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Integrated modeling of the customer identification process in the banking industry using blockchain technology in line with regional planning and sustainable development

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Abstract

A vital element for all institutions and organisations is to identify the identity of the customer. The Customer Identification Process (KYC) is a customer identification program that verifies and records customers' identities and addresses. The customer identification process that financial institutions (FIs) are required to follow whenever they establish a financial relationship with a new customer is financially burdensome but does not add any productive value. The customer identification process is a regulatory and compliance obligation for the conventional banking and financial system to capture customer information before processing and providing any financial services. In banks, the customer identification process is embedded in the account opening forms, which allows customers to provide accurate information and ideally update them as soon as any changes in customer identification data occur. Currently, the customer identification process is carried out separately by different businesses, and the same data is provided by users to several businesses and independently verified by each of them. It will be much more efficient if the customer identification process is securely shared between organizations to provide the customer a better quality of experience (QoE). However, due to the lack of trust between organizations, this data is not shared between them, hence the need for a solution that can guarantee trust and reliability. In this research, using blockchain technology, the development of a new and native model is discussed, the purpose of which is to accelerate and improve the efficiency of the customer identification process. In this research, using the design science method (DSR) and Hevner et al.'s [19] approach, we will try to understand the situation, identify the needs and goals of the customer, provide the necessary plan, and then create a comprehensive and optimal customer identification model based on blockchain technology.

Keywords: Know Your Customer (KYC), Blockchain, Design Science Rsearch (DSR), Self-Sovereign Identity (SSI).
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1 Introduction

Customer relationship management is the infrastructure that reveals and enhances customer value. To have effective customer relationship management, it is necessary to collect information about customers' values and segment them to

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meet the unique needs of each segment. Today's competitive market is rapidly changing and evolving and has special features such as repeating customers' purchases in time intervals, high volume of customers, valuable information about customers' purchasing behaviour, etc. In such markets, the goal of customer relationship management is to understand and predict the purchase pattern and identify customer needs and supply according to customer demands and expectations. Therefore, customer relationship management is implemented as a prerequisite for marketing activities such as targeting customer segments.

With the growth of information technology, increased competition between banks and the provision of services in new forms of electronic banking, the possibility of losing customers has increased. On the other hand, the impact of environmental and psychological factors such as advertising, providing new services, etc. has caused customer behaviour to be unstable in some situations and banks face uncertainty in analyzing and predicting the behaviour of customers so that to better understand the needs and forecast The customer's behaviour was carefully examined, the dynamic nature of their behaviour [4].

Therefore, one of the legal requirements that all banks and financial institutions strictly consider themselves obliged to comply with is the requirements related to the customer identification process, which was notified to banks by the regulator to prevent fraud, money laundering and other illegal actions. Is. Customer identification in its simplest form may be considered at the level of customer authentication, and this identification can be completed gradually as necessary by completing information related to the job, income or assets of each customer. The limited range of price fluctuations, ease of recording transactions, information security, immutability and universality are the most important attractive features of asset-backed cryptocurrencies, which have created a suitable vehicle for attracting small capital in high-yield markets such as real estate [43]. Although identity is a completely abstract concept, it is a vital element for all institutions and organizations. The customer identification process is a customer identification program that verifies and records the identity and address of customers. The customer identification process has different implications and concepts and has a higher perspective than preventing money laundering and fighting terrorism financing. Acceptance of customer identification standards is an important part of banks' risk management method. Banks that do not have proper customer identification standards face many legal problems and risks, especially credit risk. Therefore, effective customer identification procedures should be considered from a wider perspective than money-laundering operations and as an important factor in the efficient management of banking risks. The current standard customer identification process meets the functional requirements for banks and regulatory authorities, but due to the development of technology and changing laws and regulations, the customer identification process has become increasingly costly and complex [29]. The customer identification process includes the exchange of documents between the customer and the financial institution. This process includes receiving and checking a set of basic identity information of people to prevent illegal activities. Also, customer identification has become a mandatory part of banks, insurance and other businesses. Currently, the customer identification process can cause delays in bank transactions. This process usually takes 30-50 days to complete the information to a satisfactory level. The current standard process meets the functional requirements for commercial and regulatory authorities, but due to the development of technology and changes in laws, it becomes increasingly expensive and complicated [15].

Blockchain technology is a decentralized database based on a global distributed ledger. All transactions are done on the internet, and the history of all transactions and records of people's assets are kept in this ledger. Decentralized means that the data is not stored in a central database; rather, the information is stored in a distributed manner [17]. This blockchain technology has special features that can be used in the financial industry of countries, but until today, this technology has not been used on a large scale in modern society. By reviewing the sources and research of the past regarding the use of blockchain technology in the financial industry, it can be said that one of the features of blockchain technology is its scalability, which creates the ability to be used from the scale of the village to the country and even continents. Gird [11].

Mu Qi-Guo [12] examined the role of blockchain in financial technology and stated that although the main function of blockchain technology is to store and transfer information on a digital platform, it can be used in financial technology and banking. Recently, international institutions, including the United Nations and the International Monetary Fund, as well as advanced nations such as America, England, and Japan, have paid much attention to blockchain technology and its role in financial technology. A study conducted by Accenture shows that more than half of top banking executives claim that blockchain will play an important role in the success of financial companies and banks shortly. Accenture analysts have concluded that the banking sector will save up to 20 billion dollars by 2022 through the implementation of blockchain [15]. Therefore, according to the necessity of mesh identification better understanding of customer needs and accurate prediction of customer behaviour [4] and also considering the history of using blockchain and the decisive role of this technology in the financial industry [12], an issue that banking industry activists always They have doubted how to use blockchain technology to provide a comprehensive and integrated model for customer

identification in the banking industry [31]. Over the past few years, the trend of banking industry professionals towards the use of new technologies has changed significantly. To the extent that the professionals in this industry show a great desire and enthusiasm to use these technologies, but due to the newness of this technology, no consistent research has been done in this field, so a general customer identification solution using blockchain technology for meeting the members of the organization The chain donor is required in the block [7].

The current research aims to provide a comprehensive and integrated model for using blockchain technology to implement the customer identification process in the banking industry to reduce the processing time and common use of this technology by bank branches. In this direction, it is necessary to examine the application of blockchain technology in banking services, products, and especially the implementation of the customer identification process. In this study, using the DSR research method, an optimized model based on blockchain technology is examined, which increases the capabilities of financial institutions and provides a unified and optimal model for the customer identification process using development and evaluation.

