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Assessment of Blockchain Technology Readiness Level of Banking Industry: Case of Turkey

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Abstract: *This research focuses on the assessment of blockchain technology readiness level of banking industry. Firstly, blockchain technology is defined and its specifications have been highlighted. Secondly the answer for the question how the domains of information systems integration are related to the areas of adoption of blockchain technology is researched. Then the readiness level for blockchain technology is defined in conjunction with adoption theories and its similarities with the factors in the domains of information systems. As a case study Turkish banking industry has been reviewed and the results are discussed to give an idea about the readiness of Turkish banking industry for blockchain technology.*

Keywords: *Blockchain technology, Domains of integration, Integrated information systems, Turkish banking industry*

I. Introduction

Blockchain is a decentralized transaction and data management technology developed first for Bitcoin cryptocurrency in 2008 and it has attributes that provide security, anonymity and data integrity without any third-party organization in control of the transaction (Yli-Huumo et al, 2016). The Bitcoin community has shown significant resilience to survive despite going against the entrenched institutions of fiat currency and the global banking system (Teigland et al, 2013). Since 2008, Bitcoin cryptocurrency has recorded its transactions in a public log called the Blockchain (Eyal & Sirer, 2018). In this way, blockchain allows the building of a distributed peer-to-peer network where members can interact with each other without a trusted intermediary, in a verifiable manner (Christidis, K., & Devetsikiotis, 2016). Blockchain is an exciting invention like the internet because internet connects the world to enable new business models based on online business processes, while blockchain can help resolve the trust issue more efficiently using network connections (Zhao et al., 2016).

Diffusion of innovation (Rogers, 1962) theory suggests that there will be innovators, early adopters, early majority, late majority and laggards in terms of adopting a technology. With respect to the blockchain technology in the banking systems, if blockchain were an innovation to be reckoned with, such formation of groups is also to be expected. Thus, given blockchain technology, whether it will create a division among Turkish banks and form groups that will be identified years later as, early adopters, early majority, late majority and laggards is to be seen.

With respect to the rest of the world, there is the influential R3 blockchain consortium today which brought together over 40 of the world's leading financial institutions, including Bank of America, Citigroup, Morgan Stanley, Deutsche Bank, Barclays Bank, Ping An Bank and China Merchants Bank which allows strengthening the exchange and cooperation of top financial institutions in the blockchain technology. As a result, globally, the major financial institutions have a relatively positive attitude toward improving the back-end processing efficiency of blockchain technology, and place significant emphasis on its potential (Guo & Liang, 2016).

The objective of this study is to find out the level of readiness for the blockchain technology in Turkish banks, and if there is, how the blockchain technology is to be integrated into the information systems (ISs) of such banks. In order to achieve a report of analysis, an exploratory study is conducted to shed a light on the differences among the perception and readiness of Turkish banks regarding the blockchain technology.

II. Literature Review

In the following literature review, blockchain technology will be discussed along with the domains of integration of ISs. Following that, the implications of blockchain adoption of banks on the domains of ISs, readiness to blockchain technology and the current status of Turkish banking industry will also be discussed.

2.1 Blockchain Technology

Blockchain has four key characteristics: decentralization, persistency, anonymity and auditability. Decentralization is such that unlike the conventional centralized transaction systems, transactions need not be validated through a central trusted agency. Blockchain does not need a third party and instead consensus algorithms are used among the parties. In that way, blockchain technologies create the opportunity to generate the necessary level of trust between anonymous counterparts and allows them to trade without the need of intermediaries (Aste et al., 2017). Blockchain technology, also allows the rethinking how inter-organizational business processes are managed since an execution can be realized without a central party serving as a single point of trust (Mendling et al, 2018). It is also persistent such that it is nearly impossible to delete or roll back a transaction once it is included in the blockchain. This allows invalid transactions to be discovered immediately. Anonymity comes from the fact that each user can interact with the blockchain with a generated address and the identity of the user does not need to be revealed. Finally, auditability means that each transaction has to refer to some previous transaction, thus all transactions could be easily verified and tracked (Zheng et al, 2017).

