

A Blockchain Based Land Registration System Proposal for Turkey

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Abstract— Although the popularity of Blockchain is thought to increase with the appeal of Bitcoin, this technology promises much more. The eye-catching advantages of Blockchain technology are the high level of security it provides, transparency, and allowing stakeholders to trade without the need of any intermediaries. Land registration systems are also one of the areas with high potential where Blockchain technology can be used. When we look at the examples from all over the world, we see that countries have started to update their current land registration processes to be Blockchain-based. Considering the local land registration process in Turkey; some serious problems are observed like the number of physical transactions is quite high and the fact that property sale prices declared to land registry office lower than it actually is to avoid the increment value tax. Therefore, a Blockchain-based solution has been prepared suitable for use in Turkey. In order to this; the land registration process, which took place in eight steps, was analyzed, system participants were identified, and an application was developed using the selected smart contract infrastructure. In this paper, these steps of developing a Blockchain-based land registration system for Turkey will be explained.

Keywords—Blockchain, Land Registration, Geographical Information Systems

I. INTRODUCTION

Although Blockchain technology was found in 1992, the name began to be heard in Bitcoin cryptocurrency. With the eye-catching effect of Bitcoin and other cryptocurrencies financially, the broad technical infrastructure offered by Blockchain technology has been overshadowed. Blockchain technology is defined as a decentralized distributed database system. All the processes that take place in the system are created in the form of a block structure and are connected as an integral chain by connecting with each other from the first block. The main claim made by Blockchain technology is the high level of security offered by the information obtained on the system is precise and cannot be changed in any way. Blockchain provides a distortion-proof digital ledger that can be used not only in financial transactions but in all transactions that allow us to record everything we value. This value can be anything that can be expressed in code. Supply chain management, food traceability, and training information are some examples. The number of these examples is quite high, and thanks to this wide range of applications and the remarkable advantages it offers, some technologists call Blockchain technology "New Internet". It is argued that Blockchain will make the structure provided by the Internet for communication to share information. The basis of this ambitious approach is the "Distributed Notebook" structure, which is one of the copies of all stakeholders participating in the network and is the basis of Blockchain technology. Every transaction performed on the Blockchain network that has

been established is recorded and stored in the digital ledger of all participants. This essentially eliminates the need for reliable third parties, such as banks or notaries. In other words, it can be said that the distributed ledger structure, which is the basis of Blockchain technology, acts as a digital notary. Although it is a relatively new technology, the number of studies on it is increasing significantly; large companies tend to work on the field.

Blockchain technology has become one of the new generation technologies due to its popularity and extraordinary advantages. In addition, many large research institutions have conducted research on this technology and carried out studies to determine its potential. Gartner, one of the world's leading information technology research and consultancy companies, was not insensitive to Blockchain technology and conducted research. When we examine the "Hypecycle" curve in the "Emerging Technologies" report that they prepared and which shows the maturity life of the emerging technologies, we see that Blockchain technology has passed the peak of inflated expectations and progressed towards the trough of disillusionment phase (Fig 1). If we evaluate this circumstance, the unrealistic expectations about Blockchain technology will start to decrease, although this situation will cause disappointment; it is predicted that the realism related to technology will increase and the scenarios where technology will be really useful will increase. Proceeding in this way, it is estimated that the technology will reach the efficiency period in the next 5-10 years. It is evaluated that unresolved problems will be eliminated, deficiencies will be eliminated and technology will reach the expected maturity level at the end of this period.

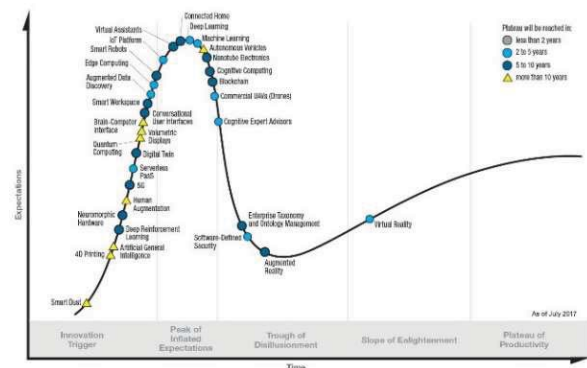


Fig. 1. GARTNER Emerging Technologies Hypecycle [1]

Although the usage areas of Blockchain technology are quite wide, it is seen that it has started to be applied in many areas especially since 2015. Geographic information systems (GIS) are one of the high potential technologies that

Blockchain technology can be used together. Blockchain is considered to provide diversity and information to work in various areas of smart property [2]. There are many applications where GIS and Blockchain are used together. The land registration application is one of the most popular and potential rising stars of these uses. Although the requirements of the land registration systems vary by country, the common feature of all will be the eye-catching advantages and conveniences of such a Blockchain-based system. In this article, generating the land registration system with Turkey's requirements will be explained.