2 The importance and necessity of conducting research

The customer identification process includes the exchange of documents between the customer and the financial institution. This process includes receiving and checking a set of basic identity information of people to prevent illegal activities. The customer identification process has become a mandatory part of banks, insurance and other businesses. Currently, the customer identification process can cause delays in bank transactions. This process usually takes 30 to 50 days to complete the information to a satisfactory level. The current standard process meets the functional requirements of commercial and regulatory authorities but is increasingly costly and complex due to technological development and changing laws. Bella Kechin technology is a decentralized database based on a global distributed ledger on the Internet platform. The history of all transactions and people's property records can be stored in this ledger in a decentralized manner. Blockchain technology has a significant potential to improve the customer identification process in the current global payment system, which has advantages such as increased reliability, less ambiguity, more speed, high accuracy, and cost reduction [17].

An identity recognition system allows a person to prove that "you are who you say you are". It is estimated that approximately one billion people worldwide do not have access to an officially identifiable identity, and most of these people live in developing economies. Globally, regulators recognize that implementing a legal digital identity system is a "game changer" in achieving the goal of financial inclusion. Digital ID systems can be more secure than analogue systems, with stronger, smarter and more monitored data protection measures, which in turn provide better guarantees for Data privacy protection [43]. The customer due diligence process that financial institutions are required to follow whenever they establish a financial relationship with a new customer is a significant financial burden. The customer due diligence process consists of a series of routine tasks that, when performed, are intended to verify the legitimacy of a potential customer's activities. Every financial institution must follow the customer identification process before starting work with a new customer. Customer identification costs are increasing. Thomson Reuters [42] estimates that, on average, large financial institutions with a turnover of more than $10 billion will increase their annual costs related to customer identification obligations from $142 million to $150 million in 2016. According to Thomson Reuters [42], corporate customers work with an average of eleven financial institutions, which means that this costly customer identification process is repeated an average of eleven times for each customer. The average time it takes for a financial institution to complete a customer's information ("acceptance") is 26 business days. The increasing use of blockchain technology has led to the development of new systems aimed at improving the efficiency of the customer identification process and the possibility of cooperation between financial institutions. The Financial Action Task Force, an international body for combating money laundering and terrorist financing, has set an international standard for the customer identification process. This standard is stated in the recommendations of the Financial Action Task Force (FATF, 2012-2017), a document first published in 2012 and updated in November 2017. The proposed dynamic customer identification system based on blockchain technology reduces the costs of the customer identification process, allows these costs to be shared proportionately with participating financial institutions, eliminates the need for a trusted third party (TTP) to manage authorizations in the system, and updates It performs dynamic changes according to the situation of the financial institution's customers over time [30].

Know Your Customer also known as KYC, is a regulatory and compliance obligation for the conventional banking and financial system to capture customer information before processing and providing any financial services. In banks, the customer identification process is embedded in the account opening forms, which allow customers to provide accurate information and ideally update it as soon as any changes in customer data occur. Likewise, other financial institutions such as stocks, mutual funds, insurance companies, etc., also require customer identification information.

First of all, the customer identification process helps financial institutions prevent identity theft, money laundering, terrorist financing and the elimination of fugitive creditors. Identifies how blockchain advancements can transform the entire identity ecosystem (in a trustless digital world) and bring privacy control to end-users or end-customers, where they move from a decentralized (distributed) customer identification process to use focused, transparent and trust-based customer titles [4]. The customer identification process is an integral part of the customer processing process for a company. This process requires independent and tedious verification of customer identity documents by businesses, resulting in wasted resources. Know Your Customer refers to the steps taken by a company to establish customer identity, understand the nature of customer activities, and assess risks (if any) with the customer. This is a legal requirement for financial institutions to identify customers. The customer identification process requires the submission of documents. An identity by the customer to the businesses or organizations they want to be a part of. Currently, customer identification is done individually by each business, and the same data is provided by users to several businesses and independently verified by each of them. It would be much more efficient if the identification process customer can be divided securely between organizations and hence provide a better quality of experience to the customer. However, due to the lack of trust between organizations, this data is not shared between them, hence the need for a solution that can guarantee trust and reliability. The system (KASE) performs the customer identification process as a service - a service that acts as a one-stop solution for all customer identification needs of customers and businesses. The customer provides data to the service, where the service verifies the data using machine learning techniques, stores its encrypted format in the distributed file system and stores each transaction of customer identification data in the blockchain. Blockchain is one of the newest technologies in the field of cybersecurity and ensures trust in untrusted environments. This blockchain-based system uses a decentralized database, machine learning-based image processing, and data mining for old customer identification processes. Through blockchain, KASE ensures that parties using the service can trust the service and its reliability and will use it for other solutions [31].

One of the uses of blockchain is to improve KYC/AML compliance regimes. Banks, insurance companies, and other financial service providers (collectively, financial institutions worldwide) devote significant resources to "Know Your Customer" and "Anti-Money Laundering" compliance programs. According to a 2017 Thomson report, financial institutions individually spend US$60 million to US$500 million annually to comply with anti-money laundering/customer identification laws. In addition, as regulatory regimes around the world become more complex and penalties for non-compliance increase Increasingly penalized (both in terms of cost and reputation), these compliance costs continue to rise. Existing compliance costs are at least in part due to inefficiencies in compliance programs, which are generally paper-based. They require significant human input and often lead to duplication of work within and between financial institutions. In addition to the enormous costs of compliance with anti-money laundering/customer identification laws, financial institutions are increasingly pressured by customers rather than transactions. Distributed ledger technology is a tool that can be used by the financial institution to meet these previous needs [24].

Blockchain is one of the most powerful technologies that has challenged the world these days. One of the most important of them is the financial challenges because verifying the customer identification document for different financial departments is a time-consuming process and the data is insecure because the documents are kept by the centralized organization. Decentralized customer identification systems built by blockchain can be used to prove individual identity, and this is also a cost-effective method, and the data stored in the decentralized program is an additional security [25].

Knowing your customer's current trends, used in practice, is time-consuming, expensive and redundant. A Thomson Reuters study stated that while banks globally spend around $60 million on average, this figure may increase to 500 million dollars for some banks. Therefore, to improve the efficiency of this process, the use of a blockchain-based mechanism is suggested. The use of smart contracts also provides the opportunity to add features that cannot be obtained with the current process [35].