The security attribute of blockchain has also evoked attention. As there are studies mentioning the caveats of blockchain security; there are also those that provide resolution to the threats foreseen. Eyal & Siri (2018) claim that they can break the decentralized system with an attack and reveal the foreseen vulnerabilities of blockchain. In the study by Li et al, (2018) where a survey and a systematic analysis is conducted on the real attacks of blockchain systems, the exposures of the security features are examined.

The financial sector leads the way in developing blockchain applications and business models (Beck et al, 2017). Stock exchanges have proposed using blockchains as a new method for trading corporate equities and tracking their ownership. Yermack (2017) claims that emerging markets may be among the first to experience stock exchange integration of blockchain technology, due to the convergence of three forces: inadequacy of existing record-keeping systems, mistrust of corrupt and ineffective market regulators, and high penetration of information technology (IT) such as smartphones. Blockchain also allows companies to eliminate transaction costs and use outside resources as easily as internal resources (Tapscott & Tapscott, 2017). Blockchain-based applications have been springing up in the areas such as electricity trading (Sikorski et al, 2017; Kang et al, 2017), energy markets (Mengelkamp & Gärttner et al, 2018; Mengelkamp & Notheisen et al, 2018), healthcare (Kuo et al, 2017; Xia et al, 2017; Mettler, 2016), IoT (Huh et al, 2017; Dorri et al, 2017; Kshetri, 2017), transport (Lei et al, 2017; Yuan & Wang, 2016), food industry (Tian, 2016), cloud data provenance (Liang et al, 2017), shared economy (Huckle et al, 2016), smart cities (Biswas & Muthukkumarasamy, 2016), smart contracts (Watanabe et al, 2016; Kosba et al, 2016), government (Olnes et al, 2017), land registry records (Lemieux, 2016) and accounting (Dai & Vasarhelyi, 2017).

The approaches of different studies vary regarding blockchain and banking industry. Peters & Panayi (2016) state the concept of blockchain technology has potential to disrupt the world of banking. Guo & Liang (2016) claim that with appropriate industry standards blockchain could revolutionize the payment clearing and credit ISs in banks thus enhancing the efficiency of the banking industry.

The next section demonstrates how blockchain requires the attention of the domains pertaining to the integration of ISs for the banking sector.

2.2 Domains of Integrated Information Systems (IISs)

In terms of a model to handle the concept of the IISs, the infrastructure of the study will be inspired by the approach mentioned in the previous studies of Madnick& Wang (1988,1990,1991) and Wainwright & Waring (2004). Madnick & Wang (1988) claim that a careful and delicate interplay between choice of strategic applications, appropriate technology, and appropriate organizational responses must be made to attain success. In their 1990 study, they root the architecture of their study on the fact that, many applications require access to multiple heterogeneous database systems and as a result their integration is core. As a result, the connectivity of these composite ISs is necessary and three types connectivity, which are strategic, organizational and technical, were researched. In the 1991 study, Madnick & Wang mention logical connectivity as a second-order issue, which include issues such as schema-level integration, and inter-database instance identification.

2.2.1 The Strategical Domain

states in his 1980 study that ISs functionality of an organization is very critical, moreover political even more than technical, in the sense that it is related to social change. However, as Wildavsky had stated (1974) politics have been equated with evil, corruption and blasphemy, whereas it is essentially the process of getting commitment, of building support, of creating momentum for change, hence from a perspective desirable in a future full of ambiguity and uncertainty.

The concept of integrating the ISs brings with it many decisions to be made before any activity begins; in other words, it necessitates the determination of a strategy. Chen et al. (2010) described ISs strategy as the organizational perspective on the investment in, deployment, use, and management of ISs. ISs strategy

addresses the scope of the entire organization in order to improve firm performance. The degree of IT integration into a firm's strategic planning process varies from firm to firm, with important consequences in industries with information intensive processes (Vitale et al., 1986).

