Challenges and Opportunities of Blockchain Integration in the Egyptian Banks: A Qualitative Analysis

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Abstract The purpose of the research is scanning the opportunities and threats of implementing blockchain technology in one of the major applications in the banking sector in Egypt: cross border payment and settlement. To reach this aim a qualitative analysis was conducted in which a semi-structured interviews approach was used. The main findings manifested the ability of this technology to prevent fraud, enhance transparency, and ensure financial stability and accountability. It enables a secure environment to store and transmit data between organizations and can reduce uncertainty. The process is faster, and this can promote customer experience. The results disclosed that integrating blockchain technology within the current systems in the Egyptian banks should undergo a transitional phase in which the technology can be outsourced to ensure security and efficiency. The originality of the research lies in the attempt to reconnoiter the readiness of the Egyptian banking sector to embrace innovative technologies.

Keywords Egyptian banking sector · Blockchain · Cross borders payments settlements · Digital IT adoption · Digital economy

1 Introduction

Throughout time, innovative technologies threaten the traditional ways of conducting business inside any organization that adopts those novel technologies. Zahra and Covin [1] defined innovation as *the lifeblood of corporate survival and growth.* After several years O'Sullivan and Dooley [2] gave a more detailed definition; in their words, innovation is *the process of making changes, large and small, radical*

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S. G. Yaseen (ed.), *Digital Economy, Business Analytics, and Big Data Analytics Applications*, Studies in Computational Intelligence 1010,
https://doi.org/10.1007/978-3-031-05258-3_37

and incremental, to products, processes, and services, that results in the introduction of something new for the organization that adds value to customers and contributes to the knowledge store of the organization. Accordingly, the role of innovation is enduring a competitive advantage and generating values as well. Therefore, it is crucial to find adequate solutions to the innovator's dilemma [3]. The innovator's dilemma states that any organization possesses relatively limited capabilities compared to the ones needed by novel technologies. One way out of this dilemma is adopting a strategy that ensures a smooth transition from a traditional centralized organization to a more distributed and decentralized ecosystem.

When scanning the chronological order of the emergence of digital innovative technologies, from telebanking to fintech, it can be interpreted that the obvious advantages of those technologies were; convenience, availability, speed, efficiency, effectiveness and transparency of the banking processes as well as facilitating transactions across various sectors [4]. The recognition of the importance of innovations caused a swift and a cursory dependence from the banking sector all over the world on the rising information and communication technology (ICT). This dependence offered an alternate way to conduct some functions such as the banks business structure and the customer relationship management [5]. One of the most important rising ICT is the Blockchain Technology (BCT). BCT can be comprehended as a radical digital paradigm that can cause disruption [6–8]. Blockchain, an emerging infrastructural technology, can fundamentally transform the ways people transact, trust, collaborate, and identify themselves [9].

BCT has received exceptional attention in the business, regulators as well as academic circles. Since the inception of BCT, it was affined to the financial domain and can be a concrete approach to unify the process of collection and verification of data in a manner that decreases costs to the minimal. In addition, BCT ascertain that the information is neither altered nor forged. This fact can ameliorate the reliability of the collected data. It mutated the financial sector and took over the currently used traditional business models and technologies [10]. Another major advantage is the undoubtful effect of BCT on the shape, size, and the conduction of business in the banking and finance industry [11].

While the focus of several studies, covering BCT, was about implementation and the technical challenges [12, 13], those challenges should not be the only concern. Technological design and implementation might constitute a less threatening challenge if compared to business processes related challenges [14, 15]. Although BCT can offer myriad benefits to the banking system, some constraints can slow down or even hinder the thorough adoption of this technology in both macro aspects (such as requiring large investments in infrastructure, a need of a solid legal foundation, etc.) and micro aspects (such as the acceptance, knowledge and ability to use new technology, etc.).

This unjustified bias towards technological adaptation when studying the BCT resulted into an empirical and theoretical gap. This research attempts to contribute to that field by addressing adoption challenges that organizations might face when they merge a novel technology with their information systems. A special focus is

given to how the banking industry employees evaluate the challenges regarding the infusion of BCT in banks.