II. LITERATURE REVIEW

Lemieux argues that Blockchain is a new technology with the potential to radically change the record of land and real estate transactions. The author highlights Blockchain-based land registration practices developed by the requirements in Brazil, Georgia, Honduras, Ghana, India, Japan, and Sweden. Pilot applications in the regions determined within these countries are explained and it is predicted that the number of full-time uses will be increased [3].

Spielman claims that Blockchain technology will have a revolutionary effect on the land registration process and will change the course of the process positively. It is suggested that with the start of managing the existing land registration processes with Blockchain technology, the efficiency will increase in transactions, the fraud experienced during property hand exchange transactions can be prevented, transactions can be carried out with higher security, traceability, and transparency can be achieved, and there may be lower sensitivity to natural or human-caused disasters [4].

When we look at the examples of the Blockchain-based land registration, it is seen that the applications in Brazil, Honduras, and Sweden come to the fore. US-based Blockchain technology company Factom has developed a Blockchain-based land registration solution for Honduras. Honduras' application is the first application to use Blockchain technology for land registration. The main reason why the Honduran government wanted to switch to a Blockchain-based land registration system was that it wanted to prevent irregularities in the land registration. For this reason, they made a radical decision and agreed with Factom to implement a Blockchain-based system. The system was operated for 3 months starting from November 2015 [3].

Brazil, which carries out the ownership transfer in 13 steps, is another country that has switched to the Blockchain-based land registration system. In addition to reducing costs and irregularities, the Brazilian government decided to use Blockchain technology to ensure accuracy, transparency, traceability and high security in transactions, and a solution developed by Ubitquity was put into use in Rio Grande do Sul Province in May 2017. When the data obtained as a result of the system, which was operated for a period of 3 months, was evaluated, it was seen that the errors in the recording system decreased and an important convenience was obtained in archiving [5].

Although Sweden is another country that transfers land registration transactions to a Blockchain-based system, the reason for its use differs slightly from other countries. According to Sweden "World Bank Business Index" data, it is one of the most reliable countries in property registration transactions. While the main reason for countries such as Brazil and Honduras to switch land registration processes to

Blockchain technology is to avoid irregularities in land registration processes, Sweden does not have such a situation. In Sweden, which manages the property transfer process in 7 steps in total, ChromaWay company has taken advantage of Blockchain technology and carried the processes to Blockchain technology by making a digital breakthrough. Work is still underway to expand the system used between July-October 2017 [3]. An example of user interface representation showing the transaction between the owner and receiving parties on the developed system is shown in Fig.2.

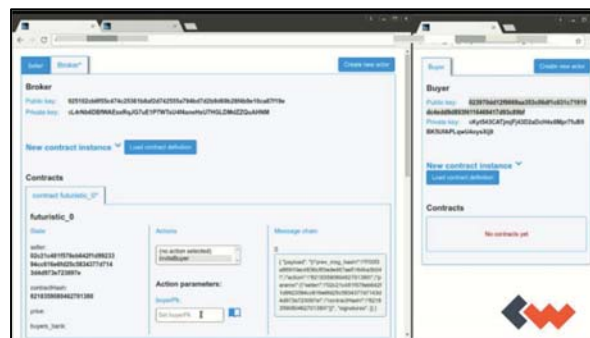


Fig. 2. A Screenshot of Chromaway Land registration Application [6]

With the effect of the success achieved by ChromaWay company and its success as a pilot in Sweden, the Ukrainian government has started working to use the same system for its own countries. Similarly, one of the Indian states, Andre Pradesh, announced that he will start to use the ChromaWay Blockchain land registration system [7].