Throughout time accessing information in large company and businesses has been put in the focus of the strategic component, hence strategic connectivity which is the identification of the strategic requirements for easier, more efficient, integrated intra-organizational and inter-organizational access to information has become essential (Madnick, 1990). ISs strategy also encompassing investment decisions which create a bridge between IT and business units and supports organizational strategy to avoid conflict in goals (Gottschalk, 2008; Tanriverdi & Uysal, 2011).

It is stated that few ISs academicians refer to the wider generic strategic management literature which puts the focus on outdated bureaucratic planning approaches as opposed to dealing more explicitly with the social, cultural and political process for implementing strategy (Wainwright & Waring, 2004). Moreover, there are studies that have confirmed the hypothesis that practitioners largely ignore academic literature and do not use it in support of their strategic planning endeavors (Teubner, 2007; Moeini et. Al, 2019). Wainwright & Waring (2004) for example, instead put more importance on the organizational domain as being extremely important for successful integration of ISs.

However, Wade & Hulland (2004) state that how resources are developed, how they are integrated within the firm and how they are released have been under explored in the literature. In the study where they have focused on the process of implementing strategic ISs, Silva & Hirschheim (2007), state that apart from prescribing approaches which concentrate on proposing theoretical arrangements that organizations should or could embrace to achieve strategic objectives, few studies concentrate on the issue of implementation.

Finally, ISs strategy has been defined as the shared view of the ISs role within the organization and as such it is the degree to which the organization has the common objective to seek innovation through ISs. This topology suggests that the organization's ISs strategy falls into one of the two defined categories which the innovator or the conservative, or undefined (Chen et al. (2010).

2.2.2 The Organizational Domain

If integration is to be looked at from an organizational point of view, it can be seen that it is a highly complex process with several variables, since organizational integration involves the integration of people, their ideas, and decision-making processes (Wainwright & Waring, 2004). The organizational component is therefore considered to be a critical part of ISs. Business processes, policies, roles, management and frameworks around the integration of data need to be taken into consideration while considering organizational integration as well as the regulatory and legislative environment of the business (Sabooniha et al., 2012). Organizational success is increasingly linked to the extended enterprise and the appropriate use of different channels that enable organizations to change in order to integrate their business operations more closely. Organizations need to incorporate strategic connectivity to enable transfer information and knowledge between organizations and to coordinate operational functions and assets.

Weiner (2009) described organizational readiness as a shared psychological state in which organizational members feel committed to implementing an organizational change and trust in their collective ability to do so. This way of thinking about organizational readiness is best suited to examine organizational changes where changes in collective behavior are necessary to effectively implement the change and, in some cases, to produce anticipated benefits for the change.

Silva and Hirschheim (2007) find that implementing strategic systems can mean dealing with bureaucracies, therefore implementation efforts may require a change in structures of organizations. These structures might include the attributes of core values and believes, services technology and political time, power distribution, organizational structure and nature type and pervasiveness of control systems.

2.2.3 The Technical Domain

The technical perspective is powerful in the fields of IS and computer science, and integration is viewed as a goal of making complex software and hardware artifacts. This can be through representation in databases and IS application systems at the level of signal and data message content as well as communication of shared semantic meaning. Buckelew (1985) asserted that computer dictionaries defined "integration" as "the ability of computer hardware or software systems to work with previously incompatible systems" and early authors subscribed to this view, specifically referring to the difficulty of "physically" integration. Physical connectivity remains at the base of the process of system integration and creates the root of the integration process (Wainwright & Waring, 2004). From this perspective, significant technical advances in operating systems, databases, network and communication technologies and standards have all contributed to the adoption of the technical architectures of the distributed client server (Willcocks et al, 1997). As stated by Asproth (2007), technological devices can be viewed as an interface tool for improving organizational integration.

Logical integration is another component of IISs where Wainwright & Waring (2004) named it in their study as the system domain. The lack of logical integration can cause numerous problems, such as users accessing different databases with the same and unstandardized data. Logical connectivity should be provided using various methods in order to avoid data redundancy and provide consistency between databases. Madnick & Wang (1991) asserted five issues to handle such problems: database navigation (knowing the location of the required data), attribute naming (not using different naming for an attribute), domain value mapping (metric conversions), instance identification (using unique identifiers) and concept inferencing (performing inferencing action).