KYChain is a privacy certification protocol for customer identification data that allows customers to securely share customer identification data from one financial institution to another. To ensure integrity, a public blockchain is used with an external database to store encrypted (verified) data. Customers have control over how customer identity data is stored and with whom it is shared. In addition, the system allows customers to update or delete submitted customer identification data. KYChain can significantly reduce time and costs by monitoring changes in customer identification data by the financial institution through automatic detection of updates in the ledger and loading time by accepting certificates made by other financial institutions [9]. Know Your Customer is a process that businesses and financial institutions must employ to identify their customers and assess any potential risk due to illegal intent and foul play to business relationships in compliance with a national regulator. The term KYC often refers to banking regulations and anti-money laundering regulations that exist to monitor such activities. Blockchain is a disruptive technology,

and its use is increasing day by day, and thanks to the decentralized database (IPFS), it has been tried to create and improvise in the storage area. A decentralized database is cost-effective and makes the system space efficient. Also, the user benefits from the security aspect of the architecture through the use of smart customer identification using blockchain and decentralized databases because the third-party conflict is completely limited. River [37].

Blockchain-based decentralized customer identification systems can be used to prove individual identity. The immutability feature of the distributed ledger is the main concept to ensure that the data stored in the system is not tampered with. This system is similar in functionality to the old customer identification system. The data is stored in a distributed database to ensure data replication, data backup and the absence of a single point of failure. The completely decentralized architecture of this system ensures no dependence on centralized client-server architecture. There is no third-party involvement to create trust between stakeholders. The data stored in the decentralized database is encrypted to create an additional layer of security. A decentralized database system is a cost-effective, decentralized database for storing data that is used throughout the system. This system is cost-effective compared to other decentralized customer identification architectures [38]. Know your customer is a process that is usually done by banks on their customers. Therefore, banks must collect information about their customers, for example, their identity and home address. This data is then used to conduct security and background checks on customers. However, the customer identification process is cumbersome and costly and must be done repeatedly by each bank for each of its customers. In addition, the customer identification process must comply with data protection regulations. To carry out such a process, blockchain can be used to perform tasks automatically and provide the possibility of sharing data related to the Customer identification process [28].

Know Your Customer is a mandatory onboarding step for any financial institution. Often, data is stored centrally, and computer programs are centrally managed. Different organizations do not have a unified program where identifying information The customer will be seamlessly distributed among them without any risk of repudiation by any of the participating organizations. Know Your Customer is used by financial institutions around the world to detect illegal activities of individuals involved in a business relationship with the aforementioned financial institution. The main purpose of customer identification is to prevent banks from using it for money laundering and other criminal activities. Currently, the customer identification process is done manually because document verification is better in person to prevent the forgery of digital documents. be done. The financial organizations involved do not trust each other and repeat the customer identification process. KYC-Chain offers a distributed customer identification blockchain application that is designed according to today's needs of the customer identification process. One of the strengths of a blockchain platform, such as a distributed ledger, is its immutability. The advantages of a blockchain-based solution are: The advantage of existing solutions is that unauthorized modification of sensitive customer identification data is not possible. This solution is provided with a lower infrastructure cost for companies. This method ensures that a user who has logged in once does not repeat the process. This helps you avoid duplicate work. The benefits of the decentralized peer-to-peer network over a centralized network are also transferred to this system. Centralized systems are often easy targets for cyber attacks. This system also uses a platform for simulating situations where a bank may not trust other banks in the network and solves it by using digital signatures. This solution ensures that the customer identification process is always verified by authorized entities and the identity of customers is never modified [11].

Blockchain technology, with its time-stamped and distributed ledger model, can effectively help banks and financial institutions to facilitate fast, accurate, real-time exchange of data between various stakeholders for faster and more effective verification. Improve your customer identification. A blockchain-based solution, with ledger, ease of integration, and significantly lower operational and infrastructure costs, is a better option compared to existing systems. By reducing redundancy in the verification process and Automatic reporting, customer identification with blockchain can reduce the costs of all participating parties. Through the use of blockchain, the cost of processing, storing and transferring digital information is minimized [16].

A new model for sharing the customer identification process between banks has been presented, which helps customers, after visiting in person and having their identity identified by a bank, avoid going to other banks to perform the customer identification process. In this process, an issuing bank provides several identification tokens to the customer, and the customer can prove his identity or other characteristics by presenting these tokens to any accepting bank. On the other hand, announcing and disclosing any customer information only under the customer's authority is done by using his private key. This model can be done for any network based on a distributed ledger. In this model, the possibility of denying any of the three pillars of the issuer, receiver and customer is denied and all transactions It is referable and traceable. Since each of these elements has signed the customer's identity transfer transaction when sending it, they cannot deny the occurrence of that transaction. On the other hand, due to the high security of public key encryption algorithms, the bank and customer's concerns regarding the disclosure of personal information and violation of privacy it is completely resolved. Due to the concerns that banks have regarding their

customers' information, if a bank's customer identification transactions are tracked in the distributed ledger, only the information related to the customers' public key is accessible, and nothing about the identity and details of the owner of that key. The public cannot be extracted [14]. The increase in regulatory costs due to customer recognition in banking is one of the biggest challenges that the banking sector is currently experiencing. A new system based on distributed ledger technology (DLT) will reduce the costs of the main customer identification verification process for financial institutions. Reduces and improves customer experience. In this system, the main process of verifying the customer's identity is done only once for each customer, regardless of the number of financial institutions that the customer intends to work with. Thanks to distributed ledger technology, the result of the original verification of customer identification can be securely shared by customers with all financial institutions they intend to cooperate with. This system provides the possibility of increasing efficiency, reducing costs, improving customer experience and increasing transparency in the entire process of customer processing [29]. The capabilities of blockchain allow banks to significantly change their business, reduce excessive bureaucracy, conduct transactions at a lower cost, and improve confidentiality. However, for this technology to materialize, banks need customer acceptance. Identifying factors affecting customer approval is the most important concern of bank leaders and scientists around the world [34].

Table 1: Research background

Row	Author (year)	Research topic	Findings in summary	Suggested (future) research
1	Amirshekari and Latifi 2016	The role of blockchain technology in facilitating the customer identification process in the banking industry	If this management of the customer identification process is common among all banks in the country, it will save time and money and help reduce fraud, money laundering and terrorist financing. Blockchain technology has a significant potential to improve the customer identification process in the current payment system. It is a world where some of its key advantages are as follows: increased reliability, less duplication, more speed, high accuracy, and cost reduction.	
2	Arab Regional Fintech Working Group 2020	Digital identity and e-KYC guidelines in the Arab region	If the digital ID systems are reliable, they can provide new possibilities to achieve sustainable development goals. To strengthen the scope of finance, financial institutions can use the classified and electronic customer identification regime to predict customer goals, needs and conditions. use yourself	
3	Para and Ross 2019	Optimal and dynamic customer identification system based on blockchain technology	The system we propose eliminates the need for a trusted third party and makes the system truly decentralized, enabling a distributed structure for storing information independent of the blockchain architecture, which allows The cost of its implementation is more economical and convenient for financial institutions. This system is only used to grant and manage distributed database reading permissions, which motivates participation in investment funds.	We are convinced that the conceptual system we propose here can be used to improve the existing customer identification process and they are another necessary step towards the adoption of blockchain-based systems in the enterprise environment.
4	Kapsoulis et al. 2020	Implementing the customer identification process with smart contracts in a privacy-based decentralized architecture	Customer identification processes play an even more dominant role in accelerating the execution of future transactions in the case of blockchains. The paper has shown how modular, general-purpose and easy-to-manage architectural frameworks can be implemented on top of permissioned blockchains, for example, through smart contracts that can implement customer identification processes a convenient reality for the collection. Convert a wide range of decentralized applications.	As for future extensions of the system, work is underway on API design so that more data sources can be integrated into our architecture and support more complex ways of gathering diverse information about specific entities.

