions related to data storage, data verification and data queries

The revenue will serve as motivation for stakeholders contributing to the platform and can be used to cover the following system costs:

- » Platform development, maintenance and repairs
- » Taxes
- » Marketing activities

System's revenue model and costs will be evaluated in detail in future stages of the project.

3. REASONS FOR SETTING UP THE SYSTEM WITH BLOCKCHAIN

3.1. Requirements of the proposed solution

A consensus model consisting of different stakeholders needs to be set up for the supplier platform. Reaching a consensus state would mean that the veracity of the data is accepted by everyone and is simultaneously saved and stored.

For data management purposes, an infrastructure where non-erasable copies of transaction details can

3.2. The advantages of using blockchain technology

Blockchain, simply-put, is a data storing technology; it is a database. It is differentiated from other database technologies through its design. The most important difference between blockchain and an ordinary database is blockchain's being a widely-accepted database onto which more than one more party can upload information.

The blockchain technology's philosophy is to instil trust. Put more generally, it was designed with the aim to instil technological trust.

The following make blockchain, with its potential to be applied to many different areas, special:

- » **Consortium:** The data is only acceptable if *approved by the stakeholders*
- » **Relational data:** Each new piece of data is added *in relation to existing data*
- » **Distributed architecture:** The database design allows for the data to be *stored in multiple locations*
- » **Hash function:** Using cryptography to create *unique IDs* for actors and transactions on the system and provide security through two-factor authentication
- » **Smart contract:** Coding conditions agreed upon by the parties in order to trigger specified transactions when the conditions are met

Consortium

Relational
data

Distributed
architecture

Hash
function

Smart
contract

3.3. Deciding on the use of blockchain technology

Considering the requirements of the platform, blockchain, with its aforementioned attributes, would be a suitable database for the platform. Blockchain would allow data that is distributed across firms and under the responsibility of different firms as a result of the nature of supply chains to be correctly, consistently and efficiently stored and tracked. Additionally, there will not be a need for a central authority with access to all the data to ensure the data's trackability.

Blockchain technology will allow many different companies from different sectors of different sizes to overcome problems they encounter while doing business with each other; it will fasten processes, allow parties to trust one another or completely abolish the need for trust.

The supplier exploration platform aims to digitalize workflows and its use of blockchain technology will allow the involved parties to communicate faster and make it easier for the parties to be mutually compliant. Supplier relationship management will, therefore, be more efficient.

4. EXPECTED BENEFITS

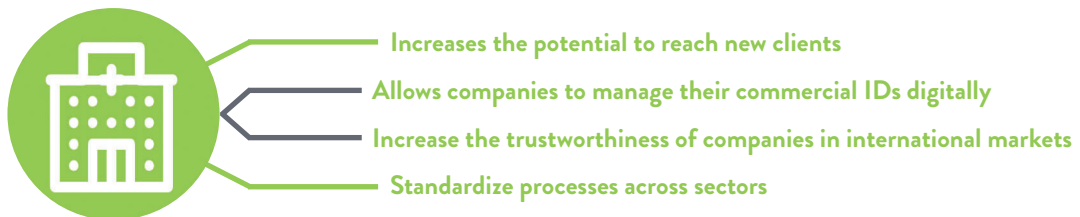
The supplier exploration platform will be designed to provide important and different benefits tailored to each party's needs. The most significant benefits can be summarized as follows: it will simplify communications between the supplier and the buyer, allow for a move to paperless trade, accelerate the digitalization of supply chains, increase productivity by significantly reducing processing time while preventing mistakes due to fraud and human error and therefore be beneficial for the entire ecosystem. The system's benefits for the supplier, the client, the public sector and the whole ecosystem will be discussed below.



4.1. From a supplier's perspective

The platform will make it easier for suppliers to reach potential clients, allow them to better present and represent themselves by managing their digital IDs and decrease the effort spent on sharing information and documents and proving one's commercial identity.