2.3 Blockchain Adoption and the Domains of IISs for Banking Industry

As stated by Tan and Teo (2000) banking has always been a highly information intensive activity and banks rely heavily on IT both to process information and to differentiate products and services. In this context banks have to constantly innovate and update to retain their customers (Tan & Teo, 2000).

With respect to the developments in IT regarding banking, a comparison among blockchain plus traditional banking, traditional banking and internet finance can be done using four headings, adapted from the study of Guo & Liang (2016). The headings for comparison are the categories of customer experience, efficiency, cost and safety. With regards to customer experience blockchain plus banks provide personalized service with good customer experience and as a result, perform better over the other two. Blockchain and banks are more efficient than internet finance or traditional banking businesses since distributed ledger transaction makes clearing easier and there is point to point transmission instead of many intermediate links. In terms of costs blockchain plus banks are low in costs since everything is completely automated whereas both internet finance businesses and traditional banking require a small amount of manual inspection. In terms of safety block change plus banks, because of their use of asymmetric encryption, provide more security in terms of users' personal information. In addition, with blockchain, distributed data storage cannot be tampered whereas in the other two, centralized data storage is easier to be tampered with (Guo & Liang, 2016).

2.3.1 Blockchain and Strategical Domain of IISs in the Banking Sector

How the ISs department should approach blockchain adaptation strategically is the first question to be answered. In the pre-blockchain ledger technology the centralized control has been with the trusted management of central and commercial banks. Thus, with the political design of the current economy the state and banks have the control of the central ledger as well as the power to reconstruct credit money (Velasco, 2017). Having such a power has its downsides since according to Yan et al. (2016) bank credit is one of the main drivers of crisis contagion, like the financial crisis that began in 2007. Brett Scott (2015) states that banks are positioned in the current economy as entities controlling the recordings of transactional data and proposes to replace the databases of banks to find a way for people to control them. In that sense, blockchain is already a solution for him. Lipton, (2018) claims that distributed ledger technologies have opportunities of making conventional banking activities efficient and cheaper but such as advancement requires overcoming not only technical but also political obstacles.

Some argue so far as saying blockchains will exist separately and compete with banks. For example, it is forecasted that 2 million bank jobs would be cut off once blockchain technology is applied in the next decade (Demos, 2016). The main argument of MacDonald et al. (2016) is that blockchains are competition to banks and enable banking transactions to shift out of centralized hierarchical organizations and back into decentralized markets due to the competitive power of their low transaction costs. They claim further that banking may not change whereas banks might MacDonald et al (2016).

Despite the protests against centralization, in the real world, a certain extent of centralization needs to be applied in the financial sector. Complete decentralization can even be impossible and thus a need to shift from a technical to a regulatory perspective exists. Implementing blockchain technology needs to be more in tune with reality and accept centralized consortium and private blockchains rather than completely decentralized public blockchains (Guo & Liang, 2016).

Just as much the massive benefits that blockchains are to bring to consumers, current banking system and whole society (Nguyen, 2016), there are weaknesses of blockchains. Tsai et al (2016) claim that financial systems need to have high throughput, high reliability, high privacy, strict regulatory enforcement along with low latency whereas the current blockchains have the opposite of these features which need to be improved.

In terms of individual competitiveness of the bank, blockchain limits the competition between individual banks since blockchain network is to be shared among all banks participating in the system. Strategically blockchain application requires time for research and banks also face payment risks because of loss of balance caused by high automation if things were to go without getting properly ready (Nguyen, 2016).

However, blockchain in banking activities faces challenges. Due to the different needs of the different stakeholders such as pressure from shareholders on profit versus the demand from regulatory bodies for a rapid

simplification of business model; banks are more reluctant to change due to uncertainty of new technology (Nguyen, 2016). Blockchains are decentralized and permissionless, and that might lead to major disruptions in the financial sector, especially in payment clearing (Guo & Liang, 2016). Uncertainty comes also because even though bitcoin has been in the market for five years it has not been widely used due to inaccessibility by the public. The reluctance also stems from the lack of support from governments as well as legal acceptance from insurance companies (Nguyen, 2016).