In this research, in an attempt to better understand the underlying potentials and challenges of the use of BCT in the banking sector; interviews with practitioners and experts were conducted. The interviews main aim was to analyze the perceived importance and potentials of BCT functions in the banking industry. It is widely believed that one of the strength points of qualitative research is supporting the researcher in understanding the nature and complexity of the studied phenomenon. Advocates of the usage of qualitative research believe that when the texts are quantified, the phenomenon under study can be better analyzed [16]. This research contributes to the emerging research on how BCT can enhance the existing banking process; and discuss the readiness of the Egyptian banking sector to embrace technology, especially in the process of Cross Border Payment Settlement (CBPS).

Accordingly, the research is organized as follows: after this introductory section, section two presents the conceptual background of BCT. Section three discusses the potential benefits and challenges of the applications of BCT in the banking sector with a special focus on CBPS. The methodology of data collection and interview analysis are presented in section four. Section five is a discussion of the research outcomes, while section six concluded the research.

2 Blockchain Technology Concepts

The inception of blockchain implementation began in 2008 when Nakamoto [17] proposed the eminent cryptocurrency "Bitcoin" and discussed that such technology can aid in solving the double-spending issue. A blockchain is given that name because of its features and structure. It is mainly made up of blocks of information that are chained together through a code, in each block this code relates to the previous one, similar to a timestamp, provides the link to the previous block making it impossible to modify or corrupt previously recorded transactions and thus leading to an unalterable ledger. Blockchains are constantly growing over time as more blocks are added, so they actually form a chain-like structure tracking back to the root block [18].

BCT came with a new scheme where data validation and responsibility of data insertion are distributed among all nodes of the network [6]. The validity of the history can only be achieved if, and only if, a consensus is reached all over the system that the transaction history is completely correct and comply with the rest of the data stored all over the nodes of the network. Therefore, BCT enhance transparency through ensuring the validity of an entire history of the transaction [19, 20]. BCT can be seen as an analogue to a distributed ledger that is maintained, updated, and verified in a harmonized matter by each of the nodes involved in the transactions within a given network. No single node can maintain the database; rather each one has a copy of it.

The concept of storing data in a centralized system cause the data to be prone to hacking and fraud. A problem that blockchain distributed decentralized mechanism

can overcome since all transaction must be verified by different nodes making fraudulent transactions implausible [21]. In addition, each node of the network stores a replica of the data, so data is hardly lost [22]. The decentralization feature of BCT gives rise to the replication of data all over the nodes of the distributed network. Authorized users can retrieve data whenever needed and hence data availability is guaranteed even if some setbacks affect a number of nodes. Transactions that occur in the network are recorded in automatically and in real time, which make it hectic to any organization to forge date as this, will entail the simultaneous modification of the entire copies of the ledger [7].

If BCT is utterly adopted, it will undoubtedly maintain a reasonable level of security and transparency of data. Unauthorized or mischievous users are not able to modify or add blocks to the blockchain without being perceived because simply the rest of the nodes will promptly notice the deceitful behavior. Thus, it is impossible to threaten the integrity of the blocks of the ledger [23]. Even in the case of hacking the ledger, the actual verified network copies will overwrite the hacked versions returning the records to its original state [24]. It can be seen that the monitoring process is switched to networked computation rather than human entities; this feature adds trustworthiness to the process and is a genuine feature of BCT.

2.1 Classification of Blockchain Systems

Although all blockchains are analogous in structure, they differ in many other aspects [25, 26]. The differentiation between blockchain systems can depend on factors such as participants who can access data, immutability, control, and the degree of openness of the blockchain. Blockchains can be broadly divided into public, private or consortium networks. In a public network, access is granted to all nodes; any node can join, act, and leave the network without distressing the mechanism of the network or affecting the generation of new blocks. The distinguishing feature of decentralization of the public BCT causes any procedure to be completely uncontrollable by one single organization. Such type of networks is characterized by the presence of a considerable number of participants, so any attempt to alter or counterfeit data is almost impossible. Public blockchain guarantees transparency to all transactions taking place in the network, it might not seem applicable for all industries [27].

In private networks, access to the network is granted only to authorized nodes. The operator of the private blockchain holds the responsibility of the entire network and determines the privileged nodes who are permitted to join the network and specify their roles. Based on their assigned roles, entitled nodes will verify the transaction and accordingly the new transaction will be visible to the rest of the nodes in the network. Communication between nodes possessing a copy of the ledger is necessary for reviewing, writing and hence approving new transactions. The ledger is updated each time a newly submitted or newly verified transactions occurs. Moreover, the operator can abolish inactive nodes, so nodes are required to possess a pre-determined minimum number of connections to be considered active and to continue as a part

of the network. Private blockchains are typically designed and configured to have better performance and scalability than the public ones [18].