III. WORK DONE

Land registration procedures are processes that vary according to the local operations of the countries. It is seen that each country adopts functioning by its local structure. Therefore, it is not considered reasonable to create a land registration system that can be developed globally. Our starting point was to start developing our application for Turkey in the first stage. Based on this purpose, a plan was developed for the development of the system and a road map was determined. Firstly, the examination of the process of the land registration system in Turkey was carried out. As a result of the examinations made, the requirements were determined and the system was designed with these requirements. While designing the Blockchain-based system, the optimum choice among the Blockchain infrastructure options offered was decided. In the end, the Blockchain-based land registration system that will meet Turkey's needs and system requirements specified in the configuration result has been established.

A. Land Registration Process in Turkey

Land registration processes include many stakeholders and vary according to local laws. In some countries, the process is carried out entirely with the state institutions; in some countries, it is carried out through a process involving external stakeholders such as notaries and lawyers. When we examine the process in Turkey, it is seen that it is a process that is not under the control of notary public and other external stakeholders but only under the control of the land registry offices. This land registration process is carried out in eight steps in total after the owner and receiving parties reach an agreement between them (Fig. 3):

- i. After the agreement between the owner and receiving parties, the owner of the property requests the municipality to which the property is located to determine the fair value of the property.
- ii. A formal letter is taken from the same municipality, stating that the property has no debt.
- iii. At fair value by the owner and receiving; separately, a 2% title deed is deposited into the bank where the title deed is agreed together with the circulating capital fee.
- iv. If the receiving party will pay the agreed fee with a bank loan, the mortgage documents are prepared by negotiating with the bank.
- v. For the exchange process, both the owner and receiving parties prepare documents such as identity card copy and photo. In addition, the owner party physically brings the deed document.
- vi. Payment receipts, mortgage documents, and all necessary documents for the transfer are collected and delivered to the land registry office.
- vii. In order to process the deed transfer, an appointment is made from the land registry office.
- viii. As a result of the evaluation made at the land registry office, if there is no obstacle to the sale, the owner and receiving parties are physically invited to the land registry office. After physically transferring money, official signatures are signed and the transfer of the property is completed.



Fig. 3. Current Land Registration Process in Turkey

It takes 2-3 days to complete the entire process, even if there is no glitch in any of the steps listed above and actions are taken at maximum speed. The vast majority of this period is to make physical applications to many different institutions and to prepare many physical documents; in short, it passes with a physical rush.

When we examine the laws regarding the sale of property in Turkey; when the property owner sells the purchased property within five years, he is liable to pay a tax arising from the difference between the purchase and sale prices. This tax is called the increment value tax. Accurate determination of the increment value tax is of great importance to ensure that public investments are returned equally to all citizens. Therefore, obtaining real sales values is of great importance for public welfare. In order to avoid this tax liability, it could be observed that there are situations where sellers show the housing sales price as lower than it actually is.

In the current situation, after the owner and receiving parties agree on the landed property, the owner applies to the land registry office together with the fair value of the property which is taken from the municipality. The residential sales value is a value reported by the owner, and since the transfer of money between the parties is mostly physically, the land registry office cannot control the accuracy of the declared

price. In case the sales prices are displayed in a destroyed way, the situation of the failure to obtain the correct sales values and data is seen. As a result of the destroyed data, the value increment value tax will not be collected correctly, so there will be a situation where public investments cannot be returned to all citizens equally.

B. System Design

Operational steps and needs were determined after analyzing local laws and the current land registration process; then, the Blockchain-based system design phase started. The use of the Blockchain-based land registration system begins when the owner and receiving parties enter the system and enter the agreement information after the agreement on the transfer of the property subject to sale. From this point on, the management of the land registration process is carried out completely through the system.

After entering the reconciliation information over the system, the property is put up for sale, and a sales code is generated by the system. The receiving party is included in the system by sharing this code with himself, examines the spatial, attribute, and reconciliation information about the property. After confirming that it was the same way they agreed before, it gives transaction confirmation.

After the owner and receiving have reached the agreement also on the system, transactions are carried out by the municipality to determine the fair value of the property and to confirm that the property does not have any debt. After the municipality's transactions are completed, banks of both parties are included in order to transfer the fee to the owner party. Here, transactions are made with a completely digital approval mechanism, and instead of physical money transfer, there is a money transfer and approval process in which banks are digitally involved. In order to avoid the increment value tax of the sellers, which is one of the biggest problems experienced in the land registration process, the problem of showing the property sales value lower than actual is; can be eliminated with the transparency obtained as a result of the banks performing the transactions digitally.