So, another question that may become is that despite all the pros towards a promise of a new system, this sort of heavy load on computer systems may cause problems with the availability of energy, however it can be said that the blockchain technology can achieve sustainable development, using more efficient systems than at present (Cocco et al, 2017).

2.3.2 Blockchain and Organizational Domain of IISs in the Banking Sector

Blockchain adoption poses numerous organizational challenges for companies within the payments industry (Holotiuk & Moormann, 2018). If there is new technology to be adopted, there are implementation changes to the organizations (Bingi et al., 1999). Adequate new skills are required with the introduction of a new technology and exchange needs to be integration into the organization are to be achieved with activities that are directed towards making people more familiar with new technology (Basoglu et al., 2007).

What is more, financial products are innovated and product innovation spawns a new batch of financial organizations and thus with advancements in technology, traditional physical branches have disappeared or transformed. Hence, for example, data mining and data analysis capabilities are the main competencies of bank client managers instead of waiting at their desks to be visited by new/existing clients (Chen, 2017). The organizational structure definitely changes with new technology, and if the strategy and technology indicate a change so strongly, organizational change is to accompany the technology and strategy.

2.3.3 Blockchain and Technical Domain of IISs in the Banking Sector

The technology of blockchain can impose an impact on the financial markets in terms of banking payments, security trading, web security, trade reporting and interest rate (Demos, 2016). With blockchain technology the complexity of bank processing can be reduced, expensive database, middleware processing applications can be replaced, fast multi-entity transaction settlement with clearing can be supported and fraud prevention can be enhanced (Tsai et al., 2016). These features of blockchain will require the technological integration of ISs of banks. If blockchain is to be integrated with existing banking processes many system integration and scalability issues are to be encountered. High-speed communication networking instead of P2Ps needed and fast consensus protocols should be used rather than the mining process used in common blockchains at the moment (Tsai et al, 2016).

Given that, payments industry represents a major business field of banking and is the cradle of the blockchain technology (Holotiuk et al., 2019), there are studies done to discuss the usage of blockchain technology within banking transaction to transfer amounts, protect card details and names of participants (Popova & Butakova, 2019). According to the study of Taufiq et. al. (2018) in terms of payment processing in the banking world, blockchain technology will be adopted for qualities that are associated with ease of use, usefulness, low transaction fees, risk perception, behavior intention of use and effectiveness. A range of innovative financial instruments, such as micro-payments (<10usd), peer-to- peer lending and even more "non-regulated-money" which would include the non-banking population into the picture are possible with the blockchain technology all the more even with lower transaction costs (Lindman et al., 2017). Even, a solution is offered for cashless payment in remote rural regions where network connectivity is intermittent through blockchains that allow maintaining a record of verifiable transactions in a distributed manner (Hu et al., 2019).

While distributed ledger technology is exciting there are other blockchain related financial applications handling exchanges, payments, trade finance, rehypothecation, syndicated loans (Lipton, 2018). For example, an important application of blockchain is Central Bank issued Digital Currency (CBDC) as it will affect national currency systems and will require the technology to handle it. Bank of England was the first to sponsor CBDC and other countries have indicated their interests in CBDC and may deploy these systems in the future (Tsai et al., 2018; Lipton, 2018).

Technology would also be responsible from data protection. The privacy protection of data in financial scenes is a crucial subject and all countries have different strategies and regulations towards it due to their financial maturity such as the General Data Protection Regulation by European Union. Financial blockchain has still got some issues with regards to data protection needs (Ma et al., 2018).

2.4 Readiness Levels of Blockchain Technology in terms of IISs

Readiness level of blockchain technology will be determined by how capable the firms are to adopt a blockchain technology. There are many theories used in IS research that deal with technology adoption such as

technology acceptance model (TAM) (Davis, 1986; Davis et al., 1989), theory of planned behavior (TPB) (Ajzen, 1985; Ajzen, 1991), unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003), diffusion on innovation (DOI) (Rogers, 1995), and technology, organization, and environment (TOE) framework (Tornatzky & Fleischer, 1990). Of these theories, the DOI theory and the TOE framework, are the only ones that are at the firm level.