The platform's benefits for suppliers



Increasing the potential to reach new clients

The aim is to make the supplier exploration platform a prominent platform where suppliers prove their trustworthiness, introduce themselves in their fields and present their references along with any reviews they have and to open doors to new business partnerships.

Allowing companies to manage their commercial IDs digitally

Members will be allowed to update the information/documents they have on the system and add new pieces of information or new documents.

These updates will allow that the members' collaborators are instantly informed of any changes and have access to any new information that is within their authority. Therefore, suppliers will not have to inform each of their customers of any changes separately and thus have a reduced communications workload.

Increasing the trustworthiness of companies in international markets

The solution will be designed to be able to serve foreign markets as well as the domestic market. A reference system will be created for local suppliers to allow them to reach international markets easily.

Standardizing processes across sectors

The aim is to achieve a certain level of standardization by reviewing both sector-related processes and inter-sector processes and determining commonalities. This will prevent suppliers from running in to any unexpected document and information requests when they work with companies from different sectors.

4.2. From a buyer's perspective

The platform will prevent problems that buyers run into when looking for a new supplier, shorten the relevant processes and ensure that the effort spent in finding a new supplier has an efficient and effective result by providing better supplier-buyer matches.

Benefits of the Platform for the Service Company



Simplify deals

As long as member companies keep contributing to the verified database and keep it up to date, transactions between companies will be simplified and the time it takes to collect information and documents will be shortened.

Eradicate the repetition of processes

In current supplier approval processes, buyers have to re-verify the supplier multiple times by obtaining information from institutions such as those in the public sector.

Publishing verified, supplier-managed and up-to-date versions of such information on the supplier exploration platform would aim to end the repetition of such verification processes.

Create a trustworthy supplier platform

The plan is to create common approval criteria which can be used both within one sector and across sectors. Actual scores created as a result of these criteria would contribute to the establishment of a trustworthy environment for suppliers and buyers.

Enable discoveries of verified suppliers

Finding a supplier can be a challenging process for companies. Working with new suppliers can be considered to be risky. The platform would make it easier for companies to find new suppliers that have already been verified.

Provide recorded communications and proof of communications

Today, companies communicate with one another using different procurement platforms or emails. When there is a disagreement about past agreements or previously shared information/documents, the companies need to go back to find and present old records. With the supplier exploration platform, companies will be able to communicate using a unanimously accepted method and it will be easier to find previous records. Further improvements on the supplier exploration platform will allow companies to not only reap the aforementioned benefits but many more.

Increase buying and tracking options

Nowadays, different companies buying the same product can make joint purchases. In more advanced versions of the supplier exploration platform, it may be possible to track joint purchases and chain purchases (supplier-intermediate supplier-subcontractor, etc.) on the platform. This would allow companies to transparently manage issues such as the status of the purchase and which action needs to be taken by whom.

Allow companies to track obligations during their contract periods

The platform can also be used to track actions that the supplier is required to take and actions (such as SSI and tax payments) that are under the joint responsibility of the buyer and the supplier. Smart contracts can be used to automatically trigger some of these steps.

4.3. From the public sector's and ecosystem's perspectives

The platform will be beneficial for the entire ecosystem, regardless of sector. While the platform's main benefits will be standardization, easier transactions and auditability, it is expected to make Turkey a leading figure in impacting global importation-exportation processes, creating new sources of revenue and digitalization.

Benefits of the Platform for the Service Company



Establish a corporate identity infrastructure

A corporate identity infrastructure for platform members is being constructed. The infrastructure will allow companies to have unique records and the platform to become a company repository.

Prevent information and document fraud

Blockchain is expected to be effective in preventing information and document fraud since the source and the verifier will be known when information/a document is shared on blockchain, the information/document will only be saved upon a consensus and non-erasable and non-modifiable transaction records will be kept.

Increase confidence in public initiatives

Confidence in public initiatives would be increased if the public sector managed blockchain-based verification processes on the supplier exploration platform as a result of blockchain's high security standards and ability to prevent attacks to delete or modify information.