In the consortium blockchain, a sub-category of private blockchains, the accessibility of data and some transaction processes are only assigned to a group of participants instead of only one that is why it is considered to be partially centralized. Similar to private ones, consortium blockchains are designed for higher performance, scalability, and confidentiality if compared to public ones [28].

3 Blockchain Technology Applications in the Banking Sector

BCT played a crucial role in the paradigm shift caused by the amalgamation between financial technology and the financial sector [29]. In financial services, data security is indispensable. Hence, the usage of a private or consortium blockchains is a congruent option [30] because it gives the moderators an adequate control over the nodes participating in submitting and verifying transactions. The applications of BCT in the banking industry can be categorized into Fraud Reduction [31], Trade Finance [32], Know your Customer [33] and Cross Border Payment and Settlement [34, 35].

Tapscott and Tapscott [8] believe that intrinsic properties of BCT can easily disrupt the core functions of any financial system through altering the way they work. Holotiuk et al. [36] added that the BCT would result into a more efficient payment system. It will not only ease the cross-border transactions, but it will minimize intermediary costs as well. Santander being the first UK bank to introduce BCT for international payments predicted that this technology could reduce banks' infrastructure costs related to cross-border payments, securities trading, and regulatory compliance [37]. The introduction of blockchain at Barclays has cut down the time necessary to execute a capital exchange from ten days to less than one day [38].

In the traditional centralized banking procedure, the transfer of money across borders is safe and secure but it is also slow and expensive. An important application of BCT in the banking sector is improving the clearing and settlement procedures, an inter-banks payment settlement for both domestic and cross borders transactions. This step allows banks to align the transaction participants without the need for an intermediary institution to control the process [36]. Applying this procedure converts the settlement process into an instant one. This research focuses on a prevalent application of BCT: Cross Border Payment and Settlement (CBPS).

3.1 Cross Border Payment and Settlement (CBPS)

The globalization process is deepening; international trade is increasing rapidly and the flow of factors of production between countries is increasing as well according

to the OECD statistics, those facts necessitates a revision to the CBPS procedures. Interbank payments are needed to perform such procedures and they are conventionally conducted through intermediary clearing firms. The intermediary clearing firm undergo a series of steps starting from bookkeeping followed by the transaction and balance reconciliation, then payment initiation and the process goes on from a step to another. This process is money and time consuming. In the CBPS the clearing procedures for each country is different, a remittance for example requires several days to arrive. In order to overcome those drawbacks and inefficiencies BCT can be used in a point-to-point payment scheme. If such proposal can be implemented, transaction costs of banks will be reduced. Banks will be able to offer a swift and a satisfying payment clearing services for cross-border commercial activities instead of the tedious traditional risk management functions [28].

J. P. Morgan applied BCT in various applications in Asian countries; *Confirm* (that globally validate accounts information) and *PayDirect* (the global clearing solution) to transfer payments through the most efficient route. J. P. Morgan added a step to improve international funds transfers between banks through the BCT, and those transfers cover a myriad of payment transactions. The cost reduction accompanied by this procedure is inevitable since the number of rejected transactions caused by mismatched payment are almost negligible and the transactions are done near-real time [39]. Furthermore, those applications will boost both transparency and customers' payment experience.

The experimental usage of BCT platforms in CBPS is dispersing worldwide and an increasing number of financial institutions are joining the novel field. Al Rajhi Bank has also used the Ripple BCT for the first time in Saudi Arabia. The bank used the platform to undergo a secure, cross-border money transfer. Furthermore, The Saudi Arabian Monetary Authority is encouraging domestic banks to indulge in the RippleNet allied banking blockchain network, it expected to make monetary transfers with regional banks faster, cheaper, and more secure. It will also ensure for domestic banks' customers faster, cheaper, and more transparent cross border transactions [40].

Standard Chartered bank used the Ripple blockchain platform to manage its first cross-border transaction. The transaction completed in less than 10s including the foreign exchange process. This is likely unbeaten. The existing banking system and traditional network would have taken up to two days to perform the same operation. The National Australia Bank has also used Ripple's ledger technology to transfer funds between two banks [28]. Enterprise software provider R3 is teaming up with Mastercard, this partnership is expected to provide faster payments and to establish a blockchain solution for CBPS through augmenting worldwide connectivity. Finally, according to the results of Evan's econometric model, BCT adoption has positive and significant relationship with the financial market development [41].