Row	Author (year)	Research topic	Findings in summary	Suggested (future) research
5	Haolin He et al. 2020	Quantifying blockchain benefits for AML/KYC, settlement costs and underwriting expansion	The use of blockchain in financial assets should be evaluated according to the possible benefits and costs. Cost savings from AML/KYC, settlement and underwriting expansion are quantified in this report. Other benefits of tokenized assets include: faster settlements - wider customer base - stability against political risks - reduced risk of inflation / reduced inflation rate	
6	Azhar Hussain and colleagues-2019	Decentralized customer identification process based on blockchain	In this exploratory approach, it is tried to identify the basic problems that the current customer identification databases are facing and how the development of blockchain can transform the entire identity ecosystem (in a trustless digital world) and give privacy control to end users or customers. to reach the final ones, to be identified. Where they use DKYC as customer-focused, transparent and trust-based.	Open areas for research include: addressing intelligence, device identity creation, challenges of dApps such as fraud protection using artificial application models, on-chain/off-chain lectures, performance and master plan for decentralized identification privileges. Customer
7	Douglas et al. 2018	The identity challenge in finance: from analogue identity to digital identification to digital customer identification programs	Solutions. This solution also uses decentralized file storage to ensure complete decentralization. data and reducing points of failure. Running our prototype through smart contracts brings encouraging results. KASE service can be used as a one-stop solution for all customer identification needs	This is the basic premise of RegTech: designing systems that are capable of achieving regulatory goals better than existing systems while increasing efficiency and reducing costs for market participants.
8	Patel et al. 2020	Customer identification as a service (KASE) with blockchain approach	Using the power of machine learning (ML) and explainable artificial intelligence (AI), the system can be freed from manual verification. In today's interconnected world, people are sharing personal information at an unprecedented rate, which is likely to continue to the introduction and adoption of 5G, the Internet of Things, open banking and other technological advances. Organizations are expected to Obtain, process and verify this personal information in a fast and efficient manner while protecting this information from being hacked and complying with	Using the power of ML, AI and explainable artificial intelligence, the system can be freed from manual verification. Look up detail
9	Collin and Swartz 2019	Use of blockchain for KYC / AML compliance	KYC / AML rules. DLT is a tool that can be used by the financial institution to fulfill these previous needs.	
10	N.sundareswaran et al. 2020	Optimized customer identification blockchain system	The proposed solution addresses the issue of additional registration in the customer identification process that exists in the current situation. In addition, encryption uses a standard symmetric encryption algorithm to control access to customer identification data and maintain their secrecy, generate a random key, and create a random key. The proposed system can reduce storage requirements by approximately 20%.	In the next versions of this system, separate access keys can be given to separate parts for better access to users' private data. To analyze and achieve a more efficient solution in a real-world decentralized environment, an extensive study of all encryption techniques and compression techniques can be done.
11	Dakshaini 2020	Blockchain's ability to solve the problem of customer identification through a comprehensive platform	The overall platform outline for the three organizations is as follows: Blockchain conceptually provides a suitable platform for providing an automated, secure and reliable customer identification, i.e. user identification and verification solution that improves the participant experience, processes Simplifiesoperationsandenhances regulatory compliance	It can further develop the public customer identification solution using blockchain technology, and non-blockchain participants can replace the manual process of customer identification.

Row	Author (year)	Research topic	Findings in summary	Suggested (future) research
12	Mohammad Rafik and Kumar 2019	Blockchain technology to verify customer identification document	By implementing a blockchain program to verify the customer's identity document, it provides the customer's identity certificate in the bank and provides transparent access to all banks that are connected to the blockchain network, ensuring faster access to the customer's identity document and Also security. By doing this, we can reduce the cost of maintaining the document in the centralized organization	
13	Shashank et al. 2020	Using blockchain in compliance with customer identification	To increase the efficiency of current banking procedures in identifying customers, blockchain can be a solution. The inherent characteristics of immutability, security, and decentralization can prevent redundancies in the existing process. However, since the blockchain industry as a whole is still very novel, it is unclear how these methods are viable in the real world. It is not predicted because we only have existing simulations at the moment.	Increasing mass adoption and education about blockchain technology will go a long way in improving the bridge between blockchain and the financial industry. Only then can we transform blockchain into current customer identification validation mechanisms
14	Catalin and Manulis 2020	KYChain: KYC user-controlled subscription and certification	Introducing KYChain, a privacy certification protocol for customer identification data that allows customers to securely share customer identification data from one financial institution to another. Update or delete data at any time and Reduce cost and ensure the confidentiality of customer identification data and the accuracy of certification for customer identification data compliance.	
15	Singhal and Sharma 2020	Smart customer identification with blockchain and distributed database	The proposed system is a required alternative to the existing system, the distributed database is cost-effective and makes our system space efficient. Also, the user benefits from the security aspect of the architecture through the use of Smart KYC using blockchain and distributed database. because third party involvement is completely eliminated.	In the future, we suggest to implement this system on a larger scale to get more results.
16	Solay et al. 2020	Customer Identification Analysis Processor optimization and prioritization and customer re-awarding with P	L (Profit and Loss Statement) link launchers	Proposes KPIs and KRIs (Key Performance and Risk Indicators) to manage and optimize the customer identification process and correlate costs with slippage reduction.
17	Sinha and Kaul 2018	Decentralized customer identification system	Decentralized database (IPFS) is a cost-effective and decentralized database for data storage that is used throughout the system. The proposed system is cost-effective compared to other decentralized customer identification architectures. Also, decentralized architecture benefits users in terms of security, usability and trust. Third party dependency is also eliminated in decentralized architecture.	
18	Robert Norvill et al. 2020	Blockchain to simplify and automate the sharing of customer identification results	This paper presents a test of a system that allows automation and simple and authorized sharing of documents between banks. It is specifically designed to reduce the heavy and redundant workload required by the customer identification process. The demo version provides information about the system's performance. It shows how the system works from different angles, customers and banks.	Future work includes investigating data leakage and duplication cases, for which potential solutions are discussed.