After the banks approve the money transfer, the land registry office will examine the entire transaction process in detail and, if no obstacle to sale is detected, will approve the transfer of the property. Money and property transfers will be carried out at the same time, following the signatures of the owner and receiving parties, together with the approval obtained from the land registry office.

The diagram obtained as a result of the system design and detailing all this flow is shown in Fig. 4. During the approval flow, if any of the parties that are obliged to approve in the relevant step does not approve the transaction, the purchase/sale transaction will be completely canceled at the end of the specified period.

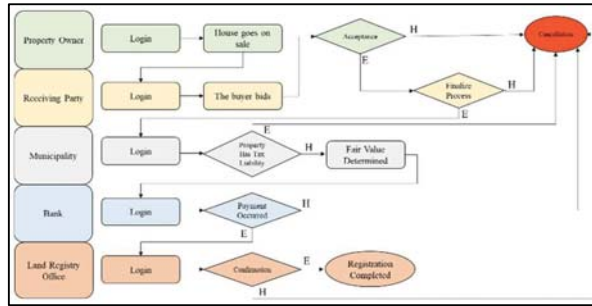


Fig. 4. System Design Flow Diagram

C. Application Infrastructure Decision

Smart Contracts and Smart Properties are the terms in which Blockchain technology is announced together. The idea of smart contracts is the heart of Blockchain technology. With smart contracts, workflows are managed and executed without the need for any external triggering. Thanks to the automatically working business rules, the flow is provided without any central trusted authority. Although the idea of smart contracts was first proposed by Nick Szabo in 1997 [8], the concept of "Smart Ownership" was firstly proposed by Mike Hearn to follow the property transfer process [9]. Ethereum and Hyperledger are the most popular and powerful infrastructure providers that offer smart contract infrastructure.

Ethereum, announced by Vitalik Buterin in 2015, is an important smart contract infrastructure service provider for developing Blockchain applications. Also, it has its own cryptocurrency, which is one of the most popular and widely used cryptocurrencies in the world [10]. Many cryptocurrencies are traded on the market using Ethereum infrastructure. Ethereum can be used not only in cryptocurrency applications but in all areas where the smart property is built. Ethereum serves its users to create their smart contract-based application open to the public (unauthorized) with the language of Kotlin.

Another popular provider that provides smart contract infrastructure like Ethereum is Hyperledger. Unlike Ethereum, Hyperledger does not have its own cryptocurrency. Hyperledger was founded in 2016 by the Linux open-source development community. Hyperledger, which is a formation supported by many members from both financial companies and technology companies, aims to develop industry-independent Blockchain applications. Hyperledger allows its users to set up a flexible network, with or without permission network permission structure [11].

It is very important to set the criteria correctly to choose between two powerful alternatives such as Ethereum and Hyperledger. The most important of these is the nodes' participation permission in the network. There are two options here; public or private. In the case of public networking, there is no control mechanism for participants to join the network. The best example of this is the Bitcoin cryptocurrency network. Here anyone can join the network, get a copy of the distributed notebook. However, when an application will be created at the business level, it is necessary to establish a private structure to determine the participants and assign their powers. In the private structure, a network is created in which only authorized readers and authors can participate [12]. At this point, we see that we need such a private structure in the

system we will establish. Ethereum offers its users a public network, as well as restrictions on flexibility. Besides, Hyperledger provides its users with the opportunity to create a network publicly or privately. In addition, Hyperledger provides its users with a more flexible installation of the network. Considering all these advantages and our needs in the system we will build, it was decided that it would be more appropriate to choose Hyperledger.

Different alternative products of Hyperledger are available depending on the type of applications to be developed. Entering the Blockchain world with the support of the Linux Foundation in December 2015, Hyperledger entered, unlike other competitors in the industry, stating that it wants to establish a distributed systems infrastructure for institutions and business networks. As a result, different types of systems and tools have been developed to adapt to changing needs. The systems offered by Hyperledger are Burrow, Indy, Fabric, Iroha, and Sawtooth; tools are designated as Caliper, Cello, Composer, Explorer, Quilt [13].