In Egypt, cross borders payments are seen in remittances. Egypt is in the top five nations globally in terms of remittance flows from expat communities. Given the important role that remittances can play in the Egyptian economy, the National Bank of Egypt (NBE) is continuously aiming to develop and enhance the infrastructure that pertains to this line of business. Hesham Elsafty, group head for Financial Institutions

and International Financial Services at NBE: confirmed that joining RippleNet will provide the bank with *cheaper, quicker and more reliable payments* [42].

NBE took major steps in adopting BCT. It was the first Egyptian bank to join the R3 blockchain Consortium. R3, the enterprise blockchain technology company, is leading an ecosystem of more than 300 firms working together to build distributed applications for usage across various industries such as financial services, insurance, healthcare, trade finance, and digital assets. NBE main target group is Egyptian expats who constantly send their remittances to Egypt. By improving its blockchain platform through this step, NBE can improve liquidity management and have access to real-time financial records. The higher productivity that will result from joining the R3 blockchain consortium will enable NBE to expand its network and activities not only in Egypt but also throughout North Africa, and the Middle East. The bank seeks to expand its client base by offering more efficient and faster CBPS. Hisham Okasha, NBE chairperson, clearly stated that *by joining this initiative together with world banks and companies, we will be able to closely monitor and engage directly in global blockchain developments* [43].

3.2 The Potential Benefits of BCT

3.2.1 Enhance Data Integrity and Availability

Data integrity refers to the accuracy and consistency of data, integrity is closely related to availability [22]. When a customer faces a service failure or denial, this may cause or be caused by an integrity violation. In the banking sector, in particular, the importance of data integrity is a paramount issue. Unauthorized alteration of data is unacceptable. Data must stay accurate and consistent all over the process through setting predefined rules that ensures the correctness and validity of the database. Data integrity will ensure that crucial financial data can be recovered if lost, searchable and traceable [25, 44]. To safeguard the immutability feature of BCT and data remains unaltered; an encryption process is undergone using both public and private key procedures. The decryption mechanism can be done by authorized entities. When BCT verifies a transaction, and this transaction is added in a chronological order to the database, a time stamp is appended to this transaction making the tracing of the transaction an easy task [45].

3.2.2 Enhance Data Security and System Resilience

The details of transactions lead to a tampering free data because the machine-based algorithm ensures the correctness of data checking and security and replaces the human-based checking. The less the human intervention the more secure the transactions. The BCT can trace any invalid transaction or any information that deviate from the network consensus and declare it as an invalid transaction [11]. BCT enhances

information transparency and security: two themes that lowers the risks in the banking sector. Data security has always been a dilemma for the banking industry. Encrypting information using the BCT can aid in this context where sharing information between several nodes of the network is secured and protected. Once data is added to the block it becomes inherently unaltered. The BCT reduces the risk associated with centralized ledger approaches; there is no central point of failure. Banks using blockchain can eschew cyber-related crimes including hacking and fraud [46].

3.2.3 Shared Infrastructure and Cost Reduction

All the nodes of the network who represent the peers of the blockchain initiate a shared infrastructure. Using a shared infrastructure reduces cost and time and is an important advantage [47]. BCT systems can minimize the intermediaries in the payment processing system. The less the intermediaries the higher the security. Another benefit of reducing intermediaries in the payments process can be seen in the cost reduction as well [36].

3.2.4 Increase the Efficiency of the Processes

When the permitted nodes update the records, the entire blockchain is updated making the monitoring and analysis procedures more effective for the banking sector on the aggregate level. BCT is used in CBPS to overcome the disadvantages of traditional ways and reduce the transaction risks [28]. In addition, the automation of financial applications leads to a ledger that is less prone to errors.

3.2.5 Improved Customer Experience

BCT can also enable consolidated, accurate repositories of customer information that can be accessed by all parties in the network. Using BCT, banks may be able to serve customers far more quickly than with traditional systems. Smart contracts can be substantial nodes in BCT based networks in the banking sector. BCT enables deploying code with predefined rules that automatically execute when conditions are met through smart contracts mechanism. Smart contracts automatically execute across all ledgers. The enforcement of such contracts can restrain defaults [48].