Row	Author (year)	Research topic	Findings in summary	Suggested (future) research
19	Rahnad Syah et al. 2020	Financial monitoring Dynamic control for customer behavior using a customer identification system	This discovery uses big data, which is different from optional information to separate data in the database review and speed up practical work, one of these experiments is the use of big data by electronic measurements or we call it as We consider financial technology program.	
20	Denson George et al. 2020	A blockchain-based solution to the customer recognition problem	The advantages of our blockchain-based solution over existing solutions is that unauthorized modification of sensitive customer identification data is not possible. This solution is provided with a lower infrastructure cost for companies. The proposed work also ensures that a user who is logged in once does not repeat the process. The advantages of using a decentralized peer-to-peer network over a centralized network are also inherited by our system. This solution ensures that the customer identification process is always verified by authorized entities and never modified.	The digilocker ecosystem currently stores customer identification user data in unencrypted and plain text. There are two ways. One is that we can use a centralized key distribution server, which is a symmetric key used to encrypt each identity record. Saves the client and issues its key to the bank if requested by the bank. The disadvantage is that the solution is not fully decentralized. Another method can be to store the symmetric key in the blockchain itself by encrypting it through the banks' public key. This method is more efficient and completely decentralized.
21	Lalitha Soujanya 2020	Financial sector innovations: Empowering microfinance through the use of blockchain customer identification technology	Blockchain, also known as distributed ledger (DLT), is a data structure that allows you to create and share tamper-proof digital ledgers. Blockchain enables the perfect and secure exchange of information between trusted individuals. Institutions can significantly reduce processing costs, as the infrastructure cost of building a new solution will be only 20% of the current costs of customer identification processing.	The most important barriers to adoption of blockchain include lack of training, information and user-friendly interface. There is little awareness of the concept of blockchain and its benefits among the main stakeholders in the financial sector. Risk-averse individuals/institutions always continue to use traditional financial institutions because Their trust in the name "bank" or financial institution is weak. Therefore, institutions have to come forward to implement blockchain technology for effective transactions.
22	Mohammad Javad Samadi-Mohammed Tehrani 2017	Sharing customer identity information between banks based on distributed ledger	In this article, a method for identifying and recording customer characteristics on the platform of distributed ledger is proposed, which is applicable not only for banks but also for all institutions and organizations that are required to identify and record their customers' information. In this model, it is possible to deny It is removed from each of the three pillars of the issuer, receiver and customer, and all transactions are referable and traceable. In this model,onlytheinformation related to the customers' public key is accessible	
23	Para and Ross 2017	Optimizing customer identification using distributed ledger technology	The authors propose a new system based on distributed ledger technology (DLT) that reduces the costs of the core customer authentication process for financial institutions and improves the customer experience. In the proposed system, the main process of verifying the customer's identity is done only once for each customer, regardless of the number of financial institutions that the customer intends to work with. This system allows to increase efficiency, reduce costs, improve customer experience and increase transparency. Provides overall customer processing steps.	

Row	Author (year)	Research topic	Findings in summary	Suggested (future) research
24	Laurie Hughes et al. 2019	Blockchain Research, Practice and Policy: Applications, Benefits, Limitations, Emerging Research Topics and Research Agenda	Blockchain is still a relatively immature concept, and studies have shownthat beyondfeasibility, there are few real applications, creating a dilemma for organizations looking at the technology to understand the impact of their existing processes.	The expectation of profit through one or more features of blockchain technology creates positive capital in business applications. Standardization and international governance have a positive impact on accelerating blockchain business applications. Positive cultural and social effects follow the transition to blockchain applications. The expectation of benefits from citizens overcomes the resistance to using blockchain applications. Developing passions to solve fundamental issues that directly affect the lives and well-being of citizens are facing blockchain.
25	Hao et al. 2020	Factors affecting customer acceptance of blockchain technology adoption	This research shows that in addition to the two main factors affecting the individual's attitude and intention to use new technology: perceived ease of use and perceived usefulness. Personal characteristics, understanding of risk, trust and self-command are also important indirect factors for creating the belief of customers and their acceptance to adopt blockchain.	1-The bank must provide the trial version of the blockchain programs to the customers to experience, evaluate and complete the program. 2- A control system (including defined rights, obligations, controls and standards) and a customer assistant system to improve convenience. Perceived use by customers is essential. 3- Finally, the bank should prepare backup plans for the situation when the blockchain system is disrupted or does not achieve the expected results.
26	Victor Chang et al. 2020	How Blockchain Can Impact Financial Services - Overview, Challenges and Recommendations from Expert Interviewees	This article highlights the fact that the financial industry is on the brink of a new financial era using a new disruptive blockchain-based system.	Blockchain can create disruptive changes in banks and financial services, banks and organizations that adopt blockchain must manage technology, culture change and employees who work in blockchain. To manage, evaluate and integrate recommendations A comprehensive framework for blockchain adoption should be developed, expert interviewees said.

Amirshekari and Latifi [17] studied the traditional customer identification process in the world and using the regulations of the central bank and the opinion of banking experts, customer identification in Iran and the limitations of the current process have been examined, then the role of blockchain technology in the customer identification process, especially in reducing costs and improving the customer experience in the world, and finally a customer identification model using blockchain technology using the DSR approach (The approach of Hevner et al., [19]) focusing on the three components of the environment, information systems, and knowledge base has been proposed for Iran, and to strengthen the quality of the proposed solution, the process of scientific design research has been used based on the method of Peffers et al. [32]. Scientific processing coordinates design with information systems.

Parra and Rose [29] in response to the question: "Can we conceptually create a blockchain-based solution that improves the customer identification process for improve financial institutions and solve the open problems of previous proposed systems while rewriting it and turning it into a workable, verifiable and repeatable example?" using the DSR method in collaboration withblockchain andcustomer identification experts fromOrigo (leading systems integrator and management service provider Iceland) have proposed a blockchain-based system that reduces the costs of the customer identification process with financial institutions that work with customers, and for financial institutions to dynamically update information about customers and enables the dissemination of this information among participating financial institutions without the need for any central instance to store customer information.