Fabric is one of the most popular, and useful systems of Hyperledger. Designed as a basis for developing applications or solutions with a modular structure, Hyperledger Fabric ensures that components such as consensus and membership services are plug-and-play. It is also the first Blockchain to run applications written to a certain standard in general programming languages, without systemic dependence on the cryptocurrency. Fabric creates the model with a mobile membership concept that can be integrated with industry-standard identity management. To support this flexibility, Fabric offers a completely new Blockchain design and, along with the Blockchain model, offers a new solution to challenges such as resource consumption and performance optimization [13]. Therefore, Hyperledger Fabric is decided to use. Besides, Hyperledger Composer one of the tools offered by Hyperledger was preferred for the installation and display of the network on Hyperledger Fabric. Composer tool provides easy creation of Blockchain smart contract structure with its easy interface, it offers flexibility and easy use at the point of network distribution.

D. Development of the Application

After the Blockchain smart contract service provider was determined, the development phase of the designed system started. As a result of the system design, the flow was clearly revealed. Before starting the system development, it is necessary to determine all parties concretely, then to determine the sequence of transactions according to the system flow. In the designed system, six stakeholders were identified: the owner party, the receiving party, the municipality to which the property is affiliated, the bank of the receiving party, the bank of the seller, the land registry office (Fig. 5). The completion of the process flow in the proposed system is carried out with the sequential approvals of these participants.

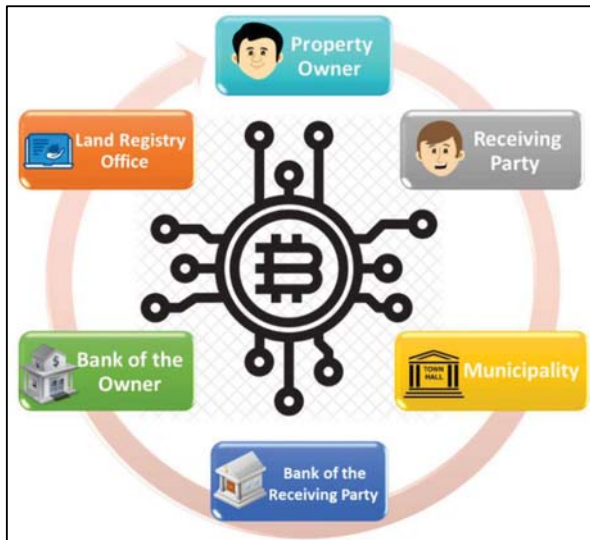


Fig. 5. Nodes of the Blockchain Based System

Identifying the parties to take part in the Blockchain-based system was the first step to start the development phase. After determining the system parties, the system flow should be determined with the smart contract structure. With the smart contract structure, it is determined that in which order the transactions will be made between the parties and what the approval mechanism will be. Hyperledger Fabric offers different approval mechanism. Research has been carried out to choose the most suitable one for our system flow among the different approval mechanisms it offers. It is decided to use a sequential approval mechanism, namely Proof of Authority (PoA), since there will be a sequential approval mechanism between the system parties, and on the other hand, no mining effort will be required. With the PoA method, the system parties perform sequential transactions and approve line with the flow determined by the smart contract structure. Hence, it is seen that this method is compatible with the system we designed. Another point that should not be forgotten when determining the smart contract structure is the necessity of determining the conditions such as the maximum approval period of the parties for the approval, which of the acceptance or rejection status will be determined automatically. After the approval mechanism and smart contract, the template was determined, the visualization phase of the system was started. Especially when it is evaluated that the display of the block structure, the transparency, and traceability of the flow will be increased, it has been decided to provide the display with the block history in all process flows. The representation of the block structure created for each transaction performed on the system is given in Fig. 6.

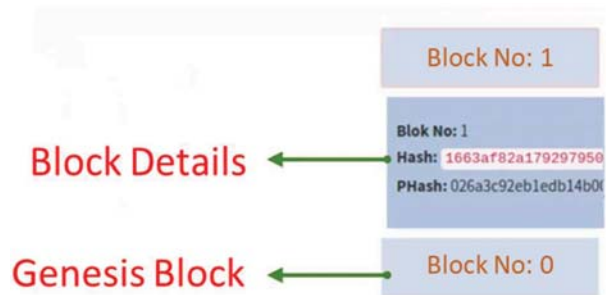


Fig. 6. An Example of Block Structure in the System

In the first step of the designed system, the property owner logs on to the system and selects the property that he wants to put up for sale in the list of properties he owns (Fig. 7). It enters detailed information about reconciliation (such as price, receiving party information, etc). After entering the reconciliation information, the smart contract flow is created by the owner party, and a property sales code is generated by the system so that the receiving party can be included in the transaction. The owner party logs into the system with this sales code and displays the spatial information of the property and detailed information about the reconciliation. If he does not find it appropriate after checking this information, he stops advancing the agreement, so the flow is canceled and the process is completed. If it accepts the spatial information and reconciliation conditions of the property, it approves and proceeds the process.