Based on DOI theory (Rogers, 1995), innovativeness is related to leadership such as leader attitude toward change and organizational characteristics. Organizational characteristics include centralization of power, complexity of the organization members knowledge, formality of the organization in terms of adherence of rules and procedures, interconnectedness of the interpersonal networks, organizational slack, size of organization and system openness (Rogers, 1995).

TOE framework identifies three aspects of an enterprise's context that influence the process by which it adopts and implements a technological innovation: technological context, organizational context, and environmental context (Tornatzky & Fleischer, 1990). Technological context involves internal and external technologies relevant to the firm, organizational context refers to descriptive measures about the organization such as scope, size, and managerial structure and environmental context is the external arena where business is conducted such as the industry, competitors and the government (Oliveira & Martins, 2011)

Both of these theories at the firm level can be applied to ISs adoption. These theories are more or less in line with how the integration of ISs is handled in the study. That is the strategic organizational and technical domains are all mentioned within the adoption theories. The readiness analysis therefore will be around how capable the banks are to adopt blockchain in terms of their strategic organizational and technical traits.

2.4 The Turkish Banking Industry

According to Onay & Ozsos (2013) the history of the Turkish Banking industry can be divided into two episodes: the pre-twin and post-twin banking crisis of November 2000 and February 2001. The Turkish economy had to live with chronic inflation combined with economic and political instabilities for many years and in the aftermath of the crisis, the Turkish banking system went through a structural reorganization accompanied with increased mergers and acquisitions activity which led to consolidation in the sector (Onay & Ozsoz, 2013). As a result of these, the banking industry became a major part of the financial system in Turkey.

Banking services in Turkey were mainly delivered in branches until 1987 and digital (electronic) banking in Turkey was first introduced in1987 by Turkey Is Bank, Turkey's largest private bank, by establishing automatic teller machines (ATM) and internet banking services in 1997, followed by Garanti Bank the same year (Polatoglu & Ekin, 2001). Since 1997, digital banking (DB) services are a major part of everyday life in Turkey. At the beginning of the 2000s internet banking and ATMs were the main DB services and then call centers were added. Mobile applications emerged as a means of DB after 2011.

According to The Banks Association of Turkey; the number of deposits, development and investment banks was 52 with 34 in deposit banks group and 13 in non-deposit banks group, while there were also 5 participation banks at the end of December 2018. Turkish banking sector net profits stood at TL 53.52 billion ($10.16 billion) in 2018. The non-performing loan ratio of the banking sector stood at 3.87% at the end of 2018, up from 2.95% the previous year, while capital adequacy ratio remained unchanged from a year earlier at 17%

According to Banking Regulation and Supervision Agency of Turkey, as of February 2019 all banks total assets are TL 3.94 billion (USD 660 million). Banking sector loans (TL 2.42 billion) and liquid assets (TL 500 million) represented 61% and 13% of assets, respectively. The share of securities was 12%. The share of subsidiaries and fixed assets was 2%. Deposits and non-deposit funds accounted for 53% and 28% of liabilities, respectively. The share of shareholders' equity in total liabilities was at 11% level.

The Turkish banking industry is very competitive and it is necessary to invest in DB services just to keep the competition as it is. It can be concluded that in Turkey investing in DB services is a strategic necessity since the competition is fierce. The banking industry is already profitable and all banks in this study have a good amount of profit. That is why almost all of them are efficient in both stages (Kahveci & Wolfs, 2018).

III. Methodology

In order to execute the objective of this study, which is to understand the levels of readiness of Turkish banking system for blockchain technology, a survey was conducted. The survey questions were prepared with two ISs academicians and an industry professional experienced in blockchain technology under the inspiration of a survey managed by Deloitte (Deloitte Blockchain Survey 2018). In the end, there were nine questions, five of which had further individual diffractions as items.