In a research entitled "Implementation of customer identification with smart contracts in a privacy-based decentralized architecture", Kapsoulis et al. [23] have designed a general architecture that uses highly decentralized technology such as IPFS and blockchain, and through smart contracts processes It provides multi-party customer identification on the blockchain. In this approach, the use of blockchains is used only as a timing mechanism and not as a storage of information.

In a joint research report between the University of Cambridge and Hashstock Inc. conducted by Haolin He et al. [18] the benefits that can be solved by blockchain, such as faster and cheaper exchanges, database Broader customer, AML/KYC costs, political risk and stability, inflation/inflation risk, transaction cost reduction are stated. In this report, it is stated that most financial institutions have done the customer identification process independently and have a separate database. and most of the costs are covered through manual processing costs, also going through the tedious customer identification process and the average time to complete business accounts is from 3 to 17 hours depending on the industry. These time delays lead to To lose 2 to 4 percent of the purchases of new customers. Surveys by Thomson Reuters [42] showed that the costs and complexities of customer identification are increasing, some financial institutions spend more than 500 million dollars annually on Customer identification globally. The advantages of using blockchain for AML / KYC is that it increases transparency, increases compliance and the possibility of sharing information. It is assumed that the cost reduction effect of blockchain is 52% in the United States, 74% in Europe, and 74% in Asia. 33% is obtained. Overall, the useof blockchain can save financial institutions an annual cost of $6.4 million in the US, $14.8 million in Europe, and $1.5 million in Asia . In a research conducted by Azhar hussain et al. [4] a unique trust management system based on the self-governance model and DKYC to increase customer privacy through consent-based access, Regulatory governance and assistance to banks to use valid and accurate customer data while reducing customer acquisition costs is provided. The traditional customer identification process is based on a pull mechanism, where customer information is received from the customer upon login. DKYC from Push (customer sends information to service provider) as well as Pull model (bank or service provider seeking updates on customer profile) with customer consent on what, where and who wants information Share supports.

Row	Author (year)	Research topic	Findings in summary	Suggested (future) research

Patel et al. [31] propose a solution in which customer information is sent and confirmed only once, and the results are matched with the required jobs. Information to be shared. The proposed system uses blockchain to record and manage customer identification requests and ensure transparency. Customer identification data is verified using a machine learning (ML) process to reduce a significant amount of time. Spent time to confirm customers to ensure more efficiency in the process. In this solution, the client provides the data to the service, where the service verifies the data using machine learning techniques and stores its encrypted format in the distributed file system (IPFS), and every transaction stores customer identification data in the blockchain. The proposed system uses an Ethereum blockchain with a proof-of-work consensus mechanism. This mechanism allows the blockchain to implement "smart contracts" so that transactions are committed to the blockchain only after certain conditions are met.

Ann N.Sundareswaran et al. [40] have proposed an Ethereum-based optimized customer identification blockchain system solution using AES symmetric encryption standard and LZ-based compression mechanism. This system optimises transparency by using a distributed ledger, security by cryptography, efficiency by compression algorithm and overall blockchain features.

Dakshaini [7] introduces blockchain as one of the most famous examples of distributed ledger technology across the industry as the key to future success in the financial services industry. Blockchain is a platform that supports multiple use cases in financial services and has the potential to revolutionize several processes, including peer-to-peer payments, trade settlements, and supply chain tracking. Use is subject to the identification and verification of the participant or users. User authentication is one of the fundamental things that builds trust between participants before any transaction takes place. The gradual increase in anti-money laundering laws, along with other data protection regulations, has forced many financial institutions to implement lengthy and costly processes. To be consistent in this way. Using Hyperledger Fabric, a framework under blockchain technology, a solution to this problem is provided, providing some key features such as a permissioned network, data confidentiality, and scheduling. These features create trust, transparency and accountability.

Mohamed Rafik and Kumar [25] propose a blockchain-based customer identification verification system that creates a block for each bank and the customer creates a user account in the blockchain through The customer account adds the customer's identification information and stores it in the blockchain network, and any modification or change in the stored details can only be done by the customer and through the customer's permission. The requesting bank can view the customer's identity document by submitting a view request to the customer's profile, and if the customer allows the view request, it may allow or deny options for him. Blockchain provides transparent visibility to the bank and the government. And can correctly check the customer's identification document issued by the government. In this project, they have created a blockchain web application that creates a smart contract using a programming language called solidity. The customer registers in the blockchain network and uploads the general information required by the bank and requests the relevant bank. The bank must see the customer's documents and can see the information transparently with the confirmation provided by the customer.

Shashank et al. [35] discuss the advantages and disadvantages of using blockchain to perform customer identification processes by reviewing five articles on blockchain types and regulations compatible with different countries. which includes private blockchain in India, (2) authorized blockchain in the United States, authorized blockchain in Singapore, and multi-chain blockchain in Luxembourg. Finally, they provide an improved mechanism (Smart-KYC) that removes the limitations of the five compared articles. In the introduced block structure, the real customer identification documents are stored outside the chain, and the hashes are stored on the chain to prevent them from getting bigger. Katalin and Manolis (2020), in research titled "KYChain :(as a Mechanism) KYC User-Controlled Sharing and Certification", describe a privacy-preserving certification protocol that enables the secure sharing of up-to-date customer identification data in Several financial institutions provided and fully controlled by customers. At the core of KYChain is an immutable ledger that stores the (encrypted) hash data of customer identification and certificates issued to a specific customer. The codes for encrypting customer identification data and certificates are obtained from other financial institutions. They are encrypted and stored off-chain. The customer retains the decryption keys, which can be issued to financial institutions with whom the customer wishes to establish or maintain a business relationship. An immutable ledger helps to track all changes submitted by the user to customer identification data. Financial institutions can monitor the ledger to determine which customer identification data has been updated and request a key from the customer to receive these updates. KYChain can help reduce onboarding time for new customers by enabling the reuse of customer identification data (with certificates) across multiple financial institutions.

KYChain can be provided as a service by an entity that performs its own off-chain storage without compromising customer data confidentiality.

Singhal et al. [37] propose a system that allows the customer and the financial institution to confirm and record the customer's identity document in the distributed ledger (DLT). To do this, this system uses a peer-to-peer and decentralized file distribution system - IPFS, which greatly improves the storage efficiency of DLT. A unique IPFS hash of fixed length is received for each file. Instead of storing the full file, IPFS stores the hash of the file on the blockchain. This hash can then be used to find the actual file, thus preventing file duplication on the blockchain. The created hash is verified by an authorized person who, upon successful verification, adds the public key and the user to the list of documents verified with the public key and the address of the verifier in the document details. A key pair containing the private and public keys is created. which supports adding or updating in blockchain against username and user identification, respectively. The advantages of the proposed system include better data governance, as data changes can be tracked and controlled, saving time by directly accessing customer identification data, and finally, using storage space efficiently. Due to the saving of the complete file in the blockchain, because only the hash is stored on it.