However, while recognizing the potentials of BCT its crucial to address the potential risks and challenges associated with it. It is worth mentioning that minimizing risks and avoiding technical, social, and political aspects of failure can increase the pace of adopting the innovative technology [49].

3.3 The Challenges Facing BCT

To reap the weal of the BCT in the financial sector several technical as well as social aspects must be addressed. The mainstream of research focuses mainly on the technical challenges and strive for solutions. While in this research, the emphasis is given to the social side. The social domain includes concerns regarding data governance and how flexible is the regulatory framework.

3.3.1 Data Governance

Data governance is the process of managing the availability, usability, integrity and security of the data in an organization in order to support the decision making process. BCT is a new technology and is not integrated in many areas of governance yet. It still brings up a number of governance issues as it both removes the need for a centralized authority and second as it is a permanent data storage mechanism [28]. To reiterate, the problem lies in the very nature of BCT, it is a distributed and an immutable ledger. Those intrinsic features of BCT adds to the complexity of the governance process. Reaching a consensus about a certain aspect within a massive number of participants with different regulations and understanding makes the decision-making process a complex one.

3.3.2 Regulation

Governments seek to regulate any innovative procedure specially if it is widely spreading and touches upon financial sector [12]. The absence of regulations may hinder the diffusion of BCT within organizations [50]. Countries are getting ready with their regulatory settings to encounter the potential illegal activities that may accompany the usage of BCT [33]. Jurisdictional readiness and legal structure for BCT applications is not very mature yet. BCT needs to be thoroughly understood by the regulators in order to offer a feasible as well as an efficient regulation framework [29].

3.3.3 Behavioral Change

Change is constant, but it faces resistance. In the presence of trusted third parties (BCT), customers need to comprehend that their electronic transactions are safe and secured [51].

As an emerging technology, BCT is expected to validate itself and gradually take over traditional banking processes. Table 1 compiles the main points of comparison between the latter and the former.

Table 1 Comparison between traditional and BCT-based banking processes

	Traditional banking processes	BCT- based banking processes
Mode of control	Centralized	Decentralized
Efficiency	Redundancy and duplication of tasks	Improve payments efficiency and flexibility of transactions
Speed	Slower	High speed
Cost	Less in energy consumption but higher costs in terms of bank fees, exchange rate, book-keeping and paper work	Lower operational and administrative costs
Legal framework	Well established framework that abides to national rules	Evolving framework that might conflict with domestic and international institutions
Governance	Central governance	Decentralized governance that leads to higher complexity in the governance process
Security	Vulnerable, data might be corrupted, forged. Malicious transactions can increase	BCT is immutable and irreversible ensuring higher degrees of security

4 Data Collection and Analysis

4.1 Data Collection Methodology

BCT is another milestone in the Egyptian banking sector development, a new unprecedented business model that needs comprehensive investigation and analysis in order to assess its potential advantages and threats. In this research, data was collected using semi-structured interviews approach. This approach enables the researcher to grasp hidden and implicit information. The role of the researcher is to ensure that the questions and responses are both adequately understood [52]. The interviews were flexible and adaptable. Participants possess a high degree of freedom in expressing their views and sharing their experiences with the researchers. Four broad concepts were discussed with each participant. The first concept covers the organization strategy in adopting latest technologies and adaptability. The second concept addresses the challenges imposed when a new technology is adopted; especially the readiness of bank's employees, challenges regarding the existing regulatory framework, and data governance. The third concept addresses the benefit of adopting new information technology and the expected potentials of BCT. While in the fourth concept, interviewees were asked to mention three factors that they believe essential for the banks' success.

To analyze the outcome of the interviews the research used purposeful sampling, which is a qualitative research technique mainly used to identify and select information-rich cases. The steps of this technique are; first identify and select

knowledgeable and/or experienced participants who understand the phenomenon under study. Second step involves the availability and willingness to participate. Finally, the participant should be able to deliver knowledge and experience, beside his own opinion, in a comprehensible and accurate method [53]. The sample included respondents from both public and private banks in Egypt. Solid information was obtained from experienced and knowledgeable participants. The participants were from several departments and varied from decision makers to IT specialists. Seven interviews were conducted with an average time of 40 min, three of which were conducted face to face while the rest were performed virtually due to the COVID-19 situation. Interviews were performed during May and June 2020. To foster the competency of qualitative research, more than one data collection method should be used in the study and [54]. The researchers added two focus group; each one consisted of nine bankers. The concepts were discussed with them for one hour.