After the preparation of the questions, the item(s) under them need to be assigned to the three domains of IISs. In order to ensure the validity of this assignment, four ISs academicians and one ISs professional were consulted individually. For the cases where more than one domain was assigned to the item, the referee academician chose the domain that was in majority. If there was a tie up, both of the domains were assigned to

the question. The final domain categorization of the items is given in Table 1 where "S" stands for Strategical, "O" stands for Organizational and "T" stands for Technical domain.

Table 1. Categorization of Blockchain Readiness Asessment Items under IISs Domains

Blockchain Readiness Asessment Item	*IISs*
The status of blockchain implementation roadmap	[S]
Existence of support for implementing blockchain technology in the bank	[O]
Blockchain technology will create serious changes in the banking industry	[S]
Blockchain awareness of the executive management of the bank is sufficient	[O]
The executive management provides sufficient support regarding blockchain implementation	[O]
Blockchain technology will increase the competitiveness of banks	[S]
Using blockchain technology safer IT solutions will be developed	[T]
The benefit of distributed ledger system	[T]
The benefit of creation of digital currency	[T]
The benefit of absence of the requirements of trust among participants	[T/S]
The benefit of secure digitalization of physical contracts	[T]
The benefit of creation of smart contracts	[T]
Difficulties of limited market for blockchain solutions	[S]
Difficulties of high blockchain development costs	[O]
Difficulty of the absence of cost-effective applications defined for the industry	[O]
Difficulty of absence of adequate industrial standards	[S/T]
Difficulty of absence of experts who can develop blockchain technology	[O]
Difficulties of legal constraints	[S]
Difficulty of lack of belief in the maturity of blockchain technology	[T]
Difficulty of lack of sufficient perception of the capabilities of blockchain technology	[T]
Difficulty of lack of blockchain platforms in Turkey	[T]
Legal regulations that might affect blockchain technology.	[O/S]
Knowledge of commercial application areas that are related to blockchain technology	[O/S]
Knowledge of the impact of blockchain technology on the current systems	[O/S]
Knowledge of how blockchain technology functions	[T]
Knowledge of what blockchain technology is.	[T]
Knowledge of what distributed ledger system is	[T]
Impact of blockchain technology on	
Finance	[S]
Accounting	[S/O]
Internet of things	[S]
Law	[S]
Commerce	[S]
Management of digital rights	[S]
Supply chain and logistics	[S/O]
Information technologies	[T]
The public	[S]
The level of your blockchain application compared to the following perspective of competitors	
Banks of your own scale	[S]
National banks	[S]
International banks	[S]
Impact of blockchain technology on	
Company growth	[S]
Increasing market share	[S]
Increasing customer satisfaction	[S]
Increasing productivity	[S]

The items used to assess the blockchain readiness level of a bank was measured using a five-point Likert scale, where, depending on the context of the question of the item, "5" represented the highest level of maturity

and "1" represented the lowest level of maturity (Bruinn & Rosemann, 2005) for that item.

According to The Banks Association of Turkey (TBB) and Participation Banks[1] Association of Turkey (TKBB), in Turkey there are 33 deposit banks, 13 investment banks, 5 participation banks as of 31st January 2019. Also, there is one more bank which is currently under the control of the Savings Deposit Insurance of Turkey (TMSF). Investment banks and 10 of 33 deposit banks have less five branches and they do not operate like retail banks in Turkey. Therefore, investment banks and the 10 deposit banks are excluded from this study. In other words, 23 deposit banks and 5 participation banks are included in this study. In addition, 5 of the 28 banks are public and 23 of them are private. Also, banks are divided into 3 categories in terms of their scales. Banks that have more than 5% asset ratio are conventionally considered large banks, banks that have asset ratio between %1 and %5 are considered medium banks and the rest are small banks. The summary demographics table regarding the 28 banks that are under the scope of this study can be found in Table II.