Sinha and Kaul [38] propose a blockchain-based decentralized customer identification system that uses a decentralized database (IPFS) to store user information as well as authentication documents. Ethereum is a blockchain platform that uses a smart contract to process each transaction. The proposed system is capable of performing all the functions of a standard customer identification system. At the time of filling in customer identification information, the user of the document must provide his/her details, including identification documents and photos, for example. The user must also provide a username so that he can check the submitted document in future updates. The system will use the username to generate a public-private key pair along with the wallet address. The new user should download the original file and should save that file safely. The key will be used when signing the transaction and will be unique for each user.

Row	Author (year)	Research topic	Findings in summary	Suggested (future) research
Denson George et al. [11] have presented a distributed customer recognition blockchain application. KYC-Chain is designed according to today's needs of the customer identification process. One of the strengths of a blockchain platform, such as a distributed ledger, is its immutability, which we use to our advantage. The advantage of our blockchain-based solution over existing solutions is that unauthorized modification of sensitive customer identification data is not possible. This solution is provided with a lower infrastructure cost for companies. The proposed work also ensures that a user who has logged in once does not repeat the process. This helps you avoid duplicate work. The benefits of a decentralized peer-to-peer network over a centralized network are also transferred to the system. Centralized systems are often easy targets for cyber attacks. KYC-Chain combines a centralized as well as a distributed solution to the problem of recording and updating customer identification details. Lalitha and Soujanya [16] identified microfinance (MF) and microfinance institutions as one of the most important sources of money in financial markets. MFI) have announced. Clients served by micro-institutions are clients who do not have appropriate documents or have very few mandatory documents. Microfinance institutions include N.G.Os, credit unions, non-banking financial companies, cooperatives, and banks. For these reasons, some operational and technical problems, such as an increase in the interest rate charged, are available to There are lack of services, slow customer identification process, excessive transaction costs, etc. faced by microfinance institutions. To reduce the costs of the main customer identification verification process for financial institutions and improve the customer experience, they propose a new system based on distributed ledger technology (DLT). In the proposed system, the main customer identification verification process is performed only once for each customer. regardless of the number of financial institutions that the client intends to work with. The result of the main KYC verification can be securely shared by customers with all financial institutions they intend to cooperate with. This system allows for increased efficiency, reduced costs, improved customer experience, ownership of customer data and transparency throughout the acceptance process.				

3 The aspect of newness and innovation in research

For the first time, the present study has investigated the model based on blockchain technology using the DSR method in Refah Bank (in the Iranian banking system). A few problems with the existing manual process of customer identification are that it is time-consuming, redundant, costly, and less secure to use. Blockchain technology, with features such as immutability, security, and decentralization, makes it a good solution to such problems. Blockchain is an emerging technology in cybersecurity networks. A distributed ledger can store transactions between participants efficiently and in a verifiable and permanent way. The most important nature of blockchain is that it is very difficult to change the recorded data in the blockchain. This is achieved by having some kind of agreement in a Decentralized blockchain system is guaranteed [40].

As one of the most famous examples of distributed ledger technology, blockchain is recognized throughout the industry as the key to future success in the financial services industry. Blockchain is a platform that supports multiple use cases in financial services and has the potential to revolutionize some processes, including peer-to-peer payments, trade settlements, and supply chain tracking. The identification and verification of the participant or user is called Know Your Customer (KYC). User authentication is one of the fundamental things that builds trust between participants before any transaction takes place. The gradual increase in Anti-Money Laundering (AML) laws, along with other data protection regulations, has forced many financial institutions to implement lengthy and complicated processes. Expensive has forced them to be compatible in this way [7].

In recent years, the customer identification process has changed from a simple formality to a complete process under the supervision of national institutions. In this research, using blockchain technology, a new system is developed, the purpose of which is to improve the efficiency of the customer identification process.

3.1 Research methodology

In this research, by understanding the current situation, compared to using the design science research method (DSR) as an action-oriented method, we try to understand the situation, identify the needs and goals of the design, present the design and then create the necessary artefact and finally implement it in The study has been done. The current research tries to penetrate into the heart of this phenomenon by using its own research method. In other words, this research tries to: 1- understand the phenomenon, 2- understand the current problems and 3- create an artificial (model) to identify customers in Refah Bank. The reason for using the research method of design science in this research can be found in the research book of design science written by Peffers et al. [32], who points out: "The purpose of the research process of design science should be to provide a mental model of the characteristics of the research output".

According to Hevner et al., [19], the goal of Design Science Research (DSR) is to expand the boundaries of human and organizational capabilities by creating new and innovative models. According to Hevner et al., DSR follows seven guidelines and leads to a technology-based solution that solves a relevant business problem. These seven recipes are as follows:

Table 2: Adapted from Hevner et al., 2004

Guide	Description
1-Design as a model:	Design science research should produce a suitable model in the form of a structure, model, method or an example.
2- Problem connection:	The goal of research in design science is to develop technology-based solutions to important and relevant business problems.
3- Design evaluation:	
4- Research partnerships:	The usefulness, quality, and efficiency of a design model should be accurately evaluated through well-implemented evaluation methods.
5- Accuracy of research:	Scientific research in the field of effective design should provide clear and verifiable contributions to design models, design foundations and/or design methods.
6-Design as a search process:	Design science research depends on the use of precise methods in the construction and evaluation of design models.
7-Research communications:	The search for an effective model effect requires the use of available tools to achieve desirable goals while complying with the rules in a problematic environment.

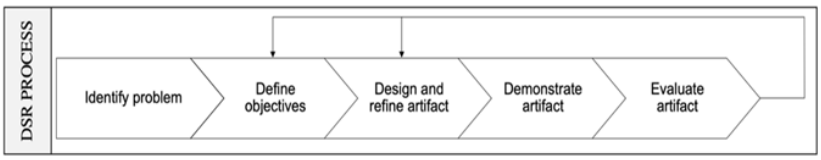


Figure 1: Taken from Peffers et al., 2008

Research question: "Can we conceptually create a blockchain-based solution that improves the customer identification process for financial institutions and customers, reduces the cost of the customer identification process and turns it into a workable, verifiable prototype?" And make it repeatable?