Contribute to digitalization by increasing efficiency and transaction speed

Using the supplier exploration platform as a single source for the data sharing conducted by the public sector, which requires information/document verification and auditing, would not only speed up these processes for suppliers and buyers but also allow our country to take a big step in terms of digitalization.

Pioneer the use of blockchain in the public sector

Being amongst the first few countries to adopt blockchain, which is a new technology for everyone, and pioneering its corporate use would be a success that would advance Turkey's global reputation.

Enable intercompany relations to be transparently tracked

Data added to the system will be saved and stored in blocks. The parties will then be able to track transactions within a framework of predefined rules and access permissions.

Speeding up customs procedures

The platform will provide access to information on manufacturers and to related documents that are required in customs procedures. However, some regulatory changes may be needed to use the platform for this purpose.

Using the platform to obtain and update any official documents required for any main or supporting platforms that exporters and importers need to register on for customs procedures would play an important role in facilitating trade and increasing trust.

5. A COMPARISON OF POTENTIAL TECHNICAL INFRASTRUCTURES TO BE USED

Some organizations are cautious about the consequences that could flow from new kinds of organizational structures and distributed applications that are based on this new technology. This caution has given rise to different “Enterprise alliances” like Hyperledger, R3, and the Ethereum Enterprise Alliance. These alliances advance different proposals for bringing the benefits of Blockchain to different sectors.

The analysis below focuses on three of these projects: Ethereum, Hyperledger Fabric, and R3 Corda; which are the most prominent platforms for blockchain applications. They have fairly substantial differences that make them more or less suitable for different purposes.

Please refer to Appendix 1 for detailed description of these projects.

5.1. Scalability & Confidentiality

Fabric and Corda were designed to overcome the issues with confidentiality for organizations and operations at scale that were raised as (and other permissionless blockchain implementations) spread.

Conceptually, Ethereum is the simplest implementation presented here. It is a peer-to-peer network that provides a virtual computer replicated across all full nodes. The state of the computer changes as digitally signed transactions are distributed and executed on each of these nodes.

This design causes the issues of performance at scale. Throughput (the number of transactions that can be recorded in the ledger) is limited by the capacity of the machines hosting full nodes. Since every node has to execute each transaction, throughput is actually limited by the capacity of the least-capable machines that host full nodes. These limiting factors apply to a lesser extent on permissioned instances of Ethereum – with more powerful machines, larger block sizes, and shorter block times. But limits to performance at scale that flow from the implementation design still persist in these instances.

Ethereum transactions must be available to every node in order for these nodes to process these transactions. Although there are features for partially anonymised transactions, and for contracts to store encrypted data for processing by separate applications outside the network instance – these are partial fixes that do not fully address the privacy concerns of all organizations that are considering a blockchain instance for a particular use-case.

Fabric’s answer to these issues is to split transactions in separate parts: execution, canonical ordering, and validation. Instead of being limited by the computational capacity of the slowest full node, throughput on Fabric

is limited by the capacity of the ordering service to receive transactions and output blocks. This produces a network with a much higher throughput capacity at scale.

Fabric also allows sub-groups of organizations to share a ledger on a dedicated channel, as well as provide sub-sub-groups of organizations to safely share private data on these channels. The “privacy” features as well as the modular features of the implementation discussed above suggest that Fabric instances can be configured to suit a wide range of potential use-cases for a permissioned blockchain.

Corda’s design is such that it does not fit neatly in the constellation of blockchain implementations. Corda abandons the goal of advancing some shared global state in a decentralised system. The concept of global state has no meaning in Corda. Instead, this implementation tracks agreements between specific parties in small subsets of the overall network.

This design should help the network perform at scale, since only a small subset of transactions need to be processed on a single node. Confidentiality is also inherent since only the parties involved in an agreement know about the agreement and its history. This confidentiality comes with the caveat that there is no way to guarantee “forward confidentiality”: a party’s identity becomes part of the list of state changes and will be shared to every future party that participates in that state.