A qualitative analysis was conducted with the interview synthesis methodology involving several steps. First, the interviews were broken down into quotes. Next, the quotes were coded; similar quotes were consolidated into a single code. Finally, a conclusion of the ideas that encompassed all the relevant points for a certain category was developed. MAXQDA analytics was used to code the script and to visualize the output.

4.2 Interview Analysis

4.2.1 Organization Strategy and Adaptability Towards Latest Technologies

Respondents affirmed that in order to be able to compete in the global market, latest technology should be adopted. They believe that technology is one of the main factors that enables a bank to remain viable and competitive in the market. Moreover, leading banks with highest market shares should be the pioneers in using the latest technology and popularize it in Egypt. The main obstacle in using the BCT is the expected resistance to change. The respondents stated that:

> The bank made a huge leap in terms of technology … introduced new services that are totally under the umbrella of Internet banking.
>
> Technology is a part of the competitive edge of international banks.
>
> The banking sector is heading to technological based initiatives; digital signature is one example so no foreseen barriers can stop adoption and implementation of blockchain.

4.2.2 Organization Strategy Towards Training and Development of Employees

Respondents acknowledged that their banks offer the training needed to increase the efficiency of their staff. The training is provided all around the year and it is

a priority within the banking sector to provide efficient training to employees in different topics. Training topics include banking related topics such as finance or monetary policy or general topics that are offered to improve the client/employee relationship. Respondents made it clear that:

> The policy of banks is to train the employees in order to get the best of them through properly designed training workshops.
>
> It is a global strategy to invest in employees.

4.2.3 Organization Strategy Towards Collaboration

Tapscott and Tapscott [55] emphasized the importance of collaboration even with competitors. This paradoxical, co-opetition is a necessity in the age of globalization. To cope with higher uncertainties, many companies have turned to co-opetition where both co-operation and competition can take place. The concept discussed in this part is how respondents perceive the challenges of collaborating with other competing banks. Respondent clarified that the idea of collaboration is not new, and that it is already implemented. Respondents were aware of the benefits of collaboration such as reducing cost, enabling better services to the customers, spillovers and sharing experience. Two main concerns were mentioned; the first issue was data privacy and governance and the second issue is the uneven distribution of collaboration rewards.

> No challenges are involved cooperation is always needed especially if this will entail efficiency and lower costs.

4.2.4 Blockchain Technology Awareness and Banks' Success Factors

Figure 1 displays graphically the codes to BCT related from all the Interviews. The frequency of the code is proportional to its font size. According to the respondents,

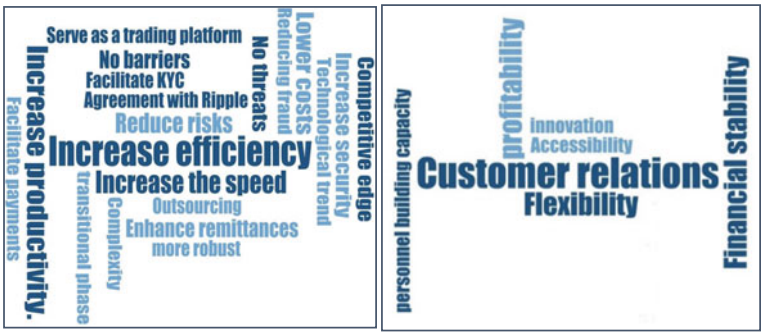

Fig. 1 Textual Analysis of the interviews' answers concerning: **a** blockchain technology, **b** banks success factors

in pane A it is stated that the most crucial benefits were efficiency and productivity followed by speeding the processes and cost reduction. Other important factors included risk and fraud. The fact that BCT can enhance the ability to compete with rival banks is among the benefits that were stated. Moreover, the application of BCT might act as a trading platform and facilitate remittances and cross borders payments. Integrating BCT within the prevailing systems should undergo a transitional phase in which the technology will be outsourced to ensure security. According to the analysis of the interviews, the regulatory framework is well prepared and ready to BCT usage and the banks are not expected to face hindering barriers in that context. While in Pane B the major three influential factors that supplements to the success of the bank institute according to the analysis of textual responses of the participants were customer relationship management, financial stability, and profitability.