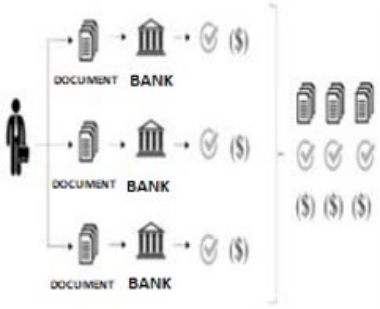
Since the implementation of such a system has important consequences for the financial sector, it should be done in full coordination with the legislator. The proposed method to solve the inefficiency of the current customer identification process is based on the following two assumptions:

1. All banks and financial institutions are obliged to comply with the same regulations for customer identification, and customer identification standards must be accepted and observed in all institutions.
2. A centralized institution is responsible for the correct implementation of this process, and financial institutions rely on that institution for an efficient customer identification process.

To answer the research question and design an effective artefact (model) that solves the problem of the inefficiency of the existing customer identification process in the framework of companies and regulations, we followed the DSR approach of Hevner et al. [19] and based on its three components (environment, We focused on IS research and knowledge base. To strengthen the usefulness, quality and efficiency of the proposed solution, we also considered the DSR process based on the approach of Peffers et al. [32], which combines the processes of design sciences with information systems and other disciplines. This process is divided into five sub-stages: 1- Identifying the problem 2- Determining the goal 3- Designing and modifying the model (artifact) 4- Displaying the model and 5- Evaluating the model. The last three stages of this process must be repeated recursively to return feedback from the environment and evaluate the model according to that feedback.

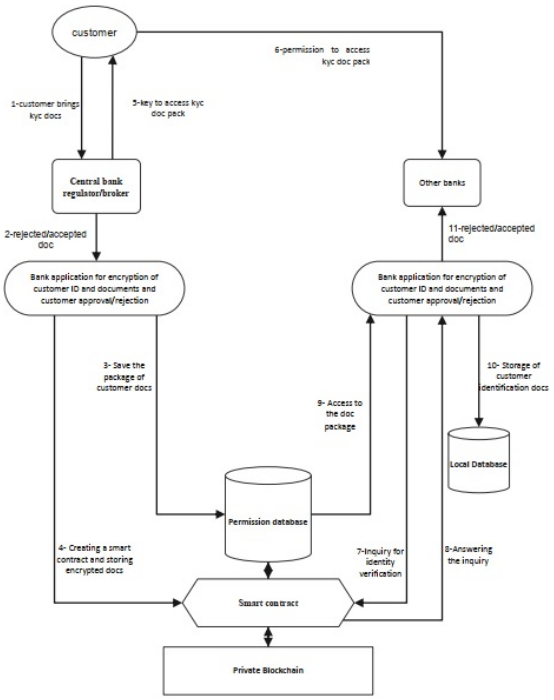
The current standard customer identification process is inefficient for the following reasons:

- Customer Experience: Customers have to submit the same documents several times for each bank separately.
- High operational cost: significant man-hours are spent on collecting relevant documents and auditing and compliance.
- Inflexible technology: Complex systems often do not adapt effectively to changing legal conditions.



The lack of integrity of information, the dispersion of information in different devices, and the absence of a specific custodian cause spending a lot of money and time on identity verification, validation, and reporting, and there is a possibility of impersonation.

4 Proposed model



Advantages of the proposed model:

Improved customer experience: The customer shares an identity ID instead of original documents for next time.

Security, efficiency and credibility: provided with a set of cryptographic mechanisms to ensure that data is not tampered with, as a reliable source for sharing identity documents, without compromising privacy and maintaining data integrity. It can be used for audits and regulatory reviews.

Transparency: Historical records of all transactions are stored and automatically tracked on the blockchain and used to comply with regulatory requests.

Improved compliance: All processes are automatically updated with new rules and regulations.

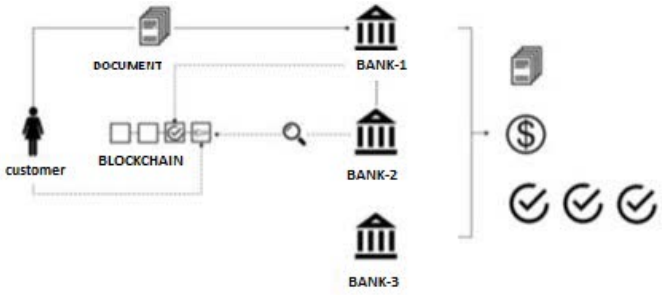
Greater speed: Due to the ease of access to stored information, the time required for reporting and validation is greatly reduced.

High accuracy: Embedding encrypted information reduces manipulation and fraud.

Cost reduction: any manual activity to perform customer identification, fraud investigation and suspected money laundering activities is reduced, which ultimately leads to cost reduction.

How the model works:

In the first step, the customer presents the required KYC documents to the representative (broker) of the central bank (legislator, regulator). By creating a smart contract, the hash of the package of documents is stored in the distributed ledger and creates a pair of public and private keys for this customer. By executing the smart contract, the ownership of the package of documents is transferred from the central bank representative to the customer. The client seeks to work with other banks (the second bank). The second bank, using the local application and communicating with the smart contract using the public and private keys previously assigned to the client, is allowed to read the documents related to the stored client. obtains and then registers his profile using a smart contract in the list of working institutions and stores a copy of the customer information in his local database.



The main efficiency that this model suggests is to prevent the duplication of similar tasks and also to divide the costs of the main KYC verification process proportionately between different financial institutions. Using banking regulations (domestic and central banks) and the opinion of banking experts, the mentioned model was examined. In a complex and dynamic world where speed is an undeniable factor, the use of new technologies in the banking system is considered a necessity rather than an advantage. All organizations, especially banks and credit institutions, need to use new banking systems and align with global changes to survive and satisfy the needs of their customers. The current research is done using library and survey methods, and the required information will be collected through interviews and field research from banking experts. The research topics are arranged into five chapters, which are respectively: general research, research literature, subject literature, data collection process, information analysis and finally, "achievements and suggestions".

A: Data collection tool (observation and test, questionnaire, interview, survey, database, etc.). This research is a descriptive-applied type of research. The statistical population of the research is the experts of Refah Bank of Isfahan province. Interviews are used to collect information for this research.

B: The spatial and temporal scope of the research: This research has presented the model by using sources and scientific texts related to the research topic and through interviews with the experts of Refah Bank of Isfahan province.

C: Steps of research implementation: This process includes two main steps:

1- Determination of measurement indicators: Determining the measurement indicators is based on the opinions of the experts in the study area. Articles and other similar works are also used to identify indicators.

2- Information collection: After determining the indicators, the data collection stage begins. At this stage, by referring to Refah Bank and documenting information and research with banking experts on the subject, the required information is obtained from them.

D: How to carry out the research (including materials, equipment and standards used in the form of separate research implementation steps)

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