Corda may face issues when it comes to long-lived interactions. For states that have a long or complex history, retrieving the history of updates could take a long time – especially if nodes are only intermittently available or fail to provide the information for one reason or another.

Also, if the same state is involved in different business processes then all the participants in the state receive updates on the state. It is unclear what compromises this might cause in confidentiality among participants, or performance at scale on the network.

5.2. 5.2. Development Tools & Ecosystem

Ethereum has a large development community. That said, the high-level programming language (called Solidity) used to write contracts on Ethereum is pretty unwieldy. Poorly written contracts (even those that were written by some of the founders of the project) have caused highly publicised issues on the public network since it was launched in 2015.

Fabric, by contrast, supports applications (chaincode) written in Go, Java, and Node.js. Corda is based on the Java Virtual Machine and officially supports applications written in Kotlin and Java – although Corda itself is written in Kotlin with much of the documentation only provided with Kotlin samples. It is worth mentioning at this stage that, there are two distributions of Corda – a “community

distribution” (that is open source) and an enterprise distribution (with extra features) that is only available with a license. On the other hand, both Ethereum and Fabric are open-source projects.

5.3. Identity

Ethereum contracts (applications) can be set up to restrict functionality to specific addresses. The implementation itself is permissionless though, so any permission schemes must be implemented at the application (contract) level.

By contrast, both Fabric and Corda are designed to use X.509 certificates to manage permissions and identity in a given instance. This makes it easier to develop many business applications, but makes it harder to implement anonymity schemes.

5.4. Conclusion

The analysis above highlighted the differences in design between Ethereum, Hyperledger Fabric, and R3 Corda. It shows how Ethereum was intended as a distributed world computer, how Fabric addresses some of the issues that Ethereum instances present for organizations, and how Corda was motivated by the same concerns to presents a different approach to shared record-keeping technology altogether.

Ethereum and Hyperledger Fabric seem to be more suitable blockchain implementations to develop permissioned networks for a wide-range of applications – some of which would be very difficult to develop on Corda. Furthermore, the modularity of Hyperledger Fabric, support for popular high-level programming languages, built-in (modular) identity management, and current capability for high- performance at scale make it an attractive implementation for a wide-range of potential business use-cases.

6. NEXT STEPS

6.1. Evaluating potential collaborations

Blockchain is a technology that would exponentially increase the value-add of solutions developed with it, given that the required ecosystems and collaborations are in place. In this regard, the Blockchain Turkey Platform, which brings many different companies from different sectors under one roof, and the collaborations set up under this roof are very important. It is also critical for parties other than BCTR members, first and foremost public institutions but also institutions such as universities, technology firms and consulting firms, to contribute to the movement for the proposed solution to succeed.

Public institutions can expand the scope and increase the use of the proposed solution by contributing on areas such as regulation, data and coordination. On the other hand, universities, technology and consulting firms can take an active part in the process and use their academic knowledge in the system's technical and architectural design and help develop the ideal structure for the platform.

Collaborating with reputable and leading international players would also be beneficial for the solutions. Becoming a Trace Alliance* member and co-developing blockchain-based applications can be considered for this purpose.

6.2. Clarifying expectations from public institutions

Currently, whenever a Turkish firm wants to make an application at a public institution, it needs to bring a copy of the Turkish Sicil Gazetesi (Turkish Trade Registry Gazette) to register and get verified on the institution's system.

Likewise, before a private company signs on a supplier, it checks how legitimate the company is using similar legally acceptable official documents provided by public institutions. The planned supplier exploration platform would make it possible to present certain documents with an "officially approved" sticker in this "company legitimacy check" stage, by using the digital IDs to be created through blockchain technology and without a need to repeat document controls, therefore fastening these transactions. A set-up in which the company uploads its information on to the platform and the relevant public institution takes on an information-approver role in the information control stage is being considered for later stages of the platform. Different data integration solutions between public institutions and the platform are being considered to make this approval mechanism work.