5 Discussion

BCT is rather a new phenomenon and its implementation in the Egyptian banking sector is in its outset. The analysis of the interviews concluded that banks recognize the potential benefits of the usage of BCT, but it is obvious that while some banks are already on track, others are still in the planning phase. A sound implementation of BCT necessitates not only the engagement of employees; but also, the understanding of the main sources of threats. Lack of knowledge, lack of trust, and complexity of the system are all threatening factors that entail a negative effect on adoption [6]. It is essential to increase the society's knowledge and understanding of new technologies and reassure users about security threats in order to succeed in the new system.

One of the dimensions that must be addressed in that context is the appropriate training strategies that can foster employees' abilities. The importance of training was clear in the respondents' views: *If employees are properly trained, it is like any other technology; it will be easy.* The research analysis also emphasized that the main three factors that can contribute to the bank success and sustainability can be enhanced through the adoption of BCT. The use of BCT will eliminate the redundancy of data collection and hence will improve customer convenience, which, is the most important factor impacting customers' experience in the banking sector. Maklan et al. [56] added that the speed of the process is another factor that adds to the customers' experience. From another angle, improving data reliability will enhance customers' experience too. This improvement can be achieved because of the decentralization manner of BCT and the encrypted data, which permits only, authorized entities to access stored data.

An increasing strand of empirical studies demonstrates that adoption and diffusion of ICT may improve profitability and banking performance could be enhanced through technological progress [5]. Several areas of expected cost reduction and increased profitability from using BCT can be excepted and CBPS is not an exception. This cost saving will result from reducing the cost of identification and onboarding processes [57]. Likewise deploying BCT in the banking sector in particular can offer

a spectrum of opportunities from the ability to compete in the market to the efficient performance of the bank. Those factors are expected to consolidate financial stability. On the other hand, the respondents added that the main threats were the inadequate infra-structure in Egypt and the governance process of the blockchain. Finally, theoretically speaking a concrete legal framework is essential in the implementation phase of a newly introduced technology, the respondents affirmed that Egypt possess an appropriate framework that complies with the needs of BCT but neoteric regulations might be needed in the future. As a step towards improving the legal framework and in order to acclimate with the BCT requirements and other rapid developments in financial technology, The Central Bank of Egypt (CBE) launched its Fintech regulatory "Sandbox" to ensure faster and easier access to new financial solutions without threatening financial stability and consumer protection [58].

The research findings are harmonious with several studies. Chang et al. [59] concluded that adaptive financial institutions that are able to embrace new technologies, such as BCT, are more likely to withstand competitive environment. The study added that continuous employees training is a corner stone in building a successful blockchain based system. Similarly, Almahirah [60], who examined the effect of blockchain smart contracts on the financial and banking services in Jordan, confirmed the benefits of BCT in terms of enhanced efficiency, boosting customer experience and reducing bank's operational costs. The research findings bolstered the importance of raising the awareness of both employees and clients in order to succeed in accelerating the technology adoption rate. On the other hand, a line of research [28] emphasized the role of top managers in hasting the acceptance and adoption of BCT, Almahirah [60] added that managers' role is undeniable in encouraging employees to comprehend BCT potentials.

6 Conclusion and Future Work

One of the keys to success in a competitive and a volatile market is innovation. A viable organization can comply with abrupt opportunities and banks are not an exception. For a bank to compete and succeed it is obliged to adopt new technologies. BCT would ensure competitive edge in a rapidly progressing technological environment and is already gaining momentum and causing paradigm-disruption effects in the banking sector around the world. The impact of BCT on the traditional business model of banks is clear. BCT allows banks to transform their business model significantly. It is able to eliminate redundant procedures, allowing for swift transactions with lower costs. It also improves security levels. However, to apply this technology in the economy, banks need to explore and probe its potentials in both economic and social applications. The benefits and potentials of blockchain are undeniable; the research suggests that BCT is one of the latest approaches that have the ability to enhance decentralization, transparency, and accountability. It enables a secure and transparent environment to store and transmit data between organizations without

a central point of control with the potency to reduce uncertainty and insecurity in transactions.

The research examined the opportunities and challenges facing BCT adoption in the Egyptian banks. Future research can expand the methodology and use empirical method to analyze the influencing factors. The research can act as an onset for building a theoretical framework for evaluating and disbanding the discussed challenges.

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