Table 2. Demographics of Turkish Banks

		Number of Banks
Type	Deposit	23
	Participation	5
Capital	Private	23
	Public	5
Size	Large	7
	Medium	9
	Small	12

Top 20 of these 28 banks in terms of asset sizes which comprise 97% of total size were contacted. 11 have replied the survey and these 11 banks possess 75 % of the total 28. Demographic information specific to the 11 banks from which answers were received is given in Results section.

The IT managers or any other department related to blockchain of each bank were sent the survey as the main participants of the study. They were asked to consult other departments for related questions if need be.

After the responses were gathered from the banks, the average blockchain readiness score for each domain was calculated using the scores of the items categorized under the related domain for each bank. In addition to that, the overall blockchain readiness score for each bank was calculated by taking the average of the scores of all items. This was different from taking the average of all of the average of domains since some questions are assigned to more than one domain.

IV. Results

The characteristics of each bank answered the survey can be found in Table 3. As it can be seen from Table 3;

- 6 of the banks are large, 4 are medium and 1 is small in size
- 7 of them are deposit and 4 of them are participation banks
- 7 of them are private and 4 of them are public banks

Table 3. Characteristics of Each Respondent Bank (n=11)

Bank	*Size*	*Type*	*Capital*
A	Large	Deposit	Private
B	Medium	Participation	Private
C	Small	Participation	Public
D	Large	Deposit	Private
E	Large	Deposit	Public
F	Medium	Participation	Private
G	Medium	Participation	Private
H	Large	Deposit	Public
I	Medium	Deposit	Private
J	Large	Deposit	Private
K	Large	Deposit	Public

[1] Participation banking is the name given to Islamic banks mainly in Turkey as well as Middle East and North Africa region and in other pan-Islamic countries, and they hold considerable assets in Turkey.

The calculated blockchain readiness scores of Turkish banks in decreasing order of their overall readiness scores are given in Table 4.

With respect to the overall readiness level, bank A, which has not been the leader in neither of the sub positions, but a bank that has done well in all three levels, gains the top position in the overall level

When the banks are ranked according to their strategic domain scores, large public deposit bank E takes the lead. With respect to the organizational readiness, large public deposit banks occupy the top three spots where K is the leader. With respect to the technical readiness outlook a large deposit public bank, a large deposit private bank, and a medium private participation bank occupy the top three positions. The leader is again bank K.

***Table* 4. Blockchain Readiness Scores of Turkish Banks**

Bank	*Strategic*	*Organizational*	*Technical*	*Overall*
A	3.67	3.50	4.08	3.83
K	3.61	3.80	4.14	3.83
E	3.87	3.40	3.77	3.79
D	3.62	3.50	3.64	3.58
F	3.42	3.71	3.78	3.57
H	3.38	3.60	3.46	3.42
I	3.11	2.86	3.20	3.07
C	3.09	3.00	3.07	3.00
B	3.04	3.10	2.71	2.85
G	2.96	2.20	2.92	2.85
J	2.38	2.57	2.80	2.50
Mean	3.29	3.20	3.42	3.30

Sample mean of the overall readiness scores of the banks is 3.30. The sample mean of overall readiness for private banks is 3.17 whereas for public banks it is 3.51. The mean for large banks is 3.49, for medium banks 3.08 and small banks it is 3. The mean for deposit banks it is 3.43 and for participation banks it is 3.06.

As can be seen there is not a huge gap between deposit and participation or public and private or medium large and small banks. However, one bank that stands out of other banks that have similar demographics is bank J. Bank J has the lowest or close to lowest scores in all of the three categories, thus the values for bank J affect the mean for all large private deposit banks. As a result, bank J is an outlier which probably will not join the adoption train.

V. Conclusion

This research focuses on the blockchain technology readiness level of Turkish Banking Industry. Thus, blockchain technology has been explained and its specifications have been highlighted. In connection to this new technology the domains of IISs have been defined and the relation of block chain technology adoption of banks with these domains has been analyzed. The readiness level and what is meant by it has been interpreted as well as the situation of the Turkish banking industry. Finally, the results of the survey have been displayed and discussed.

It is found that it is difficult to say that any demographic group is better than the other and Turkish banking industry is at the beginning of blockchain adoption.

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