^(*) **Trace Alliance** is a non-profit organization bringing the public sector, academia and technology companies together to develop practical supply chain solutions.

Through this solution, companies will not lose time and will be freed of the requirement to pay money when making applications. Likewise, the public authority will not have to spend time on examining the documents presented by the company.

Citizen satisfaction will be improved as a result of faster and easier public initiatives and companies' trust in initiatives will be improved as a result of simpler and more transparent interactions with the public sector.

The data pool built on the platform will be another benefit of the platform. Even though public institutions have rich databases containing information on private companies, they run into problems when trying to transfer the information between public institutions. The ability to safely store and transfer data using blockchain will improve trackability, enable policy makers to use this data in their analyses and help them create their roadmaps in policymaking.

Furthermore, transferring the foreign trade processes currently run by the Ministry of Trade on to a database constructed with blockchain technology would create further value add in terms of speed, efficiency and safety. The supplier exploration platform would complement this database by fastening customs procedures and increasing efficiency since it has companies' digital IDs.

Both the supplier exploration platform and moving foreign trade processes on to a database constructed with blockchain would give local firms a competitive edge by fastening customs processes and would thereby be in line with the mission of facilitating trade set out by the Ministry of Trade.

The following regulatory changes need to be made in order to ensure that the supplier exploration platform can be used widely and that the maximum amount of benefit is reaped from the platform:

- » Making the necessary regulatory changes to allow the platform to be used in sectors / areas where the use of e-signatures is not very common; making electronic documentation the norm
- » Making the necessary public and regulatory changes to reach an agreement on the acceptability of the data on the system for it to be used in processes outside of the platform, which involve queries on companies or data checks/approvals related to companies

6.3. Identifying proof-of-concept areas

Small-scale introductory tests supporting manufacturing or increasing exports, the level of security and controls must be considered to prove the functionality of the solution.

These tests can be sector-based by selecting one sector and building the solution in this sector and subsequently extending it to other sectors or product/service-based by selecting one product/service and then extending the solution to companies along the value chain of this product/service.

6.4. Settling on a reference model

The reference architecture and the decision trees currently being prepared by the Blockchain Turkey Platform Technology Group will be used to choose the proof-of-concept areas and use cases. These documents will be used to determine if blockchain technology adds value to the chosen pilots. The following steps will be completed with the Technology Group:

- » Clarify the technical infrastructure for proof-of-concept
- » Determine the blockchain platform
- » Determine the consensus algorithm
- » Clarify the data flow

6.5. Assessing compliance with competition Law and other regulations

The fact that competitors will indirectly or directly come together on the platform can be a source of concern. On the other hand, considering that the aim of competition law is to protect consumers and maintain competition, it can be argued that the platform supports competition law.

Data sharing among the different parties and the ability to allow / deny access to the shared notebook can be used in different ways. For example, a relatively new entrant to the market can provide examinable and verified records of its previous activities and thereby instil trust in potential customers. On the other hand, companies actively competing with one another can choose to share sensitive information on their operations with one another by leveraging the data structure that makes sharing private information possible. A collaboration formed through this method can result in pricing or manufacturing methods that work against the customer. However, the fact that the platform gives rise to such concerns and other ones doesn't mean that blockchain technologies will only be used in activities opposing competition. In this respect, consultants specializing in the area of competition might be needed to ensure that blockchain is used in a competition-friendly manner in the relevant markets and that the parties reap the maximum benefits from the technology.

7. LOCAL AND INTERNATIONAL EXAMPLES

7.1. International Blockchain Projects and Proof-of-Concept (PoC)

7.1.1. TradeLens

TradeLens is the product of a collaboration between Maersk and IBM. The blockchain-backed freight solution has been designed to not only encourage innovation in the industry but bring different parties together to support more efficient and safer global operations by supporting information sharing and transparency. IBM and Maersk have announced that 94 different institutions have actively joined the system and are present on the open-standard platform TradeLens as part of the preadaptation of TradeLens.