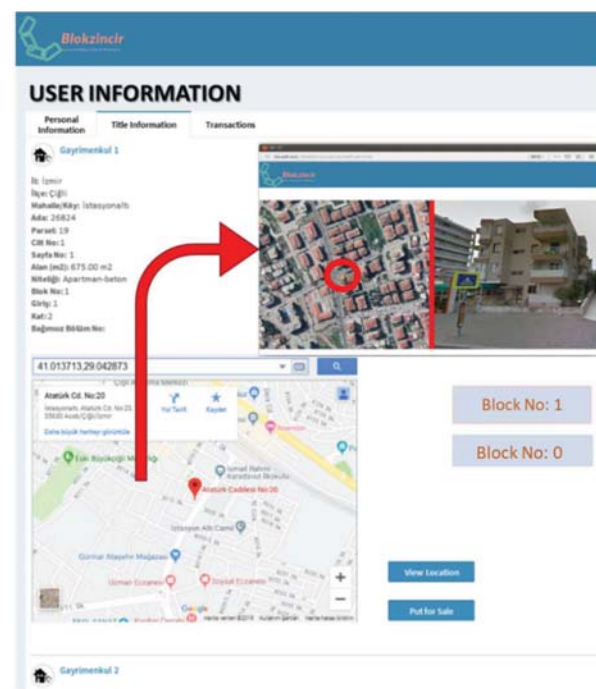


Fig. 7. An Estate Information Screenshot

After the receiving party approves the transaction, the municipality where the property is located is included in the transaction. It determines the fair value of the property and confirms that it has no debt. If the property has debt, it cancels the transaction and ends the process. If there is no debt on the

property, after determining the fair value, it approves and proceeds the process.

Following the approval of the municipality, the banks of the owner and receiving parties are included in the system in order to carry out payment transactions. After the bank of the recipient performs the payment transaction, it approves the payment order via the system. Whether this payment request will be made with bank credit, installment, cash, etc. depends entirely on the agreement between the bank and the receiving party. The system does not interfere with the agreement between the bank and the receiving party at this point. If the bank of the owner confirms that the money transfer order has arrived, the process is advanced to the next stage. If any negativity is observed by the banks in the payment transactions, the process will be canceled.

After the banks of the parties approve the payment transactions, the land registry office is included in the process. After reviewing the whole process, it approves the transaction if it does not determine any situation that prevents the sale. With this confirmation, money and property transfer takes place safely at the same time. After the hand and money exchange is achieved, the process is successfully completed.

IV. CONCLUSION

On the one hand, the creation of a Blockchain-based land registration system by the requirements of Turkey is seen tempting due to its eye-catching advantages, on the other hand, it has great importance in terms of eliminating situations such as showing the property sales price is lower than it actually is. With the increment value tax, the effect of regional investments made by the state is concretely visible, and it is aimed to shift the taxes as an investment to other regions by collecting taxes at the rate of investment. Thus, it is ensured that state investments are made equally to all regions. However, in the current situation, it is predicted that the obstacles to the correct determination of this tax can be easily eliminated with the transparency and security advantages provided by the system created using Blockchain technology. In addition, the COVID-19 pandemic once again demonstrated the importance of digitalization concretely. With such a Blockchain-based system, physical activities could be minimized and processes could be completed safely in the digital environment. Some issues need to be overcome to widely spread such a system. First of all, in order to put such a system into use, legal arrangements should be made and legislation should be updated to support the functioning of the system. Acceptance of transactions on the system as legal evidence will be critical to ensuring the continuity of the system. Another important issue is that the application developed to comply with the requirements in Turkey is transformed into a global application. Although the application is flexible with the structure of its smart contract underlying, it needs to be customized by the local flow of the country where it will be applied. For this, there is a need for country-specific personalization. By making such arrangements, the application will be accessible to a wider audience and will be an important resource in embodying the advantages it offers.

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