7.1.2. Voltron

The Voltron blockchain platform was announced in 2017 as the first blockchain prototype to be developed for international trade financing. Its first test was a great success that was conducted between the global banks ING, HSBC and the global food trade firm Cargill and decreased the process of receiving letters of credit for soybeans exported from Argentina to Malaysia from 5-10 days to 24 hours.

Voltron, which was developed by 11 global banks under the roof of 'Corda Blockchain' is expected to be released into the market in 2019 after its second test is also completed.

The digitalized letter of credit made possible by the Voltron solution is an important step for digitalizing trade. The following have been observed as a result of this transaction:

- » Digital transactions fasten and facilitate trade flows and make them more efficient
- » The letter of credit transactions that traditionally take 1-2 days can be completed within 1-2 hours
- » The system has the potential to optimize the working capital and improve the cash flow by fastening the documentation cycle that is repeated when new products are uploaded

7.2. Local blockchain projects and proof-of-concept

7.2.1. Ripple

As the first Turkish bank to collaborate with the Silicon Valley-based technology firm Ripple, Akbank completed all the required technical integrations in 2018 to enable money transfers on the Ripple platform and started to provide this service to its consumer banking customers. With this new service that Akbank has begun to offer, bank clients can now clearly see the transaction costs associated with sending GBP to the British bank Santander UK before sending the money and have benefited from a faster process.

7.2.2. Blockchain Trade Platform: BTP

BTP was developed through the collaboration of Atez Yazılım Teknolojileri A.Ş., which was exclusively funded with Turkish capital, and Chain & Chain Technologies Ltd, which was founded in the UK with local capital. BTP manages the following activities/areas under the same roof: Exportation, importation, free zone, investment incentivization, inward processing, transit products, end-use products, temporary imports, outward processing, transfer pricing and royalty licensing. Its stakeholders include exporters and importers, international shippers/carriers, local shippers/carriers, distribution centre managers, warehouse managers, courier providers, customs brokers, non-customs certification and authorization consultants, banks, insurance firms, local and international trade chambers, exporters' unions, permit certification firms and port authorities and is backed by the Turkish Trade Ministry. It is open to the participation of all parties and has set out to become an unbiased project.

BTP is a trust-based project, made possible by blockchain and offering a comprehensive and wholistic solution; it aims to be the single point of truth and includes both on-chain solutions where the data is stored on blockchain and off-chain solutions where the data is stored outside of blockchain due to local requirements. Its wholistic approach allows BTP to focus on all the problems of international trade and make every link of the chain strong.

On the exporters' side, Ümit Bisiklet San. Tic. A.Ş., Vakıfbank T.A.O., DB Schenker Arkas A.Ş., Güler Dinamik A.Ş., Universal A.Ş. and PLH Lojistik Hizmetleri A.Ş. have joined the pilot in consensus. On the importers' side, Schneider Electric A.Ş., Vakıfbank T.A.O., DB Schenker Arkas A.Ş., Güler Dinamik A.Ş., Universal A.Ş. and PLH Lojistik Hizmetleri A.Ş. have come together for the pilot.

7.3. Blockchain-based ID Infrastructure Projects

7.3.1. Smart Identity

Through the Smart Identity project created a proof-of-concept at Deloitte UK, citizens can create and manage digital IDs. Citizens can upload documents such as identification cards, driving licenses and passports and get them verified and present the verified documents to institutions asking for the information. The project has been expanded beyond personal use to include corporate use by allowing firms to similarly create and manage digital IDs.

The digital IDs created on the platform can “own” money and different physical assets through new updates. Therefore, it will be possible to track different value transfers, such as property rights and money transfers, on a single platform.

The know-your-customer (KYC) solution, which is Smart ID’s first area of application, provides an end-to-end, simple and digital solution at a lower cost for the customer introduction processes of companies of different sizes.

Parties that can use the platform have been defined as the following:

Persons: Smart ID offers the ability to gather IDs and ID-related attributes in one place. The acceptability of these documents / attributes can be improved through checks by trusted authorities on the system.

Companies: Companies can be digitally represented and be audited at the company level if they provide information such as their legal references and ownership structure on the platform. The aim would be to keep the data up to date through periodic updates.

Connected Devices: The connected devices will have the right to manage data relevant to other IoT devices that they are associated with.

7.3.2. Opperty

Opperty is a blockchain-based business ecosystem. The proof-of-expertise (PoE) protocol, the company-scoring system and the B2B/B2C Marketplace are some of the more prominent features of the ecosystem. The platform aims to ensure trust between different users; small and mid-sized businesses, companies and public institutions are the most prominent users.

The solution builds the PoE protocol on top of a blockchain structure.

Ethereum’s Plasma protocol is the blockchain platform of choice. By using “tokens” on the platform, users can utilize Opperty’s PoE protocol, create smart contracts and interact (both B2B and B2C) using the digital IDs they have been assigned. Users can gain access to different services offered by Opperty by earning or buying OPP “tokens”. The “tokens” are gifted to users who perform certain pre-determined actions that help develop the platform.

Opperty’s PoE-based company-scoring system collects data on companies’ previous business interactions and creates a unique company score, thereby allowing sector-specific reviews to be added to companies’ digital IDs and

their capabilities to be documented. Opportunity therefore provides benefits to companies in their domestic and international interactions, especially in procurement and supply chain processes; it also allows both B2B and B2C customers to view suppliers' scores.

Both suppliers and customers can manage the proposal processes on Opportunity. It is especially common for small suppliers to provide services to certified customers; this way, both sides can improve their recognition scores and earn "tokens". Interactions with crypto currencies are encouraged and customers are supported in any problems they may face in the payment process.

7.3.3. AuthenticID

AuthenticID combines different technologies to provide a digital ID service to its customers. The following are the primary features of the application:

Smart ID Wallet: The system can track and manage the IDs and transactions of verified users. Since this information is personal and confidential, each user needs to store the information in their own wallet.

The system claims it will be able to provide even more comprehensive solutions in the future, such as background profiles consisting of events crosschecked against identification information. Generally-speaking, the platform will allow for the systematic use of any information matching identification information. The solution is suitable for interactions that involve crypto-currencies and interactions which do not.

ID Confidence score: When a piece of information is requested, AuthenticID performs a multifaceted evaluation of whether the requested information is at a desirable level and relays an approval / rejection decision via the system. Specific business rules and regulations concerning the requester are considered in this process. The score is calculated after aggregating multiple sources of data; the final score is calculated by the decision algorithm on the system after it receives the aggregated data.

Smart "Oracle": The platform can integrate information stored outside the system by third parties and use this information in decision-making processes.

CONTRIBUTORS



Murat Ceylan

Akbank

Cüneyt Yetgin

Kenan Güler

ATEZ Yazılım Teknolojileri A.Ş.

Enes Türk

Okan Yıldız

Bankalararası Kart Merkezi A.Ş.

Berk Kocaman

Blockchain Türkiye Platformu

Alper Günaydın

Esmanur Acungil

Tuncay Özdemir

Deloitte

Gökçe Gönel
Hayriye Karadeniz
Özlem Keyder

Ford Otosan

Burç Akbaş
Sönmez Hazar

KoçSistem Bilgi ve İletişim Hizmetleri A.Ş.

Adem Korkmaz
Aydın Tabur

Pegasus

Çiğdem Ayözger Öngün

SRP Legal

Ticaret Bakanlığı - İhracat Genel Müdürlüğü

Gökhan Abbasoğlu

TÜBİTAK-BİLGEM



BLOCKCHAIN

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